PEEPING IN, PEERING OUT:
MONOCULARITY AND EARLY MODERN VISION

A thesis submitted in fulfilment of the requirements for the degree of
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Faculty of History
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Vol I: Text

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Thesis Title: Peeping In, Peering Out: Monocularity and Early Modern Vision
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SHORT ABSTRACT

One of the central theoretical tenets of linear perspective is that it is based upon the idea of a monocular observer. Our lived perception, also referred to in the Renaissance as *perspectiva naturalis*, is always rooted in binocular vision, however, the guidelines for *perspectiva artificialis* often imply a single peeping eye as a starting point. In the early modern period, a number of marginal art forms and instruments follow the prescriptive character of linear perspective to ludic ends. By focusing on this special class of what I would call 'monocular art forms', I will analyse the extent to which the perspectival method has been successfully applied in material form beyond the classic two-dimensional paintings. This special class of objects include: anamorphosis, peep-boxes, catoptrics, dioptric perspective tubes, and perspective instruments. It is my intention to draw attention to the different ways these devices were encountered in the early modern period. In this thesis I will be examining the specific sites of each case study in depth so as to describe the various contexts—aristocratic, intellectual, religious—in which these items circulated. In Chapter 1 I illustrate a special class of perspective and anamorphic designs that confined their illusions to a peepshow. Chapter 2 examines one of the most consummate applications of the monocular principle of perspective: seventeenth-century Dutch perspective boxes. In Chapter 3, monocular catoptric designs are studied in light of the vogue for mirror cabinets in the seventeenth century. Chapter 4 examines the innovative techniques of drawing machines and their collection in early modern courts through close study of the 'perspectograph.'

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LONG ABSTRACT

One of the central theoretical tenets of linear perspective is that it is based upon the idea of a monocular observer. Accounts of the perspectival method found in treatises on the subject often stress that in closing one eye the illusion of depth and feigned realism in a perspectival painting is reinforced. We may say that the theoretical premise of linear perspective, as well as its distorted twin method, anamorphosis, is founded on a paradox: to a certain extent, it invites us, as viewers, to limit our vision rather than expand it, in order to sharpen our perception of pictorial space. Mathematically, a correct perspectival schema requires that the centre of the projection is located in the eye of the beholder, which is idealised as a singular point. Lines extend from this singular eye and meet with any number of points on the object or scene to be drawn.

The main objective of my study is to investigate the extent to which the monocular foundation of one-point perspective has been capitalised on in the early modern period as a conduit for perspectival, anamorphic, and optical illusions. To this aim, my thesis will largely focus on a series of art works that take monocular vision as their starting point, such as seventeenth-century Dutch perspective boxes, catoptric peep-boxes, and anamorphoses. Different from the long tradition of perspectival paintings, perspective boxes and anamorphoses form an exceptional class of pictures in which, I suggest, monocular vision has been deployed. I would like to argue that these marginal images that have been little studied—with a few exceptions— draw attention to monocular vision, and as such throw

new light on the monocular aspects of linear perspective that have not yet been fully explored within the field of art history.

In addition to analysing the specific practices of picture making of anamorphosis and peep boxes, I will look at a series of instruments, and the role they play in treatises, that seem to further confirm the monocular aspect of perspective, such as a drawing instrument devised by Ludovico Cigoli (coined a 'perspectograph' by Kemp), a series of catoptric peep-boxes designed by Jean Dubreuil, and Jean-François Niceron's unusual dioptric perspective tubes. These are rare demonstrations that follow the tenets of perspective very closely, and as such, are excellent examples to further illuminate the theoretically monocular aspects of its workings. We could say that these instruments serve, in fact, as theoretical exercises that have been worked out in material form. Indeed, perspective instruments, like Cigoli's perspectograph, serve as demonstration pieces that do not necessarily aid the artist's practice in a practical sense, but instead reveal perspective's mathematical character.

Within the scope of this thesis, I am interested in the contexts and environments in which such exceptional art forms as perspective boxes, and equally exceptional devices such as the perspectograph, were produced and used, and what audiences had access to them. Most of the art forms, instruments, and theoretical demonstrations were collected within disparate courtly collections in Denmark, France, and Italy in the seventeenth century. I aim to discern as to how this special class of pictures and devices were encountered in their time—and in what way these environments affected the viewing experience—by detailing the distinctive cultural milieus and intellectual contexts in which they were created and studied. In addition, the question arises as to which forms of knowledge the observer was expected to realise in visually interacting with each object. I will draw attention to the

different ways in which traditional perspectival paintings, exceptional cases such as perspective boxes and anamorphoses, as well as optical devices were encountered in the early modern period. I will do this through an extensive discussion of the history of their collection, and their location in the designated space of the Kunstkammer (also known as Wunderkammer or cabinet of curiosity) in royal palaces where these items were stored and studied. The Danish Kunstkammer is a particular case in point. Not only did it hold three perspective boxes and a great number of other illusionistic tours-de-force such as the trompe l'oeil and cut-out paintings by Flemish artist Cornelius Gijsbrechts, but these items were kept in a so-called perspective room, which acted as an entryway to the Kunstkammer. Perspective boxes, illusionistic paintings, and optical instruments thus shared a specific location and we can imagine how their different operations were compared and discussed by visitors of these collections.

In this thesis I will be examining the specific sites of each case study in depth so as to describe the various contexts—aristocratic, intellectual, religious—in which these items circulated. While held in disparate locations, a connecting thread can be run through each device, illustration, and art form uniting them under the culture of collecting in the early modern period. As this thesis will show, monocular art forms and instruments were collected for the heightened level of illusion they concocted, in addition to the enjoyment of privacy and a particular kind of voyeurism afforded by their peepholes and apertures. What is more, perspectival instruments housed in courtly collections displayed the wealth of knowledge of their elite owners, and also facilitated their mathematical education. I suggest that catoptric peep-boxes, Dutch perspective boxes, dioptric tubes, and drawing instruments fall under the rubric of learned exercises that invite participation on behalf of their deceptive character. As

I will show, peepholes, sighting devices, and apertures that call for monocular vision accentuate this play through obfuscation and revelation.

A significant portion of this thesis explores the role that mathematicians and mathematical treatises played in the theorisation and dissemination of linear perspective. While the relationship between perspectival theory and practice was not a straightforward affair, perspective treatises nonetheless offer an opportunity to gather primary material that likely acted as a basis for the marginal art forms that implement perspective to a monocular extreme. Indeed, pictorial demonstrations of anamorphic peep-boxes, monocular drawing instruments, and pop-up peephole panels can be found in perspectival treatises throughout the Continent. As I will argue, these theoretical exercises acted as the basis of study and inspiration for the development, later, of Dutch perspective boxes, catoptric mirror cabinets, and automated drawing machines.

This thesis can be defined as interdisciplinary in its methodology in which I combine historical with theoretical approaches. I follow in the tradition set by Grootenboer's *Rhetoric of Perspective*, Victor Stoichita's *The Self-Aware Image: An Insight Into Early Modern Meta-Painting* (1997), and Massey's *Picturing Space, Displacing Bodies*. In so doing, I seek to make a contribution towards re-thinking historical objects through attention to issues such as embodiment, voyeurism, and self-awareness on behalf of the work of art. In the majority of the case studies outlined in this thesis I will begin by speaking historically about the special class of objects and instruments that capitalise on monocular vision. Here I will focus on the objects' position within European Kunstkammern, their intended audience, and the knowledge that was attained through interacting with them. After detailing their historical legacy, I will ask

how these perspectival devices can gain new relevance in light of twentieth-century theory and philosophy. Through such theories I am able to discern how this special class of art forms and instruments stand as such compelling illusions. What is more, they help to flesh out the visual and physical dynamics involved in each set-up, and hence allow me to complicate the problematic association between perspective and disembodiment made repeatedly in modern theory.

Due to perspective's restrictive qualities, it has been characterized as a disembodied mode of vision, an argument largely predicated on perspective's monocular constitution (Crary, Jay, Berger, Harries). As this thesis aims to show, this could not be further from the truth. A monocular way of seeing does not presuppose disembodiment. In point of fact, the myriad ways in which the observer perceives perspectival space through peepholes, telescopes, and instruments, is a complex process where the body is often fully involved in solving the visual riddles or working to accommodate perspective's strict code. While the success of monocular perspective rests upon moments of stasis and occlusion, the *process* of interpreting this method often involves movement and activity, as the observer attempts to conform.

VIII. Outline

In the first chapter, 'Peeping Askew: Perspective and Anamorphosis as Peepshow,' I outline the monocular principle as it applies to one-point perspective and anamorphosis. A treatise on perspective by Joseph Moxon will be employed at the beginning of the chapter to animate how perspective was often theorized as a monocular peepshow. Following, I will address how the development of printing technologies

impacted mathematical treatises like Moxon's. Afterwards, a history of anamorphosis and perspective will be shared, with special focus on atypical examples that involve viewfinders and peepholes. A crucial antecedent to these monocular demonstrations is located in the very origins of the perspectival method itself: a peepshow devised by Florentine architect Filippo Brunelleschi in the fifteenth century. By detailing Brunelleschi's panel demonstration, I will show how perspective offers the observer a fixed, monocular point of view that is void of peripheral distractions. In order to demonstrate effectively why peepholes serve such an important role in the practice of perspective, I outline the physiological differences between monocular and binocular vision and share how perspective acts as a highly successful monocular cue for depth in the absence of stereopsis. Finally, this chapter outlines how perspectival peepshows resurfaced in the mid-twentieth century in perceptual studies and art historical theory. Intriguingly, like the origins of perspective, twentieth-century experiments in illusionism are also based on peepshow models.

After having detailed the origins of perspectival peepshows, I turn the most consummate form of this method: seventeenth-century Dutch perspective boxes. Created in the Netherlands between 1650 and 1675, perspective boxes consist of wooden cabinets that are rectangular, triangular, or pentagonal in shape and stand atop a heavy wooden pedestal. Looking through a coin-sized peephole, the viewer sees into an illusionistically-rendered space painted flat on the box's interior panels. Because the illusion presented within the box is only visible when seen through a peephole, this marks the perspective box as a preeminent reification of the principles of perspective. With only six extant examples left in the world, perspective boxes are highly rarefied objects that have been

under-examined in art historical literature. Chapter two, entitled, 'Illusionism, Interiority, and Spaces of Domestic Intimacy: Peeping into Seventeenth-Century Dutch Perspective Boxes,' explores how these boxes demonstrate how perspectival and anamorphic illusions can masterfully deceive the viewer on multiple planes. Moreover, these art forms stand as the logical consequence to studies on perspective found in sixteenth- and seventeenth-century treatises, and hence often pictorially footnote these theories in several clever ways. In terms of their monocular structure and repeated use of the Dutch domestic interior as their subject, I will argue that perspective boxes foster a visual intimacy with the viewer, much akin to dollshouses, by inviting inhabitation and enlivening a cultural interest in miniaturization.

Chapter three, 'Spiritual Study, Collectors' Keepsakes, and Metaphorical Wit: Jean Dubreuil's Monocular Optical Illusions', continues my exploration of peep-boxes through a close study of Jesuit perspectivist Dubreuil's treatise, *La Perspective Pratique* (1649). Specifically, this chapter centres on his study of catoptric illusions—the art of reforming a distorted picture by means of reflection. Dubreuil's treatise argues that by incorporating peepholes and apertures into catoptric arrangements, one can enhance the effect. As a means of contextualizing these theories, I will explore the role of catoptrics in Jesuit education and orthodoxy, and discuss the environments in which one could happen upon a mirrored illusion. Following, I focus on a set of four unusual mirror-lined peep-boxes illustrated in *Perspective Pratique* that I argue were designed to be incorporated as peep-box drawers in early modern art cabinets. Art cabinets were popular furniture pieces used to house objects belonging to a collection, such as jewellery, books, or instruments. The mirror-lined peep-boxes illustrated in *Perspective Pratique* would have provided an

illusory thrill for the patron peeping within. Another rare monocular device collected in elite circles in the early modern period was the dioptric telescope, sometimes called a 'perspective tube'. This instrument used a fragmented crystal fitted within the confines of a long tube to amalgamate a carefully plotted, and seemingly skewed, portrait. As I will show, like their catoptric counterparts, dioptric illusions were mainly used in the service of creating powerful political or religious allegories, and capitalised on the illusory effects of a restrained monocular observer.

The final chapter of my thesis, 'Perspective's Compass: Ludovico Cigoli's "Perspectograph" and Kinetic Navigation,' explores the methods artists and theorists devised to shortcut the theoretical study of perspective and anamorphosis. Specifically, I investigate a seventeenth-century perspective instrument devised by Cigoli, (1559-1613) found in his treatise on perspective, *Prospettiva pratica* (1610-1613). This device, which Kemp coined as a 'perspectograph,' is capable of tracing any object onto a picture plane by mechanical means. I will discuss how despite the unpublished status of Cigoli's treatise, knowledge of this device gained momentum throughout the sixteenth and seventeenth centuries, finding its way into the collection of a French courtier, Louis Hesselin. Here, the perspectograph was exhibited in an art cabinet similar to those for which Dubreuil designed his peep-box drawers. After exploring the enthusiasm for illusionism in Hesselin's court, I will show how the ruling elite of Europe often used drawing technologies as means of mathematical education. The second half of this chapter explores the legacy of the perspectograph within Hesselin's collection, and the manner in which it was happened upon by perspectivist Niceron, who discussed the device in much detail in his second perspectival treatise, *La Perspective Curieuse* (1652).

Niceron used the perspectograph as a means of circumnavigating the difficulty in achieving anamorphic effects. However, devices like the perspectograph remained in the realm of theoretical exercises, not intended for practical use. This chapter seeks to map out the accord between perspectival theory, drawing, and monocularity; how monocular gazing is the preferred mode of studying perspectival illusion time and time again. I aim to show that the body is fully engaged in this form of study, as a kinetic means of navigating the second dimension.

This study aims to reveal the complex relationship between the static, occluding, and prescriptive structure of a special class of monocular art forms and instruments, and the embodied, mobile observer who works to accommodate and conform his body as he peeps within. While the vast literature on perspective and illusionism offers a multitude of different ways of looking at this method, I offer this body of work as a unique frame of reference that has not previously been afforded much space in the story: the point of view of the single-eyed observer.

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‘There is a sense of companionship as I write—though I don't know who the companion is.’ So replied author Lydia Davis when asked if she keeps an ideal reader in mind whilst composing her prose. I think this is a very poignant way of articulating that while writing and researching may be largely solo endeavours, we are nonetheless accompanied by the presence of others along the way. Unlike Davis, I am keenly aware of those people who have accompanied me throughout my doctoral studies, my ideal readers, and I give thanks to them here.

First and foremost, I am greatly indebted to my supervisor Hanneke Grootenboer for her guidance throughout the stages of this thesis. I have immensely profited from her exceptional intellect and innovative scholarship. Having followed her work from afar years prior to stepping foot in Oxford, seeing her comments on the pages of my writing has never lost its thrill. Her encouragement, enthusiasm, and intellectual generosity has been my prime source of inspiration for the writing and researching of this thesis, and has served as the beacon of light I have needed in times of uncertainty, or when lost beneath collected materials.

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my research questions, and I thank him for his critical analyses and for offering me more avenues of inquiry with which to expand my project.

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My sisters, Jenifer and Jacklyn Spencer, have been a constant source of love, kindness, and hilarity throughout the course of my life. Their unflinching support and well-timed notes of encouragement have carried me on my travels abroad, and I am grateful to modern technology for always keeping them close at hand.

I have never been in want of strong female role models in my life thanks to the close relationships I share with my two very tenacious and sharp-witted grandmothers, Leona Preston and Barbara Drummond. If every student were suited with their level of perseverance and fortitude, a doctorate would be an effortless endeavour.

Words cannot express how deeply grateful I am for the support, patience, and humour lent by Georges Bilodeau. The conversations we have shared about this thesis, his acute and detail-oriented observations, and most importantly, his love and companionship, have had a profound effect on the direction of my writing, and my life. He will continue to be my first and last ideal reader.

Finally, I dedicate this thesis to my parents, Beverly and Robert Spencer, with more gratitude than is possible for me to express here. Not a word of this thesis could have been written without their love, kindness, and support. To my father, thank you for instilling in me a love of art and the humour to carry me through life's challenges. To my mother, thank you lending me your ear in times of need, and for serving as the model I will always strive to emulate.

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Vol I: Text

INTRODUCTION

> The binocular perception is not made up of two monocular perceptions surmounted; it is of another order. The monocular images are not in the same sense that the thing perceived with both eyes is.
>
> —Maurice Merleau-Ponty,
> *The Visible and the Invisible*

> Space reaches *from* us and construes the world:
> to know a tree, in its true element,
> throw inner space around it, from that pure
> abundance in you. Surround it with restraint.
> It has no limits. Not till it is held
> in your renouncing is it truly there.
>
> —Rainer Maria Rilke,
> 'What Birds Plunge Through
> is Not the Intimate Space'

I. Peeping into Perspective

Peering along the margins of the enigmatic treatise *Traité de Perspective* (1660) by Jacques Le Bicheur (1599-1666),[1] a lone eye takes stock of a series of lines strewn across the page (fig. 1). A string emanating from the eye's pupil comes to rest to its right, while before it, two triangles stand at attention, casting shadows across the paper's surface. This single, hovering eye is intended to demonstrate one of the fundamental principles of linear perspective: in order to illustrate an object in proper proportion and diminution, the picture plane (here represented by the vertical triangles) should intersect the line of sight (materialised by the string) that exists between the eye of the observer and the depicted object. Le Bicheur's three-dimensional perspectival exercise beseeches

[1] Copies of Le Bicheur's treatise are very rare, as corroborated by K. Andersen, *Geometry of an Art: The History of the Mathematical Theory of Perspective from Alberti to Monge* (New York, 2007), p. 464; and C. Goldstein, 'Studies in Seventeenth Century French Art Theory and Ceiling Painting', *The Art Bulletin* 47, no. 2 (June, 1965), p. 239, note 69. The copy studied by Goldstein is registered in the Bibliothèque Nationale, Catalogue du Fonds Ancient in Paris. While Le Bicheur was an academician of the *Académie de peinture et de sculpture* in Paris, and rose to Professor in 1660, no extant painting exists under his name.

the reader to grab hold of the string and touch it to any of the six lines that terminate along the edge of the page. In so doing, the observer will learn visually as well as tactically how these points correspond to the picture place, and as such s/he will come to understand the practice of perspective.

In addition to functioning as an effective exercise, Le Bicheur's singular eye is emblematic of one of perspective's central theoretical tenets: that it is based upon the idea of a monocular observer.[2] Accounts of the perspectival method found in treatises on the subject often stress that in closing one eye the illusion of depth and feigned realism in a perspectival painting is reinforced. We may say that the theoretical premise of linear perspective, as well as its distorted twin method, anamorphosis, is founded on a paradox. To a certain extent, it invites us, as viewers, to limit our vision rather than expand it, in order to sharpen our perception of pictorial space. Whereas in our daily life, our visual perception is based on looking with two eyes, perspective—as a method to create the illusion of depth on a flat picture plane—is often explained by theorists as relying on single-eye vision, which illustrations such as Le Bicheur's indeed confirm. When standing before a strong perspectival work of art such as a Renaissance ideal cityscape (fig. 2),[3] the illusion of depth is as compelling when seen with two eyes as it is with one. Mathematically, a correct perspectival schema requires that the centre of the projection is located in the eye of the beholder, which is idealised as a singular point. Lines extend from this singular eye and meet with any number of points on the object or scene to be

[2] I use the term 'observer' after Jonathan Crary in *Techniques of the Observer: On Vision and Modernity in the 19th Century* (1992). As will be discussed, while reticent about Crary's theories on perspective and the *camera obscura*, I do share an affinity with his preference for this term. While I try to differentiate my descriptions of perspective's audience at times, using other terms such as 'spectator' and 'viewer' in order to avoid overuse, I am partial to 'observer' for, as Crary elucidates, it means 'to conform one's action, to comply with,' a pictorial conceit. J. Crary, *Techniques of the Observer: On Vision and Modernity in the 19th Century* (Cambridge, 1992), pp. 5-6.

[3] This enigmatic painting will be discussed at further length in chapter 4.

drawn. Our lived perception, also referred to in the Renaissance as *perspectiva naturalis*, is always rooted in binocular vision. However, the guidelines for *perspectiva artificialis* often imply a single peeping eye as a starting point. Furthermore, since its invention, linear perspective has largely become the model for explaining the workings and operation of visual perception. Among others, Ernst Gombrich has pointed out that there is, in fact, a discrepancy between our lived visual perception based on binocular vision and pictorial perspective that has largely become its model.

This thesis will examine the significance of monocularity for the understanding of *perspectiva naturalis* and *perspectiva artificialis*, and their interrelationship. Whereas the literature on the origin and history of perspective is vast, little attention has been given to the role of monocular vision within this history. This is remarkable as perspectival experiments often revolve around single-eye vision: from Brunelleschi's two panels, to Dutch perspective boxes, to Ames' tests, a single peering eye has been central in these examinations of vision and deception. Thus, this thesis asks: to what extent in, for instance, Brunelleschi's demonstration, has 'regular' vision been reduced to monocularity? Has 'one-eyed peeping' become considered as our blueprint of vision?

The main objective of my study is to investigate the extent to which the monocular foundation of one-point perspective has been capitalised on in the early modern period as a conduit for perspectival, anamorphic, and optical illusions. To this aim, my thesis will largely focus on a series of art works that take monocular vision as their starting point, such as seventeenth-century Dutch perspective boxes, catoptric peep-boxes, and anamorphoses. Different from the long tradition of perspectival paintings, perspective boxes and anamorphoses form an exceptional class of pictures in which, I suggest, monocular vision

has been deployed. I would like to argue that these marginal images that have been little studied—with a few exceptions— draw attention to monocular vision, and as such throw new light on the monocular aspects of linear perspective that have not yet been fully explored within the field of art history. Whereas perspective as a field has been explored in Martin Kemp's formative book, *The Science of Art: Optical Themes in Western Art from Brunelleschi to Seurat* (1990), Judith Field's *The Invention of Infinity: Mathematics and Art in the Renaissance* (1997), Hanneke Grootenboer's *The Rhetoric of Perspective: Realism and Illusionism in Seventeenth-Century Dutch Still-Life Painting* (2005), Lyle Massey's *Picturing Space, Displacing Bodies: Anamorphosis in Early Modern Theories of Perspective* (2007), as well as Samuel Edgerton's *The Mirror, The Window, and the Telescope: How Renaissance Linear Perspective Changed Our Vision of the Universe* (2009), this remains an overlooked part of perspective studies.

In addition to analysing the specific practices of picture-making of anamorphoses and peep-boxes, I will look at a series of instruments, and the role they play in early modern treatises, that seem to confirm the monocular aspect of perspective, such as a drawing instrument devised by Ludovico Cigoli (1559-1613, coined a 'perspectograph' by Kemp), a series of catoptric peep-boxes designed by Jean Dubreuil (1602-1670), and Jean-François Niceron's (1613-1646) unusual dioptric perspective tubes. These are rare demonstrations that follow the tenets of perspective very closely and are thereby excellent examples to illuminate the monocular aspects of its workings. We could say that these instruments serve, in fact, as theoretical exercises that have been worked out in material form. Indeed, perspective instruments, like Cigoli's perspectograph, serve as demonstration pieces that do

not necessarily aid the artist's practice in a practical sense, but instead reveal perspective's mathematical character.

Within the scope of this thesis, I am interested in the contexts and environments in which such exceptional art forms as perspective boxes, and equally exceptional devices such as the perspectograph, were produced and used, and what audiences had access to them. Most of the art forms, instruments, and theoretical demonstrations were collected within disparate courtly collections in Denmark, France, and Italy in the seventeenth century. I aim to discern as to how this special class of pictures and devices were encountered in their time—and in what way these environments affected the viewing experience—by detailing the distinctive cultural milieus and intellectual contexts in which they were created and studied. In addition, the question arises as to which forms of knowledge the observer was expected to realise in visually interacting with each object. By focusing on this special class of what I would call 'monocular art forms', I will analyse the extent to which the perspectival method has been successfully applied in material form beyond the classic two-dimensional paintings. I aim to draw attention to the different ways in which traditional perspectival paintings, exceptional cases such as perspective boxes and anamorphoses, and optical devices were encountered in the early modern period. I will do this through an extensive discussion of the history of their collection, and their location in the designated space of the Kunstkammer (also known as Wunderkammer or cabinet of curiosity) in royal palaces where these items were stored and studied. The Danish Kunstkammer is a particular case in point. Not only did it hold three perspective boxes and a great number of other illusionistic tours-de-force such as the trompe l'oeil and cut-out paintings by Flemish artist Cornelius Gijsbrechts (1630-1683), but these items were kept in a so-called perspective

room, which acted as an entry-way to the Kunstkammer. Perspective boxes, illusionistic paintings, and optical instruments thus shared a specific location and we can imagine how their different operations were compared and discussed by visitors of these collections.

II. Monocular Illusions as Collectible *Artificialia* and *Scientifica* in the Early Modern Kunstkammer

In this thesis I will be examining the specific sites of each case study in depth so as to describe the various contexts—aristocratic, intellectual, religious—in which these items circulated. While held in disparate locations, a connecting thread can be run through each device, illustration, and art form uniting them under the culture of collecting in the early modern period. Just as the Dutch perspective boxes were acquired for the royal Danish Kunstkammer in Copenhagen, another set of remarkable monocular art forms that I will focus on are Dubreuil's catoptric peep-boxes, which were likely designed as drawers for art cabinets. These cabinets were used to store curiosities in Kuntskammern or the homes of wealthy European collectors. A third collected item investigated in my thesis is a model of Cigoli's perspectograph, which was exhibited within an art cabinet in the collection of a French courtier, Louis Hesselin. Cigoli's instrument is exceptional in that its workings were described in a thesis penned by him that was never published but still circulated in perspectivists' circles. In addition to these specific devices, I am also interested in other sets of collections of anamorphoses, catoptric mirrors, and perspective instruments housed in Rudolph II's collection in

Prague,[4] the Dresden Kunstkammer,[5] and the *studiolo* of Francesco I de' Medici in Florence.[6]

Generally, a Kunstkammer can be understood as an antecedent to the modern museum, where different natural and artificial objects are organised, displayed, and collected.[7] Each courtly Kuntskammer was distinct in its organisation and accessibility depending on the ruling elite's preferences. Collected artefacts ranged from natural forms, otherwise known as *naturalia*, which demonstrate the awe-inspiring capabilities of nature that were often selected for their aberrant size or exotic derivation, such as embalmed animals, tusks, horns, or exotic shells; man-made objects, known as *artificialia*, that serve as testaments to man's ingenious capabilities such as paintings, sculptures, books, antiques, vases, jewellery, and automata; and scientific instruments, known as *scientifica*, such as astrolabes, clocks, measurement devices, and drawing instruments.[8] The early modern Kunstkammer was intended to provide a microcosmic, encyclopaedic survey of the wonders of world.[9] As such, Alexander Marr has defined it as 'the emblem par excellence of early modern curiosity and wonder.'[10] Perspectival

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[4] See T. D. Kaufmann, 'Remarks on the Collections of Rudolph II: The *Kunstkammer* as a Form of *Representatio*', in D. Oreziosi and C. Farago (eds.), *Grasping the World: The Idea of the Museum* (Burlington, 2004), pp. 526-537; and R.J.W. Evans, *Rudolph II and His World: A Study in Intellectual History, 1576-1612* (Oxford, 1973).

[5] See S. Dupré and M. Korey, 'Optical Objects in the Dresden *Kunstkammer:* Lucas Brunn and the Courtly Display of Knowledge' in G. Strano, S. Johnston, M. Miniati (eds.), *European Collections of Scientific Instruments 1550-1750* (Leiden, 2009), pp. 61-86; and H. Watanabe-O'Kelly, *Court Culture in Dresden: From Renaissance to Baroque* (New York, 2002).

[6] See O. Raggio and A. M. Wilmering (eds.), *The Gubbio Studiolo and its Conservation* (2 vols.) (New York, 2000); and A. Marr, *Between Raphael and Galileo: Mutio Oddi and the Mathematical Culture of Late Renaissance Italy* (Chicago and London, 2011), pp. 29-33.

[7] See O. Impey and A. MacGregor (eds.), *The Origins of Museums: The Cabinet of Curiosities in Sixteenth and Seventeenth-Century Europe* (Oxford, 1985); and B. Gutfleisch and J. Menzhausen, 'How a Kunstkammer Should be Formed' *Journal of the History of Collections* I (1989), pp. 3-31.

[8] Watanabe-O'Kelly, *Court Culture in Dresden,* pp. 71-72.

[9] On the cabinet of curiosity as a microcosm of the universe, see J. Kenseth, 'A World of Wonders in One Closet Shut', in *Age of the Marvellous* (Dartmouth, 1991), pp. 80-101.

[10] A. Marr, 'Introduction', in R.J.W Evans and A. Marr (eds.), *Curiosity and Wonder from the Renaissance to the Enlightenment* (Aldershot and Burlington, 2006), p. 10. See also K. Pomian, *Collectors and*

illusions like catoptric mirrors, and perspective instruments like the perspectograph, fall into the categories of both *artificialia* and *scientifica*. It can be said that perspective as a method is as much on display in the Kunstkammer as its varied accoutrements.

As this thesis will show, monocular art forms and instruments were collected for the heightened level of illusion they concocted, in addition to the enjoyment of privacy and a particular kind of voyeurism afforded by their peepholes and apertures. What is more, perspectival instruments housed in courtly collections displayed the wealth of knowledge of their elite owners, and also facilitated their mathematical education. Monocular perspectival devices thus straddle what Paula Findlen has defined as the spheres of social play ('ludus') and intellectual play ('lusus').[11] Illusions such as anamorphoses were characterised in the early modern period as 'serious jokes,' as they delight viewers superficially with deception and puzzles, but are intellectualised through their mathematical design and careful craftsmanship. Findlen contends that such serious playfulness was 'fully activated' in the sixteenth and seventeenth centuries, and that 'joking can be characterized as a practice central to Renaissance science,' as it intertwined 'the discourse on playfulness to the social experience of the naturalist-collector.'[12] I suggest that catoptric peep-boxes, Dutch perspective boxes, dioptric tubes, and drawing instruments all fall under the rubric of learned exercises that invite participation on behalf of their deceptive character. As I will show, peepholes, sighting devices, and apertures that call for monocular vision accentuate this play through obfuscation and revelation.

Curiosities: Paris and Venice 1500-1800, trans. E. Wiles-Porter (Cambridge, 1987); P. Findlen, *Possessing Nature: Museums, Collecting, and Scientific Culture in Early Modern Italy* (Berkeley, 1996).

[11] P. Findlen, 'Jokes of Nature and Jokes of Knowledge: The Playfulness of Scientific Discourse in Early Modern Europe', *Renaissance Quarterly* 43, no. 2 (1990), pp. 322-324.

[12] Findlen, 'Jokes of Nature', p. 295.

It should be noted that because this thesis contends with works of art and instruments that were created, exhibited, and enjoyed in courtly collections, Kunstkammern, and learned societies, the audiences for such pieces were largely exclusive, consisting of a small group of people. When I discuss an 'observer' or 'viewer', I am here referring to a small, highly privileged portion of the population in early modern Europe that would have frequented specific circles: learned mercantile men, princes, courtiers, and members of religious orders. Evidently, I will be mindful of the 'culturally relative pressures on perception' in the disparate environments I interpret, as stressed by Michael Baxandall's analytical method of the 'Period Eye' found in his influential book, *Painting and Experience in Fifteenth-Century Italy: A Primer in the Social History of Pictorial Style* (1972). As related to perspective, Baxandall stressed that many Quattrocento people would have been accustomed to viewing the world geometrically, or applying geometrical rules to artistic practices, as they were taught such skills in the fields of surveying.[13] As he writes: 'The idea of perspective, of imposing a network of calculable angles and notional straight lines on a prospect, is not outside the grasp of a man able to handle such an exercise in surveying.'[14] It should be assumed that the learned groups engaging with perspectival works of art in the early modern period were equipped with, in the least, a more than elementary know-how of geometrical forms.

Before turning to the specific art historical context and methodology I adopt in this thesis, I would like to make a brief terminological note on a word employed consistently in my analyses. While I often refer to the act of peering through peepholes or

[13] M. Baxandall, *Panting and Experience in Fifteenth-Century Italy: A Primer in the Social History of Pictorial Style* (Oxford, 1972), p. 107.
[14] Baxandall, *Painting and Experience*, p. 108.

apertures as 'peeping', this term would not have been employed in the seventeenth century. However, Barbara Benedict's historical account of the role of 'peeping' as a form of early modern curiosity offers terrific insight into the term's origins. In *Curiosity: A Cultural History of Early Modern Inquiry* (2002), she shares how the word 'peep'—to look furtively or illicitly—became a very popular term in the eighteenth century. Citing Johnson's Dictionary, Benedict defines peep as 'a sly look' and subsequently as a 'first faint appearance.'[15] Finding no direct etymology for the word, Johnson's dictionary concludes that 'to peep' must derive either from the Dutch 'to lift up' or the Latin for 'spy.'[16] Grootenboer has shown that this term is also imbued with voyeuristic meaning as an 'illicit glance.'[17] In my chapter on Dutch perspective boxes, I aim to extrapolate on 'peeping's' voyeuristic character.

III. Perspectival Novelties and the Mathematical Treatise

A significant portion of this thesis explores the role that mathematicians[18] and mathematical treatises played in the theorisation and dissemination of linear perspective. It is within such publications that the monocular structure of perspective is most explicitly discussed and illustrated. While the relationship between perspectival theory and practice was not a straightforward affair, perspective treatises nonetheless offer an opportunity to gather primary material that likely acted as a basis for the special class of

[15] B. Benedict, *Curiosity: A Cultural History of Early Modern Inquiry* (Chicago, 2002), p. 142.
[16] Benedict, *Curiosity: A Cultural History*, p. 142.
[17] H. Grootenboer, *Treasuring the Gaze: Intimate Vision in Late Eighteenth-Century Eye Miniatures* (Chicago, 2012), p. 78.
[18] 'Mathematician' had a broader meaning in the Renaissance than it holds today. Then, it was normally assigned to one who was involved in studying the *quadrivium*: arithmetic, geometry, astronomy, and music (as well as such related disciplines as optics and mechanics). In this sense, artists, architects, and artisans could be said to participate in mathematics should they be preoccupied with the study of perspective and proportion. P. L. Rose, *The Italian Renaissance of Mathematics: Studies on Humanists and Mathematicians from Petrarch to Galileo* (Geneva, 1975), p. 3.

art forms that implement perspective to a monocular extreme. Indeed, pictorial demonstrations of anamorphic peep-boxes, monocular drawing instruments, and pop-up peephole panels can be found in perspectival treatises throughout the Continent. As I will argue, these theoretical exercises acted as the basis of study and inspiration for the development, later, of Dutch perspective boxes, catoptric mirror cabinets, and automated drawing machines. One of my arguments is that these devices can be considered as 'theoretical demonstrations' that have been materialised. In developing this argument, I aim to complicate the influential theory set forward in Svetlana Alpers' *The Art of Describing: Dutch Art in the Seventeenth Century* (1983), in which she argues for a dichotomy between Northern and Southern approaches to painting. She claims that there is, on the one hand a 'narrative', or textually based approach mostly seen in Italy, and on the other hand, a 'descriptive' approach based on the pure recording of perception which is typical of Dutch painting. I would suggest that this distinction is far too polarised and aim to show that Dutch artists were also inclined to imbue their works with lessons garnered from perspectival treatises.

In the early modern period, books on perspectival mathematics could be found in a range of environments such as royal courts, university libraries, or artist's residences. Treatises collected within these environments were appreciated in a context distinct in their appreciation for learning, curiosity, and as Mario Biagioli's research has shown, courtly comportment.[19] Often, such books were given as gifts as a form of social exchange, an integral part of early modern court culture.[20] In this way, they could act as

[19] See M. Biagioli, *Galileo, Courtier: The Practice of Science in the Culture of Absolutism* (Chicago, 1993); Biagioli, *Scientific Authorship: Credit and Intellectual Property in Science* (New York, 2002).
[20] A. Johns, *The Nature of the Book: Print and Knowledge in the Making* (Chicago, 1998), p. 15.

'vehicles of patronage' in addition to encouraging scientific debate.[21] Volker Remmert's recent study demonstrates that frontispieces and title-engravings to books relating to the mathematical sciences acted as key constituents to the developments of what is known as the Scientific Revolution.[22] Most notably, 'an intense culture of frontispieces' flourished in Jesuit scientific circles in the early seventeenth century.[23] Through the design of frontispieces, scholars and theorists sometimes summarised the key aspects of their text in order to promote their ideas to a wide audience, and also secure patronage through clever iconography.

To this end, I will analyse a number of frontispieces designed for several seventeenth-century treatises on perspective and mathematical instrumentation. Specifically, two French treatises on perspective by Niceron (*La Perspective Curieuse*, 1638), and Dubreuil (*La Perspective Pratique,* 1649) figure prominently in my study. As will be discussed in chapters three and four, Niceron and Dubreuil's treatises offer remarkable feats of imagined perspectival, catoptric, and dioptric demonstrations, and as such are central to many of the arguments I put forward. Moreover, German Jesuit Christoph Scheiner's treatise on a drawing instrument known as a 'pantograph' (*Pantographice,* 1653) is analysed in chapter four through close study of the book's

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[21] P. Findlen, 'The Economy of Scientific Exchange in Early Modern Italy', in B. T. Moran (ed.), *Patronage and Institutions: Science, Technology, and Medicine at the European Court 1500-1750* (Woodbridge, 1991), p. 16. See also in the same volume, E. William, 'Court, Academy, and Printing House', pp. 25-50.

[22] See V. Remmert, *Picturing the Scientific Revolution: Title Engravings in Early Modern Scientific Publications* (Philadelphia, 2011); and Remmert,'"Docet parva pictura, quod multae scripturae non dicunt." Frontispieces, their Functions, and their Audiences in Seventeenth-Century Mathematical Sciences' in S. Kusukawa and I. Maclean (eds.), *Transmitting Knowledge: Words, Images, and Instruments in Early Modern Europe* (Oxford, 2006), pp. 239-270. On frontispieces in general see: see M. Corbett and R. Lightdown, *The Comely Frontispiece: The Emblematic Title-Page in England 1550-1660* (London, 1979).

[23] See G. A. Bailey, '"Le style jésuite n'existe pas": Jesuit Corporate Culture and the Visual Arts' in J. O'Malley (ed.), *The Jesuits: Cultures, Sciences, and the Arts, 1540-1773* (Toronto, 1999), pp. 38-89. See also in the same volume, L. Rice, 'Jesuit Thesis Prints and the Festive Academic Defense at the Collegio Romano', pp. 148-69.

compelling title page. By the mid-seventeenth century, illustrated frontispieces could disseminate theorists' ideas faster and more broadly than written text. Indeed, Remmert argues that 'the intense reception of title iconography illustrates the stress authors laid on visual presentation and the way it could legitimise their positions.'[24] Thus, it can be said that in addition to disseminating perspectival theories to practising artists, perspective treatises also participated in the early modern 'culture of frontispieces' that employed visual strategies to convey abstract ideas.

IV. Art and Illusion: Perspective and Anamorphosis in Art Historical Study

The genesis of this thesis takes its cue from the perceptual studies of Ernst Gombrich in his seminal work, *Art and Illusion: A Study in the Psychology of Pictorial Representation* (1960). For Gombrich, perspective's efficacy lies in its occluding character:

> Now perspective may be a difficult skill, but its basis, as has been said, rests on a simple and incontrovertible fact of experience, the fact that we cannot look round a corner. It is due to this unfortunate inability of ours that as long as we look with one stationary eye, we see objects only from one side and have to guess, or imagine, what lies behind.[25]

The illusion set forth is a glimpse, a slice, of an otherwise comprehensive view or panoramic feat. As will be shown in the course of this thesis, the nature of monocular illusions may limit the observer's scope of vision, but these restrictions are central to the success of the type of illusion it puts forth. By situating an observer in a prescribed location, perspective hides as much as it shows; it relies on obstruction and constraint

[24] Remmert, 'Docet parva pictura', p. 256.
[25] E. Gombrich, *Art and Illusion: A Study in the Psychology of Pictorial Representation* (New York, 1960), p. 211.

whilst simultaneously creating a seamless thoroughfare for our line of sight. In this way, perspective conceals that which cannot be seen from a specific, static point of view.[26] Whether restricted by its strict linear code or by a peephole, the observer is privy only to a small portion of a given scene, and in this way perspective achieves realisation.

Another principal feature of linear perspective is its claims to spatial translation. By suggesting the recession of depth on a two-dimensional surface, perspective transforms a flat plane into space marked by depth and volume. This conversion is no easy task. In his study, Gombrich stresses how difficult it is to see the visible world as a flat, two-dimensional field. It is toward the three-dimensionality of appearances that our vision is attuned and accustomed.[27] However, the artist must work within the confines of the second dimension, translating lived space onto a fixed plane. According to Gombrich, the vocabulary the artist learns to attend to on the two-dimensional space of the picture plane is 'of no biological relevance,' for it exists in a dimension we do not experience first-hand.[28] He mentions explicitly that this vocabulary is 'studied in the highly artificial situation of one-eyed stationary vision.'[29] Gombrich explains that we must shift from a binocular mode of looking to a monocular mode of looking in order to achieve the illusion of depth onto a flat surface.

In his later work, *The Image and the Eye: Further Studies in the Psychology of Pictorial Representation* (1982), Gombrich expands on the observer's relation to the monocular field of perspective, and again insists that despite perspective's apparent disregard for how we normally see, the efficacy of the perspectival method is firm: 'The

[26] M. Kemp, *Visualizations: The Nature Book of Art and Science* (Berkeley and Los Angeles, 2000), p. 29.
[27] Gombrich, *Art and Illusion*, p. 278.
[28] Gombrich, *Art and Illusion*, p. 278.
[29] Gombrich, *Art and Illusion*, p. 278.

fact that we normally look with two eyes rather than one, that our eyes move, or that our retinas are curved—all these alleged flaws in the principles of central perspective do not affect the validity of the demonstration.'[30] In this dissertation, I explore a series of perspectival exceptions in the history of art, where perspective's monocular character is in fact capitalised on. I am interested in the tension that perspective creates—between a method of depiction that creates the illusion of depth, and the body of the observer, who is invited by the art work to position himself in real space in order to take part in the artifice. One theme running through my case studies is tracing the ways in which the observer physically relates to monocular art forms and mediums such as peep-boxes and drawing instruments, by having to bend over or close one eye.

As the concerns of this thesis are instigated by the monocular nature of one-point linear perspective, my study is for a large part focused on anamorphosis. Anamorphosis turns the structure of perspective inside-out, so to speak, exaggerating it to such a degree that the image no longer appears intelligible from a frontal viewing position. The observer is invited to move his body to the extreme periphery of the image in order for the representation to realign and cohere. As will be discussed in chapter one, the anamorphic method existed in tandem with the development of perspective as early as the sixteenth century. Grootenboer has shown that through its distorted configuration, anamorphosis in fact exposes the otherwise invisible structures of perspective; by means of anamorphosis we are able to look *at* perspective's operations, rather than *through* it.[31] By skewing perspective, anamorphosis reveals the foundations on which the method is built, for when engaging with an anamorphic work of art,

[30] E. Gombrich, *The Image and the Eye: Further Studies in the Psychology of Pictorial Representation* (London, 1982), p. 258.
[31] Grootenboer, *Rhetoric of Perspective*, pp. 97-100.

> …we no longer occupy a position that literally is diametrically opposed to the painting in which image and ground coincide, but we stand by the painting's side; we have moved to its level, and look, so to speak, from the painting's point of view.[32]

Anamorphosis positions us as viewers on the edges or the boundaries of the structure, occupying an oblique point of view, and from the periphery we catch a glimpse of how perspective controls and shapes what we see. Hans Holbein's *The Ambassadors* (1533) is the clearest point in case here (fig. 3). The anamorphic imagery presented in my study offer such skewed and indirect points of view, whether through peepholes cut into painted panels, conical mirrors, or the fragmented effects of polyhedral lenses.

I am largely indebted to Jurgis Baltrušaitis' groundbreaking work, *Anamorphic Art* (1955), the first book to examine the anamorphic technique with serious and scholarly regard. Baltrušaitis famously connected anamorphosis—as a technical marvel—with its metaphorical potential, and stressed the lyrical interpretation of representational space as a 'poetry of abstraction, an effective mechanism for producing optical illusion and a philosophy of false reality.'[33] In this thesis I am interested in the lucidity of the perspectival method as in its propensity towards deceit. Indeed, I am invested in what David Summers characterises as the two 'contradictory associations of Renaissance perspective:' transparency and illusion.[34] Because the art forms, instruments, and peepshows discussed throughout my study stand in contrast to more traditional forms of perspective, such as painting, I define my case studies as representative of a baroque understanding of representational space, as characterised by Christine Buci-Glucksmann in *La Folie Du Voir: De L'esthétique Baroque* (1986). According to Buci-Glucksmann,

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[32] Grootenboer, *Rhetoric of Perspective*, p. 131.
[33] J. Baltrušaitis, *Anamorphic Art*, trans. W.J. Strachan (New York, 1977), p. 1.
[34] D. Summers, *Vision, Reflection, and Desire in Western Painting* (Chapel Hill, 2007), p. 157.

the baroque might interrogate Renaissance perspective but it does not escape its 'homogeneous, geometric' space of Renaissance perspective.[35] The seventeenth century does not necessarily represent a break with the methods of perspective established in the fifteenth and sixteenth centuries, but instead manipulates its conventions through the structures of the method itself. This period marks a moment in the history of art wherein a comprehensive view of a painted scene often depended upon the assistance of mirrors, telescopic tubes, and lenses, where, as Paul Virilio says, 'the reality-effect had become a dissociated system, a puzzle the observer was unable to solve without some traffic in light or the appropriate prostheses.'[36] This thesis contends with such prostheses, with special focus on their monocular quality.

The study of perspective continues to be a growing field ever since Gombrich's classic work on illusionism. Kemp's *Science of Art* presents the most thorough analysis of the history of perspective through the ages, and demonstrates the myriad ways in which artists have worked with scientific ideas and instruments as an aid to their practice. Most notably, Kemp argues that the realms of science and art are interconnected in their concern for optics. After Kemp, a number of studies have tackled perspective through disparate approaches. Most recent exponents of the field include Edgerton's latest study which has qualified perspective as an essential point of origin from which the developments of modern science finds provenance.[37] The impact of new printing technologies on the circulation of perspectival treatises has been mapped by Christopher Heuer, who stresses the significance

[35] C. Buci-Glucksmann, *Baroque Reason: The Aesthetics of Modernity*, trans. P. Camiller (New York, 1992), p. 76.
[36] P. Virilio, *The Vision Machine*, trans. J. Rose (Bloomington and Indianapolis, 1994), p. 5.
[37] S. Edgerton, *The Mirror, The Window, and the Telescope: How Renaissance Linear Perspective Changed Our Vision of the Universe* (Ithaca, 2009).

of written theory on perspective's application.[38] In addition, in Filippo Camerota's close inquiry of Cigoli's unpublished manuscript, *Prospettiva Pratica*, we find a detailed analysis of the interconnected character of drawing technologies on the artist's practice.[39] Sven Dupré's research on the relations between perspective, catoptrics, and early modern optics has demonstrated that the reception of illusions was often contingent on the knowledge audiences brought to the works.[40] Approaching perspective through the lens of structuralist semiotics, Hubert Damisch has shown that perspective is not only a method of representation, but a form of thought.[41] James Elkins has shown that our modern understanding of perspective is based on an overly simplified view, that perspective was in fact a complicated and fractured system of representation.[42] Grootenboer, who traced perspective's rhetorical dimension, demonstrated how perspective's contorted applications such as anamorphosis and *trompe l'oeil* allow us to catch a glimpse of its otherwise invisible structures.[43] Finally, Massey's recent work has overturned the long-held view that perspective severs the act of seeing from the observer's body, as the methods of early modern anamorphosis in fact reveal how perspective grapples with the body of the observer in a multitude of ways.[44]

Fundamental as these accounts have been for the study of perspective, what has been missing is an acknowledgment of the significance of monocularity for our understanding of

[38] C. Heuer, *The City Rehearsed: Object, Architecture, and Print in the Worlds of Hans Vredeman de Vries* (New York and London, 2009).
[39] F. Camerota, *Linear Perspective in the Age of Galileo: Ludovico Cigoli's* Prospettiva pratica (Florence, 2010).
[40] S. Dupré and H.J. Cook (eds.), *Translating Knowledge in the Early Modern Low Countries* (Berlin, 2012).
[41] H. Damisch, *The Origin of Perspective* (Cambridge, 1994).
[42] J. Elkins, *The Poetics of Perspective* (Ithaca, 1994).
[43] Grootenboer, *Rhetoric of Perspective* (Chicago, 2005).
[44] L. Massey, *Picturing Space, Displacing Bodies: Anamorphosis in Early Modern Theories of Perspective* (Philadelphia, 2007).

visual perception and linear perspective. My study would like to fill this gap by bridging perspectival theory and practice. While these pursuits often reveal a discrepancy, a split between geometrical abstraction and the realities of practice, I am interested in analysing this division and uncovering moments in which practice and theory overlap. For instance, I will tease out the theoretical dimension of the perspective boxes, and the experimental dimension of some devices like Cigoli's perspectograph.

V. Methodology: Perspective Divided

Erwin Panofsky's highly influential essay, *Perspective as Symbolic Form* (1927), had a profound effect on the course of perspective studies in the discipline of art history. In this study, Panofsky presents perspective as a homogeneous representation of space as a symbolic form, a symptom of its particular cultural milieu that was not a discovery but 'produced by construction.'[45] The crux of Panofsky's argument lies in his insistence that perspective developed out of a very particular cultural milieu—Renaissance Florence—and that pre-Renaissance epochs established their own methods of depicting three-dimensional space. In light of the fact that Panofsky based his argument on historical, scientific, and philosophical methods, the sub-field of perspective studies generated by *Perspective as Symbolic Form* has likewise been divided amongst disparate interpretative frameworks. On the one hand perspective has been interpreted in the literature as a science of vision and representation, and on the other it has been theorised as a nexus of cultural responses to the truth in painting and methods of illusion. Put another way, there have been two tendencies in the theorising of perspective. The first sees perspective as a

[45] E. Panofsky, *Perspective as Symbolic Form,* trans. C. Wood (Cambridge, 1991), p. 30.

historical construct,[46] as a method that developed out of medieval optics and geometry, and as a pragmatic solution to problems artists came up against in their attempts to convey the third dimension on a flat plane. The second tendency has been to theorise perspective as a philosophical construct and to flesh out its implications as both a method and idea.[47] As Charles H. Carman has discerned, betwixt these two diverging tendencies there exists a middle ground, or a third approach:

> It is a sort of compromise position that sees meaning in perspective, but like the first approach, links it primarily with the drive for technological advance that is often seen as central to what distinguishes Renaissance humanism and its new concern with the physical world, including the greater naturalism evident in the visual arts.[48]

It is this approach that I espouse in this thesis. I am both interested in the history of perspective as a method that developed out of a specific time and for specific purposes, while being equally concerned with larger theoretical or philosophical questions about how the observer relates to perspectival and illusory space. In light of this approach, I am keen on discerning how perspectival art forms foster visual intimacy with the viewer, act as a physical appendage, and invite participation.

This thesis can be defined as interdisciplinary in its methodology in which I combine historical with theoretical approaches. It should be noted that combining these two approaches is an established field within the history art, as it is demonstrated in publications ranging from Grootenboer's *Rhetoric of Perspective*, Victor Stoichita's *The Self-Aware Image: An Insight Into Early Modern Meta-Painting* (1997), and Massey's

[46] While encompassing different views on perspective, the historical approach can be seen in the oeuvres of Kemp, White, Edgerton, and Field.
[47] Again, while differing in their theories, this more philosophical approach can be seen in the works of Grootenboer, Baltrušaitis, Elkins, Damisch, and Massey.
[48] C. H. Carman, 'Meanings of Perspective in the Renaissance: Tensions and Resolution', in J. S. Hendrix and C. H. Carman (eds.), *Renaissance Theories of Vision* (Aldershot and Burlington, 2010), p. 32.

Picturing Space, Displacing Bodies, to the complete oeuvres of Hubert Damisch and Louis Marin. My approach follows from this tradition, and seeks to make a contribution towards re-thinking historical objects through attention to issues such as embodiment, voyeurism, and self-awareness on behalf of the work of art. Although Gombrich's theories are fundamental to the understanding as to how linear perspective has been utilised and received, this thesis will not outline in depth how monocular perspectival art forms relate to the psychology of perception. Instead, this will be discussed briefly in the first chapter in order to provide context for Gombrich's arguments. This thesis is centrally concerned with how monocular vision was used as a conduit for perspectival illusion in marginal or 'curious' art forms in the seventeenth century.

In the majority of the case studies outlined here, I will begin by speaking historically about the special class of objects and instruments that capitalise on monocular vision. Here I will focus on the objects' position within European Kunstkammern, their intended audience, and the knowledge that was attained through interacting with them. After detailing their historical legacy, I will ask how these perspectival devices can gain new relevance in light of twentieth-century theory and philosophy. For example, Damisch's post-structural approach will be employed to highlight how at the very heart of the perspectival method we find a hole, an absence or blind spot, that we literally and metaphorically peer through in order to grasp how perspective functions. Further, the Dutch perspective boxes discussed in chapter two will be interrogated through Jean-Paul Sartre's theories on voyeurism shared in *Being and Nothingness: An Essay on Phenomenological Ontology* (1943). Engagement with a phenomenological approach will elucidate how monocular peeping can in fact instigate a voyeuristic experience.

Additional phenomenological analysis of Cigoli's perspectograph in chapter four will help illuminate a previously under-lit aspect of Cigoli's innovative design—the embodied character of perspective. Through such theories I am able to discern how this special class of art forms and instruments stand as such compelling illusions. What is more, they help to flesh out the visual and physical dynamics involved in each set-up, and hence allow me to complicate the problematic association between perspective and disembodiment made repeatedly in modern theory, a point to which I now turn.

VI. Disembodied Perspective: The Contemporary Debate

This thesis starts from the premise that perspective is not a mere method for straightforward, realistic representations, but has also been used to great success in marginal forms of image making such as perspective boxes, mirror anamorphoses, and in the development of dioptric perspective tubes. In this regard, I follow Elkins, who writes that perspective 'was not a single thing, but a collection of things that extended as far as polyhedral and scientific instruments.'[49] Further to this line of thought, Elkins stresses that the mode of vision fostered by perspective is just as fractured, in both artistic examples and theoretical interpretations, and he employs a striking metaphor to outline this schism:

> Perspective can have dozens of eyes (dozens of principal vanishing points in ceiling painting and modern collage), and it can also have two eyes (in anaglyphs, stereo pairs, and in informal viewing), or just one eye (in peep boxes, anamorphoses, and especially in modern theory)…Perspective is the site of the legislation of seeing, but it has never operated under a single verdict or binding rule.[50]

[49] Elkins, *Poetics of Perspective*, p. 79.
[50] Elkins, *Poetics of Perspective*, p. 80.

While this dissertation is largely concerned with the 'one eye' of perspective as characterised by Elkins, one of my underlying objectives is to demonstrate that even if perspective is a monocular mode of pictorial representation, the eye of 'modern theory' that Elkins cites needs to be taken to task. What Elkins alludes to in this passage are the theories of modernism put forward by Martin Jay and Jonathan Crary, among others, who have claimed perspective's monocular character as a leitmotif to define early modern perspective—in contrast to that of the modern period—as a rational interpretation of space that is abstracted from the viewer's body. Providing an overview of these theories is crucial to carving out how my project on monocularity positions itself in relation to this body of thought.

In *Techniques of the Observer: On Vision and Modernity in the 19th Century* (1992), Jonathan Crary seeks to break the 'models of continuity' that attempt to wed the developments of the *camera obscura* in the early modern period with those of photography in the modern period. The model of vision brought about by the camera obscura 'collapsed in the 1820s and 1830s, when it was displaced by radically different notions of what an observer was and of what constituted vision.'[51] In order to characterise what came before, to draw a line in the sand, Crary characterises the early modern period as a monocular and disembodied mode of visuality. While his arguments are largely based upon the *camera obscura*, which is quite different from perspective, they have nonetheless affected the way that perspective practices have been viewed as well.[52] In his view, the *camera obscura* severs 'the act of seeing from the physical body of the observer,' and decorporealises vision in the same manner as the 'monadic viewpoint' of

[51] Crary, *Techniques of the Observer*, p. 27.
[52] Crary, *Techniques of the Observer*, p. 34.

perspective.[53] In an earlier essay published in Hal Foster's edited volume *Vision and Visuality: Discussions in Contemporary Culture* (1988), Crary asserts that binocular vision was not capitalised on prior to the nineteenth century, writing:

> Monocularity, like perspective and geometrical optics, was one of the Renaissance codes through which a visual world is constructed according to systematized constants, and from which any inconsistencies and irregularities are banished to insure the formation of a homogeneous, unified, and fully legible space.[54]

He goes on to argue that the monocular principle of perspective can only function through the divesting of the body; in perspective, the observer functions as a purely ocular subject.[55] In the same volume, Martin Jay's analysis of the 'scopic regime' of the modern period defines the overarching mode of vision in the early modern period as 'Cartesian perspectivalism.'[56] Likening the origins of perspective to the disembodied, cadaverous eye that René Descartes used to formulate his observations on the physiology of vision,[57] Jay contends that the eye of perspective is similarly singular, 'static, unblinking, and fixated.'[58]

This line of reasoning has been extended in the discipline, with theorists urging that perspective is an unnatural pictorial convention. For instance, Harry Berger has

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[53] Crary, *Techniques of the Observer*, p. 39-40.
[54] J. Crary, 'Modernizing Vision', in Hal Foster (ed.), *Vision and Visuality* (Seattle, 1988), pp. 32-33.
[55] Crary, 'Modernizing Vision', p. 33.
[56] M. Jay, 'Scopic Regimes of Modernity', in Hal Foster (ed.), *Vision and Visuality* (Seattle, 1988), p. 4.
[57] In *La Dioptrique* (1637), René Descartes sets out to prove that vision functions mechanically, and is akin to a *camera obscura*, in a very literal sense. In order to prove his theory, he asserts that if one were to replace the lens of a *camera obscura* with that of the eye of a newly-dead person, or in this case, a newly-dead cow, one would see the same image projected in precisely the same manner. By cutting away its backside, and replacing it with a form of a thin 'white body,' light could pass through its membranes and reflect the incoming image onto a surface area. Upon witnessing this experiment, Descartes was able to conclude that a similar picture is formed in the retina of the eye. Consequently, because the upside image is passed through the retina, which acts as a passive mediator, it is the brain and the soul which are responsible for cognition, not the eye itself. See R. S. Nelson, *Visuality Before and Beyond the Renaissance*: *Seeing as Others Saw* (Cambridge, 2000), p. 3.
[58] Nelson, *Visuality Before and Beyond*, p. 7. See also M. Jay, *Downcast Eyes: The Denigration of Vision in Twentieth-Century French Thought* (Berkeley, 1993), pp. 54-55.

characterised the observer in the Albertian perspective schema as 'a cyclopean robot, constructed and controlled by the system.'[59] Echoing Berger, Karsten Harries writes that perspective 'considers only the eye,' and in order to construct a perfectly manageable system of space it 'assumes monocular vision and a flat earth.'[60] This inflicts 'violence' on our vision, which Harries contends is evident in the fact that we normally see with 'two, constantly shifting eyes.'[61]

In contrast to Jay, Crary, Harries, and Berger, Norman Bryson puts a wholly different argument forward in his influential book, *Vision and Painting: The Logic of the Gaze* (1983). He theorises that while perspective may cunningly convey a sense of space that we can immediately identify with, it only does so once we have physically accepted the conditions on which its efficacy lies. The vanishing point is actually 'the anchor of a system that *incarnates* the viewer, renders him tangible and corporeal, a measurable, and above all a visible object in a world of absolute visibility.'[62] Moreover, 'in operating the codes of monocular perspective the viewing subject creates a self-definition as *this* body approaching the image in *this* space,' thereby grounding the observer as he assesses how to best position himself before the image or uncover what has been anamorphically skewed.[63] I largely agree with Bryson's arguments and seek to demonstrate precisely how perspective achieves this level of corporeality. I hold that the oversimplified view of perspective as a disembodied and static method of representation overshadows the complexities of the method itself and the diverse forms in which it was expressed.

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[59] In Berger's account, he rethinks Crary's claims for discontinuity between the devices of perspective, the *camera obscura*, and photography. H. Berger, 'The System of Early Modern Painting', *Representations*, no. 62 (1998), p. 32.
[60] K. Harries, *Infinity and Perspective* (Cambridge, 2001), p. 77.
[61] Harries, *Infinity and Perspective*, p. 77.
[62] N. Bryson, *Vision and Painting: The Logic of the Gaze* (New Haven, 1983), p. 106.
[63] Bryson, *Vision and Painting*, p. 106.

A crucial point of departure for the formulation of my study has been Massey's pivotal book *Picturing Space, Displacing Bodies,* in which she terms the association made between Descartes' rational, thinking subject and linear perspective—as seen in Jay and Crary's scholarship—as an 'overly comfortable, philosophical cliché.'[64] For Massey, the term 'Cartesian perspectivalism' is a misnomer, as, she argues, Descartes' own theories undermine this shallow association. Massey reasons that linear perspective cannot stand in for Descartes' subject because it is a pictorial method of expression and hence is achieved and appreciated by our sense of sight, which is prone to deceit.[65] What is more, Massey undercuts the claim that perspective posits a disembodied subject that engages on a purely ocular level. The crux of this careful dismantling of disembodied 'Cartesian perspectivalism' lies in the very makeup of the perspectival method itself: the illusory prowess of anamorphosis. In her study of perspective theorists like Niceron and Emmanuel Maignan, Massey concludes that anamorphosis actually reconstitutes perspective in 'lived experience.'[66] As an exaggerated form of the perspectival schema, anamorphosis toys with perspective's premises and in turn exposes its embodied character. As she writes, 'from the fifteenth to the seventeenth century, theorists did not ignore the body in favour of purely optical accounts of vision and representation,' but instead involved and wrestled with the body of the observer in myriad ways.[67]

This thesis owes much to Bryson and Massey's findings and largely agrees with their interpretations. However, my study pushes these analyses further by probing perspective's theoretically monocular nature as well as Crary and Jay's claims that the

[64] Massey, *Picturing Space, Displacing Bodies*, p. 25.
[65] Massey, *Picturing Space, Displacing Bodies*, p. 1. See also Massey, 'Anamorphosis through Descartes or Perspective Gone Awry', *Renaissance Quarterly* 50, no. 4 (Winter 1997), pp. 1148-1189.
[66] Massey, *Picturing Space, Displacing Bodies*, p. 1.
[67] Massey, *Picturing Space, Displacing Bodies*, p. 2.

static (monocular) eye peering through a peephole is ultimately disembodied. When engaging with the special class of perspectival art forms, or rather by 'peeping into' perspective as I suggest, our bodies are forced to remain still in a specific location before the painting to allow the illusion to take effect. However, a monocular way of seeing does not presuppose disembodiment. I propose to define 'embodiment' as physical interaction and movement, and aim to show that while, indeed, monocular illusions involve moments of stasis and restriction, the *process* of interpreting such demonstrations often requires movement and activity as the observer attempts to conform. The act of aligning oneself to meet with the precise position where the illusion coheres is an 'embodied' act.

What is more, peering through a peephole or tube is often a frustrating experience, for we are compelled to shift and move our body in order to get a better look of what is offered to us. In their restraint, peepholes and sighting devices draw attention to our normal binocular faculties and the role mobility plays in interpreting the space around us. While I do not intend to overthrow the argument that monocular optical illusions confine the observer, I aim to complicate the oversimplified characterisation of perspective as a disembodied mode of vision, which has largely been predicated on its monocular constitution. Indeed, the myriad ways in which the observer perceives feigned space through peepholes, tubes, and instruments is a complex process where the body is often fully involved in solving the visual riddles or working to accommodate perspective's strict code.

As such, I follow in the theories set forth by Oliver Grau in *Virtual Art: From Illusion to Immersion* (2003), who contends that early modern perspectival art forms such as peepshows 'stand at the beginning of a line of development that complements the

immersive spaces that envelop the body, where illusionistic effect results from bringing the images up very close to the eyes of the observer.'[68] Grau sees perspective as the origin of a continuum in visual mimesis that endures well into the twenty-first century as reified in virtual reality displays and 3D cinema. I concur with Grau that such devices incite a feeling of 'being within' a feigned space that, while predominantly visual, also encompasses the rest of our body.

VII. Outline

In the first chapter, 'Peeping Askew: Perspective and Anamorphosis as Peepshow,' I outline the monocular principle as it applies to one-point perspective and anamorphosis. A treatise on perspective by Joseph Moxon will be employed at the beginning of the chapter to animate how perspective was sometimes theorised as a monocular peepshow. Following, I will address how the development of printing technologies impacted mathematical treatises like Moxon's. Afterwards, a history of anamorphosis and perspective will be shared, with special focus on atypical examples that involve viewfinders and peepholes. A crucial antecedent to these monocular demonstrations is located in the very origins of the perspectival method itself: a peepshow devised by Florentine architect Filippo Brunelleschi in the fifteenth century. By detailing Brunelleschi's panel demonstration, I will show how perspective offers the observer a fixed, monocular point of view that is void of peripheral distractions. In order to demonstrate effectively why peepholes serve such an important role in the practice of perspective, I outline the physiological differences between monocular and binocular vision and share how perspective acts as a highly successful monocular cue for depth in

[68] O. Grau, *Virtual Art: From Illusion to Immersion* (Cambridge and London, 2003), p. 52.

the absence of stereopsis. Finally, this chapter outlines how perspectival peepshows resurfaced in the mid-twentieth century in perceptual studies and art historical theory. Intriguingly, like the origins of perspective, twentieth-century experiments in illusionism are also based on peepshow models.

After having detailed the origins of perspectival peepshows, I turn to the most comprehensive form of this method: seventeenth-century Dutch perspective boxes. Created in the Netherlands between 1650 and 1675, perspective boxes consist of wooden cabinets that are rectangular, triangular, or pentagonal in shape and stand atop a heavy wooden pedestal. Looking through a coin-sized peephole, the viewer sees into an illusory space painted flat on the box's interior panels. Because the illusion presented within the box is only visible when seen through a peephole, this marks the perspective box as a preeminent reification of perspective's geometrical character. With only six extant examples left in the world, perspective boxes are highly rarefied objects that have been under-examined in art historical literature. Chapter two, entitled, 'Illusionism, Interiority, and Spaces of Domestic Intimacy: Peeping into Seventeenth-Century Dutch Perspective Boxes,' explores how these boxes demonstrate that perspectival and anamorphic illusions can masterfully deceive the viewer on multiple planes. Moreover, these art forms stand as the logical consequence to studies on perspective found in sixteenth- and seventeenth-century treatises, and hence often pictorially footnote these theories in several clever ways. In terms of their monocular structure and repeated use of the Dutch domestic interior as their subject, I will argue that perspective boxes foster a visual intimacy with the viewer, much akin to dollshouses, by inviting inhabitation and enlivening a cultural interest in miniaturisation.

Chapter three, 'Spiritual Study, Collectors' Keepsakes, and Metaphorical Wit: Jean Dubreuil's Monocular Optical Illusions', continues my exploration of peep-boxes through a close study of Jesuit perspectivist Dubreuil's treatise, *La Perspective Pratique* (1649). Specifically, this chapter centres on his study of catoptric illusions—the art of reforming a distorted picture by means of reflection. Dubreuil's treatise argues that by incorporating peepholes and apertures into catoptric arrangements, one can enhance the effect. As a means of contextualising these theories, I will explore the role of catoptrics in Jesuit education and orthodoxy, and discuss the environments in which one could happen upon a mirrored illusion. Following, I focus on a set of four unusual mirror-lined peep-boxes illustrated in *Perspective Pratique* that I argue were designed to be incorporated as peep-box drawers in early modern art cabinets. Art cabinets were popular furniture pieces used to house objects belonging to a collection, such as jewellery, books, or instruments. The mirror-lined peep-boxes illustrated in *Perspective Pratique* would have provided an illusory thrill for the patron peeping within. Another rare monocular device collected in elite circles in the early modern period was the dioptric telescope, sometimes called a 'perspective tube'. This instrument used a fragmented crystal fitted within the confines of a long tube to amalgamate a carefully plotted, and seemingly skewed, portrait. As I will show, like their catoptric counterparts, dioptric illusions were mainly used in the service of creating powerful political or religious allegories, and capitalised on the illusory effects of a restrained monocular observer.

The final chapter of my thesis, 'Perspective's Compass: Ludovico Cigoli's "Perspectograph" and Kinetic Navigation,' explores the methods artists and theorists devised to shortcut the theoretical study of perspective and anamorphosis. Specifically, I

investigate a seventeenth-century perspective instrument devised by Cigoli (1559-1613), found in his treatise on perspective, *Prospettiva pratica* (1610-1613). This device, which Kemp coined as a 'perspectograph,' is capable of tracing any object onto a picture plane by mechanical means. I will discuss how despite the unpublished status of Cigoli's treatise, knowledge of this device gained momentum throughout the sixteenth and seventeenth centuries, finding its way into the collection of a French courtier, Louis Hesselin. Here, the perspectograph was exhibited in an art cabinet similar to those for which Dubreuil designed his peep-box drawers. After exploring the enthusiasm for illusionism in Hesselin's court, I will show how the ruling elite of Europe often used drawing technologies as means of mathematical education. The second half of this chapter explores the legacy of the perspectograph within Hesselin's collection, and the manner in which it was happened upon by perspectivist Niceron, who discussed the device in much detail in his second perspectival treatise, *La Perspective Curieuse* (1652). Niceron used the perspectograph as a means of circumnavigating the difficulty in achieving anamorphic effects. However, devices like the perspectograph remained in the realm of theoretical exercises and were not intended for practical use. This chapter seeks to map out the accord between perspectival theory, drawing, and monocularity—how monocular gazing is the preferred mode of studying perspectival illusion time and time again. I aim to show that the body is fully engaged in this form of study, as a kinetic means of navigating the second dimension.

This study aims to reveal the complex relationship between the static, occluding, and prescriptive structure of a special class of monocular art forms and instruments, and the embodied, mobile observer who works to accommodate and conform his body as he

peeps within. While the vast literature on perspective and illusionism offers a multitude of different ways of looking at this method, I offer this body of work as a unique frame of reference that has not previously been afforded much space in the story: the point of view of the single-eyed observer.

Chapter 1

PEEPING ASKEW: PERSPECTIVE AND ANAMORPHOSIS AS PEEPSHOW

> This is all perspective can and does claim. Following as it does from our inability to look round corners, a perspective picture cannot exist in its own right, as a three-dimensional model can.
>
> —Ernst Gombrich, *Art and Illusion*

I. Introduction

In one plate included in Joseph Moxon's (1627-1691) *Practical Perspective, or Perspective Made Easie* (1670), three figures, a scantily clad woman, a pudgy putto, and a stately gentleman peer out towards an erected plane as lines of sight emanate from their left eyes (fig. 4). In each instance, the figures' right eyes are closed as they wink towards the plane erected in front of them (fig. 4b). The lines of sight pierce the picture plane and land on the ground behind, meeting a point, a line, and a square, respectively. This whimsical illustration is but one of several amusing features of Moxon's treatise on the art of perspective. Turning the pages, it is immediately evident that Moxon intends his readers to interact with his book as an exercise in perspective. Panels of paper spring forth from Moxon's pages, inviting the reader to peer through peepholes following the example of the three figures, or of the propped-up paper figurines (figs. 5, 6).

The interactive features of Moxon's treatise centre on explanations of the methods of linear perspective and anamorphosis. Mimicking the two-dimensional figures illustrated in figure 4, Moxon's first flip-up demonstration features a robed gentleman steadying himself with a staff (fig. 5). From the point of his eye, this panel extends in a forty-five

degree angle and ends just next to the second propped up piece. On the right, a sheet fitted with a translucent material (mica) extends into the centre of the page.[1] A frame is drawn around the material to resemble a window. Playing with the pop-up elements of this exercise, the reader becomes well acquainted with the relations between the picture plane, viewer, and depicted scene. Likewise, in order to explain visually the dynamics of anamorphosis, in his second flip-up demonstration Moxon has fastened a square panel, rounded at the top, at the base of an anamorphic grid. A hole is cut along the bottom through which the reader can 'peep' the distortion and witness its re-alignment (fig. 7).[2] In both instances, linear perspective and anamorphosis are treated as monocular methods that require physical engagement on behalf of the observer. The process of grasping these techniques is characterised as a tactile exercise where learning is as kinetic as it is visual, for the pages are not solely intended for print, but are also repurposed as empirical demonstrations. Should Moxon's written instructions on the art of perspective remain unclear, these pop-up panels cheekily retort: 'see for yourself.'

This chapter takes Moxon's treatise as a starting point from which to explore the theoretically monocular foundations of one-point perspective and its distorted sister method, anamorphosis. In addition to amusingly illustrating the monocular means of exploring perspectival space, Moxon's treatise also serves as a prime example of the interactive nature of perspective. In light of the flip-up panels integrated into Moxon's

[1] Joseph Moxon, *Practical Perspective or Perspective Made Easie: Useful for all Painters, Engravers, Architects, &c. and all others that are any waies inclined to Speculatory Ingenuity* (London, 1670), p.7. In the copy of Moxon's treatise that I consulted at The Huntington Library, a diamond shape has been drawn on the mica sheet with a black pen. This was not part of the original design, but added later and does not correspond to the point at which the figure's line of sight meets the picture plane.

[2] Moxon, *Practical Perspective,* figure 57. In this copy of Moxon's treatise, another hole has been pierced into the flip-up panel (fig. 3). I do not believe this hole was originally intended as part of the exercise, as it appears to have been pierced with a pencil. Moreover, it is difficult to see through this second tiny piercing, it is simply too small.

designs, I aim to demonstrate through several examples that when optical illusions such as perspective and anamorphosis are seen through a peephole they can effectively fool the spectator. As famously demonstrated by Filippo Brunelleschi around 1400, standing at the very origin of perspective is a peepshow designed to feign real space. From this moment onwards, some perspectivists were known to manipulate the perspectival schema to its acute monocular end. The contents of this chapter lay the groundwork for the subsequent case studies that comprise this thesis. I begin by discussing the role that the printing press had on the dissemination of mathematical treatises, and offer insight into how such books were read in their time. Following, I explain the history and technique of anamorphosis and perspective with particular emphasis on examples that involve looking with one eye, or peering through a peephole. After detailing perspective and anamorphosis' history, I discuss the split that exists between the theory of perspective, as touted in treatises, and the practice of perspective, as used in painting. In order to demonstrate how peepholes foster illusionism, I outline briefly the physiological distinctions of binocular and monocular vision, moving towards a discussion on how particular attributes of monocular 'looking' affect aesthetic, and most importantly, perspectival appreciation. Ultimately, this chapter argues that in regard to the methods of linear perspective and anamorphosis, monocularity heightens an illusion's appeal due to the ways in which it evacuates stereopsis and occludes various elements of a representation in the process of looking.

In the last part of this chapter, I examine how monocular peepshows re-surface in the mid-twentieth century in perceptual studies and art historical theory as demonstrative of visual misapprehension. Specifically, I will detail the theories of art historian Ernst Gombrich in his seminal work *Art and Illusion* (1960). Gombrich's theories were largely

influenced by the oeuvre of American optical physiologist Adelbart Ames, who devised a number of peepshow experiments to understand the relations between perspective and binocular versus monocular vision. As in the early modern period, twentieth-century experimentation with illusionism centres upon three-dimensional structures, not flat paintings, to understand better how the eye is fooled. As a means of conclusion, I look to Jan Beutener's large-scale installation piece, *The Room* (1973), which I suggest repeats such peepshow experiments and is therefore a fitting example of the physical involvement and interactivity required from the observer when encountering an optical illusion.

II. Perspective Treatises, Print Culture, and Reading in the Early Modern Period

In the history of early modern perspective treatises, Moxon's *Practical Perspective* is a belated addition. Published in 1670, it arrived several decades after significant contributions in the art of perspective and anamorphosis were achieved. As such, it is an adaptation and culmination of theories and exercises in perspective taken from treatises past. The flip-up exercises stand as the treatise's greatest contribution to this body of thought—a novelty well suited to the very nature of the methods it espouses.

Moxon was an English printer and publisher, as well as a maker of maps, globes, and mathematical instruments. After an initial stay in England, he left to join his father as a printer of bibles in Holland, and it is here where he developed a keen understanding of printing practices.[3] By 1661, after re-establishing himself in England, he was made Hydrographer to the King (Charles II), and in the two decades following this appointment,

[3] G. Jagger, 'Joseph Moxon, F.R.S. and the Royal Society', *Notes and Records of the Royal Society of London*, 49, no. 2 (1995), pp. 193-194. Moxon was a printer first in Delft and then in Rotterdam, and Jagger surmises that Moxon would have spent a fair amount of time in Holland developing his globe-making skills. His second stay in Holland is documented in the foreword to his publication *A Brief Discourse of the passage by the North-Pole to Japan, China…&c* (1674).

Moxon was involved in the production of over forty publications as printer, publisher, translator or author.[4]

Moxon's involvement in the discipline of perspective grew organically out of his trade as a printer. Indeed, his final work, *Mechanick Exercises: Or, the Doctrine of Handy-Works. Applied to the Art of Printing* (1694), provides a comprehensive explanation of printing practices, knowledge that had previously been handed down from generation to generation. In this publication, Moxon formally codified the trade in the English context.[5] In 1655, he took up the task of translating, engraving, printing, and publishing an English translation of Florentine architect Jacopo Barozzi da Vignola's (1507-1573) five orders of architecture, *Regola delli cinque ordini d'architettura* (1562).[6] Engaged in this task, Moxon would have undoubtedly become well acquainted with Vignola's rules of perspective as well as the French and Italian perspectival traditions. In point of fact, *Practical Perspective* copies and adapts several early modern perspective treatises that will be discussed in the course of the following four chapters. His illustrations pull from what he deemed as the most edifying instructions on the art of perspective from Continental authors such as Hendrick Hondius (1573-1650), Samuel Marolois (1572-1627), Jean-François Niceron (1613-1646), Jean Dubreuil (1602-1670), and Abraham Bosse (1604-

[4] Jagger, 'Joseph Moxon', p. 198.
[5] C. S. Bliss, *Moxon* (Los Angeles, 1965), p. 19. For a discussion of Moxon's role in the context of English print culture, see M. C. Hunter, 'The Theory of the Impression According to Robert Hooke', in M. Hunter (ed), *Printed Images in Early Modern Britain: Essays in Interpretation* (Burlington, 2010), pp. 167-90; M. C. Hunter, 'Picture, Object, Puzzle, Prompter: Devilish Cleverness in Restoration London', *Art History* 36, no. 3 (June 2013), pp. 546-568.
[6] Moxon retitled the work, *Vignola: or the Compleat Architect, Shewing in a plain and easie way the Rules of the Five Orders in Architecture* (London, 1655). Bliss, *Moxon*, p. 19.

1676). While largely borrowing from books of perspective past, Moxon's treatise was the first book on perspective written by an English author.[7]

The flip-up features of Moxon's treatise may have risen out of a need to clarify toilsome theory tactically. Indeed, the task of describing such technical pictorial methods certainly proves difficult in practice, thus the three-dimensional displays serve as a more feasible entry. Pamela H. Smith has recently shown that technical writing in early modern instructional books often suffered from the divorce of embodied actions from written description. Early modern artisans largely learned their skills through practice and repetition; at times, the written word fell short as a method of learning. 'A book is not an optimal means for conveying technique,' writes Smith, and, yet, Moxon managed to fuse learning, practice, and techne in his publication.[8]

Moxon's career as both a printer and a perspectivist is emblematic of the impact that the advent of the printing press had on the development and dissemination of the perspectival method. After the invention of printing technology in the fifteenth century, publications relating to the mathematical and mechanical arts saw a tremendous increase. Prior to the printing press, the relative 'secrecy' behind mathematical studies, as well as the concern of potential plagiarism, prevented the formation of a collective field of knowledge that could be communicated to a wide range of interested parties.[9] Printing technology ensured that the same text could be printed again and again to a strict set of standards so that it would maintain a fixed meaning regardless of the disparate milieus in which it was

[7] K. Andersen, *The Geometry of an Art: The History of the Mathematical Theory of Perspective from Alberti to Monge* (New York, 2007), p. 490.
[8] P. H. Smith, 'Making Things: Techniques and Books in Early Modern Europe', in P. Findlen (ed.), *Early Modern Things: Objects and Their Histories (1500-1800)* (London and New York, 2013), p. 179.
[9] G.J. Whitrow, 'Why Did Mathematics Begin to Take Off in the Sixteenth Century', in C. Hay (ed.), *Mathematics from Manuscript to Print 1300-1600* (Oxford, 1998), p. 265.

read. Indeed, Elizabeth Eisenstein has argued that 'print culture' was instrumental in bringing about the Scientific Revolution through the dissemination of ideas in a standardised form.[10]

Another distinguishing factor of the printing press' effect on the growth of scientific ideas was how it fostered community. The publication of mathematical treatises (including perspectival texts) was often the result of collaboration between practitioners, learned men, and the elite who acted as patrons of scholarly pursuits.[11] Pamela Long defines those involved in the collaborative effort of publishing as:

> A broad middle ground of communication, a trading zone of knowledge, developed between the wellborn who were seriously interested in the constructive arts and the skilled individuals who became their employees, clients, teachers, and sometimes friends.[12]

In this educational 'trading zone of knowledge' mathematical or mechanical practitioners worked to gain the language skills necessary to publish their theories, while the ruling elite often studied under their tutelage.[13] This collaborative environment cultivated a social network where mathematicians 'could establish reputation, assert authority, and disseminate knowledge,' whilst books, as concrete things, could be gifted to secure patronage.[14]

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[10] See E. Eisenstein, *The Printing Press as an Agent of Change* (Cambridge, 1982), pp. 71-88, 113-26.
[11] P. O. Long, *Openness, Secrecy, Authorship: Technical Arts and the Culture of Knowledge from Antiquity to the Renaissance* (Baltimore, 2001), p. 246.
[12] Long, *Openness, Secrecy, Authorship*, p. 211.
[13] Long, *Openness, Secrecy, Authorship*, p. 211.
[14] A. Marr, *Between Raphael and Galileo: Mutio Oddi and the Mathematical Culture of Late Renaissance Italy* (Chicago and London, 2011), p. 109. Marr notes that printing and disseminating mathematical books required the efforts of many specialists with whom one had to negotiate costs. For a micro-history of the expenses involved in crafting and publishing mathematical books, see pp. 120-130.

Within this new culture of print, the early modern artist could surpass the designation of 'artisan' by engaging in literary study.[15] Indeed, throughout the sixteenth century, publications on painting and the art of perspective bolstered the artist's practice. In the recent study, *The Artist as Reader: On Education and Non-Education of Early Modern Artist* (2013), Heiko Damm, Michael Thimann, and Claus Zittel explain that when it came to artists' training, 'there was an interaction between practical knowhow acquired as a student and knowledge acquired through independent study and reading (although presumably seldom done systematically).'[16] In particular, Milanese painter Gian Paolo Lomazzo (1538-1592), who authored a book on painting, *Trattato dell-arte della pittura, scoltura et architettura* (Treatise on the Art of Painting, Sculpture, and Architecture, 1584), was steadfast in his belief that reading and writing were central to the pursuit of painting.[17] Lomazzo's campaign for the literary education of artists sought to elevate painting beyond mere craftsmanship to that of a liberal art, which, in turn, elevated the status of the painter to 'artist.'[18] In the *Trattato*, Lomazzo places perspective within the 'theoretical' books amongst proportion, movement, colour, and light. In this sense, he sees perspective as a necessary proficiency that the painter must acquire—a theoretical method obtained through reading that is applicable as a technical skill.[19] Thus, generally, the early modern artist was expected to study books independently as a manner

[15] H. Damm, M. Thimann, and C. Zittel, 'Introduction: Close and Extensive Reading Among Artists in the Early Modern Period', in H. Hamm, M. Thimann, and C. Zittel (eds.), *The Artist as Reader: On Education and Non-Education of Early Modern Artists* (Leiden and Boston, 2013), p. 4.
[16] Damm, Thimann, and Zittel, 'Introduction', p. 5. See also P. Nelles, 'Reading and Memory in the Universal Library: Conrad Gessner and the Renaissance Book' in D. Beecher and G. Williams (eds.), *Ars Reminiscendi: Mind and Memory in Renaissance Culture* (Toronto, 2009), pp. 147-169.
[17] L. Hermans, 'Reading Rhetoric: Oratory in Gian Paolo Lomazzo's Treatises on the Art of Painting', in H. Damm, M. Thimann, and C. Zittel (eds.), *The Artist as Reader: On Education and Non-Education of Early Modern Artists* (Leiden and Boston, 2013), pp. 241-242.
[18] Hermans, 'Reading Rhetoric', p. 242.
[19] Hermans, 'Reading Rhetoric', p. 247.

of training. We know of several early modern artists who kept extensive personal libraries, such as Nicholas Poussin (1594-1665), Diego Velázquez (1599-1660), and Pieter Saenredam (1597-1665).[20] As we will see in the next chapter, Saenredam is a rather exceptional case, for most seventeenth-century artists from the Low Countries did not own a vast library of books.[21] In regard to the concerns of chapter three, there is concrete evidence that Joshua Reynolds (1723-1792) owned and read Dubreuil's treatise on perspective.[22]

The abundance of treatises in the technical arts—such as books on mathematics, instruments, military engineering, surveying, and architecture—available in the sixteenth and seventeenth centuries contributed to what Alexander Marr has qualified as 'information overload.'[23] To cope with this wealth of new information, practitioners had to develop a number of reading strategies to aid in their study such as the use of commonplaces and copybooks. Commonplaces were books in which readers would inscribe notes, quotes, and selections of text that were pertinent to their field, while copybooks comprised of a mix of texts and images that were carefully constructed and organised in order to be used as a reference for private study.[24] In both cases, these intricate notebooks indicate that early modern readers were often driven to read 'with

[20] Damm, Thimann, and Zittel, 'Introduction', pp. 7-8.
[21] In a survey of 170 seventeenth-century artists from the Low Countries, only approximately one in five contained books A. De Vries, 'Hondius Meets Van Mander: The Cultural Appropriation of the First Netherlandish Book on the Visual Arts System of Knowledge in a Series of Artists' Portraits' in H. Damm, M. Thimann, and C. Zittel (eds.), *The Artist as Reader: On Education and Non-Education of Early Modern Artists* (Leiden and Boston, 2013), p. 265.
[22] I. Wenderholm, 'The President as a Reader: Sir Joshua Reynolds and Books' in H. Damm, M. Thimann, and C. Zittel (eds.), *The Artist as Reader: On Education and Non-Education of Early Modern Artists* (Leiden and Boston, 2013), p. 197.
[23] A. Marr, 'Copying, Commonplaces, and Technical Knowledge: The Architect- Engineer as Reader,' in H. Damm, M. Thimann, and C. Zittel (eds.), *The Artist as Reader: On Education and Non-Education of Early Modern Artists* (Leiden and Boston, 2013), p. 424.
[24] Marr, 'Copying, Commonplaces', pp. 422-423.

profit.'[25] Texts were gleaned for their usefulness and sections were recorded for future study.

Another way in which early modern artists participated in the advent of print culture was through the illustration of frontispieces or title pages to books on mathematics or natural philosophy. In the seventeenth-century, frontispieces became quite elaborate affairs, often aiming to summarise key arguments of the treatises they adorned.[26] While some artists may have created frontispieces by following instruction without close reading, in other cases, they 'literally vied with the book and studied it very closely.'[27] In regard to perspectival treatises, perspectivists themselves often illustrated their own frontispieces, rendering these images particularly relevant to the theories they set forth. In many cases, these frontispieces offered a condensed view of the book's central concerns.

This brief overview of the bookish world in which perspective manuals circulated shows that text-based learning became an important means of studying technical skills like perspective. However, as discussed in my introduction, we will see later in this chapter that the translation of perspectival theory into practice was not a straightforward affair. Before discussing the loosening of perspective's theoretical ties from its practice, it is necessary to delve into the specifics of the method itself, to which I now turn.

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[25] A. Blair, 'An Early Modernist's Perspective' *Isis* 95, no. 3 (September 2004), p. 424. See also A. Blair, 'Reading Strategies for Coping with Information Overload ca. 1550-1700', *Journal of the History of Ideas* 64, no. 1 (January 2003), pp. 11-28.

[26] S. Kusukawa, 'Illustrating Nature', in M. Frasca-Spada and N. Jardine (eds.), *Books and the Sciences in History* (Cambridge, 2000), p. 99. Kusukawa cautions that the author often had little say as to how many illustrations could adorn his book, and, likewise, how detailed the pieces could be, as finances were often a determining factor.

[27] Damm, Thimann, and Zittel, 'Introduction', p. 23.

III. Linear Perspective and Anamorphosis: Explication and Historical Overview

Moxon's illustrations offer a feasible entry into the dynamics of perspective and anamorphosis. As mentioned, the pop-up panels included in *Practical Perspective* serve to capture the method by inviting the reader to handle and engage with each demonstration. In the first exercise (figs. 5, 6), Moxon uses a panel of translucent material, surrounded by a frame, and a cut out figure to demonstrate how lines of sight pierce through the picture plane. As he explains, looking through this window, one can trace any object in the distance in proper proportion on the surface. This serves as an effective short cut to the perspectival method:

> For if you keep your Ey steddy in one point, and with a blacklead pencil trace about the edges of the same figure as you find it on the glass, you will have the true Scenographie of that Figure: As you may try by comparing it afterwards with the same Figure drawn by the Rules of Perspective, as they are taught in this Book. [sic][28]

Moxon explains how the picture plane in his flip-up demonstration is made from a layer of 'Muscovie Glass', on which the pop-up figure would ostensibly trace the square on the ground before him.[29]

This exercise is adapted from Leon Battista Alberti's *De Pictura* (1435), the first treatise to codify the principles of linear perspective. To transfer a three-dimensional image onto a flat surface, Alberti advises that the painter regard the canvas as an open window upon which an object can be traced:

> Let me tell you what I do when I am painting. First of all, on the surface on which I am going to paint, I draw a rectangle of whatever size I want, which I regard as

[28] Moxon, *Practical Perspective,* p. 9.
[29] Moxon, *Practical Perspective,* p. 6. 'The Section is a plane of transparent matter erected perpendicularly on the plain of the base, and stands directly before you, that is parallel to a straight line imagined to pass through the convex points of your two Eys: as is this Plain of Muscovie Glass erected before the figure.'

> an open window through which the subject to be painted is seen; and I decide how large I wish the human figures in the painting to be… [30]

As an outline, the tracing will correspond to the shape and size of the object at a distance. In a rudimentary rendering of perspective, the picture plane, or window, intersects the two visual pyramids that are imagined to exist within the composition and before it; one whose apex extends into the depths of the painting culminating at the vanishing point, and the other imagined to exist outside of the painting, converging within the observer's eye. These two visual pyramids mirror each other, and are joined by orthogonals that fan out from the vanishing point towards the picture plane, re-joining again with the point of view.

The vanishing point signifies the apex where the depth in the painting is directed, and it also serves to position the observer in relation to the painting. This classical ideal of painting posits pictorial space as an imaginary window, turning the surface of the canvas into a thoroughfare that extends into infinity, drawing the eye forward and through. The vanishing point quantifies the very intangible concept of infinity, and as such, perspective's systematised approach had a profound effect on theological interpretations of space, as it mathematically measured and objectively neutralised a previously immeasurable subject.[31]

If we relate Alberti's explication to Moxon's demonstrations, it is evident that the line of sight pierced through the 'window' extends, theoretically, from a single eye.

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[30] L. B. Alberti, *De Pictura,* p. 1:18. As translated in C. Grayson (ed.), *Leon Battista Alberti: On Painting* (London, 1991), p. 54.

[31] For more on the vanishing point as a development arising from early modern mathematical advances, see B. Rotman, *Signifying Nothing: The Semiotics of Zero* (London,1987), p. 16; for more on the religious implications of the vanishing point, see J.F. Moffitt, *Painterly Perspective and Piety: Religious Uses of the Vanishing Point, from the 15th to the 18th Century* (Jefferson and London, 2008), pp. 15-32; see also J. V. Field, *The Invention of Infinity: Mathematics and Art in the Renaissance* (Oxford, 1997) for a detailed analysis of the invention of projective geometry in mathematics from roughly 1300-1650, and the impact of this development on painterly perspective.

Likewise, Moxon's flip-up panel for the purposes of observing an anamorphic image only accommodates a monocular observer (figs. 7, 8). He instructs that after drafting your chosen image in perspective (here a regal portrait) in the confines of the grid *ABCD*, replicate each square in the corresponding anamorphic graph *abcd*.[32] While the portrait may appear distorted and skewed, if done with care and precision, the illustration should re-align when the eye is placed at point *f*, at the 'height of the line *f g*.'[33] However, proper alignment is not just a matter of adequate positioning, a certain type of 'looking' is also called for. Writes Moxon,

> … if you place one of your Eys directly over the point f at the height of the line f g, and **winck with the other Ey**, you shall see (if your figure be exactly drawn) the perfect shape of the figure in the second Plain. But that you may the better understand me I have pasted a thin Pastboard on the line hfg, which if you erect perpendicularly, and look through the hole with one of your Eys close to that hole, you may see the same figure in this fourth Plain that is drawn in the second. [sic][34]

Moxon beseeches his reader to 'wink' through the erected panel. By peering through the peephole, and moving about the book, *Practical Perspective* emphasises the monocular and physically interactive theory of perspective and anamorphosis.

Broadly speaking, anamorphosis skews the structures of linear perspective to such an extent that the image created can only appear intelligible when seen from an oblique angle. While it seemingly breaks with the conventions of linear perspective, anamorphosis is in fact achieved through its very premises. Hanneke Grootenboer explains that whereas perspective aims towards realism, 'anamorphic art uses perspective's own weapons against

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[32] Moxon, *Practical Perspective,* p. 62. 'Make a Plain of so many equal parts as you please, as is the first Plain ABCD, which is devided into 8 in length, and 8 in depth, as you may see markt down the side and bottom with 123 to 8, and therein draw what you think good as in the second Plain ABCD. Having thus projected your Plain, drawn therein the figure that was drawn in your second Plain: and be carefull to draw every stroak thereof in its responding Square and part of the Square, with the same proportion to each of these Squares and part of the Square, with the same proportion to each of these Squares that you find in the Squares of the second Plain.'

[33] Moxon, *Practical Perspective,* p. 62.

[34] Moxon, *Practical Perspective,* p. 62. Emphasis mine.

it in order to pursue its opposite: rather than showing images, it hides them.'[35] In one of the most famous examples of this technique, Hans Holbein's double portrait *The Ambassadors* (1533, fig. 3), the aberrant features of anamorphosis are seen in the obscure, grey shape floating above the marbled floor, disrupting the otherwise coherent composition.[36] Moving to the extreme right of the painting, this strange form resolves into a portrait of a human skull gazing towards the viewer—a daunting reminder of the transience of material possessions and worldly knowledge, so boastingly portrayed in the portrait proper.[37]

As effectively demonstrated in Holbein's *memento mori*, anamorphosis reverses the premises of perspective by creating the illusion that the object juts out in front of the picture plane in the space the viewer occupies. Instead of creating the illusion that the picture plane stands between the viewer and the object depicted (as evidenced in Moxon's first exercise), an anamorphic image intrudes upon the observer's space in a rather jarring manner. What is more, in order to re-align the distortion, the observer's body is brought extremely close to the surface of the picture plane, often necessitating physical contact with the painting or drawing.

While anamorphosis achieves cohesion from one point of view much like perspective, it is acutely contingent on this precise position, and fares more poorly than

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[35] H. Grootenboer, *The Rhetoric of Perspective: Realism and Illusionism in Seventeenth-Century Dutch Still-Life Painting* (Chicago and London, 2005), p. 98.
[36] For a detailed analysis of *The Ambassasors,* see S. Foister, A. Roy, and M. Wyld, *Making and Meaning: Holbein's Ambassadors* (London, 1997), especially pp. 59-86. For an overview and catalogue of Holbein's work in England, see S. Foister, *Holbein in England* (London, 2006).
[37] F. Leeman, J. Elffers, and M. Schuyt (eds.), *Hidden Images: Games of Perception, Anamorphic Art, Illusion: From the Renaissance to the Present*, trans. E. Childs and M. L. Kaplan (New York, 1976), p. 13; E. Dekker, K. Lippincott, 'The Scientific Instruments in Holbein's Ambassadors: A Re-Examination', *Journal of the Warburg and Courtauld Institutes* 62 (1999), p. 123. Fred Leeman writes that the skull, while seemingly representing a *momento mori*, may also stand as a pictorial pun on the artist's name, 'Holbein', or 'hollow bone.' In another intriguing study, Elly Dekker and Kristin Lippincott, have argued that the instruments arranged on the two tables between the ambassadors were all recent innovations and of German origin.

perspective from disparate vantage points.[38] In a perspectival schema, two key points determine how far the image will recede into illusory space: the vanishing point and the distance point. The identifying feature between an anamorphic and a perspectival design is the location of the distance point. In a perspectival grid, the distance point is placed outside of the composition, often on a sheet of paper separate from the canvas.[39] In a perspectival diagram drawn by Leonardo, for example, the distance point is located at the far right (fig. 9).[40] Four lines (transversals) span out from this point and cut across the schema that has been divided vertically by lines fanning out from the vanishing point (orthogonals). The distance point determines the space between the scene depicted within the composition and the viewer's position before it, and governs how close it will appear to the viewer. If it is placed further from the frame of the painting, the scene will appear to recede far into the distance. Contrarily, if it is positioned close to the frame, the scene, too, will appear closer to the viewer.[41] While the distance point generates the level of depth *within* a pictorial composition, it does so from a position exterior to it, maintaining a level of invisibility outside the very structures of painting. As such, it renders depth visible from an 'invisible' vantage point. Whereas the vanishing point remains implicit in the very depths of the painting, the distance point 'will neither be occupied nor looked at

[38] M. Kemp, *The Science of Art: Optical Themes from Brunelleschi to Seurat* (New Haven and London, 1990), p. 50.
[39] J. White, *The Birth and Rebirth of Pictorial Space* (Cambridge, 1987), p. 195.
[40] L. Massey, 'Configuring Spatial Ambiguity: Picturing the *Distance Point* from Alberti to Anamorphosis,' in L. Massey (ed.), *The Treatise on Perspective: Published and Unpublished* (Washington, 2003), p. 162. In her study on the history of the distance point in the anamorphic tradition, Massey shows how it is dubious whether or not this point originated from the Albertian one-point perspective tradition, or if it bore out of artisanal practice. While Alberti alluded to the distance point in his writings, he never explicitly discussed it and its relation to the centric ray (the vanishing point). Without hard evidence, it is difficult to ascertain if the distance point originated in tandem with the discovery of perspective as codified by Alberti. Nonetheless, in seventeenth-century texts on perspective the distance point plays a crucial role.
[41] L. Massey, 'Anamorphosis through Descartes or Perspective Gone Awry', *Renaissance Quarterly* 50, no. 4 (Winter 1997), pp. 1172.

by a spectator.'[42] It is only in an anamorphic configuration that the viewer can physically encompass this 'impossible lateral view.'[43]

In Moxon's illustrations of anamorphosis (fig. 7) we can see that when the distance point is moved and settled to rest near the vanishing point (point *g*), the perspectival grid is stretched longitudinally. Diagram *ABCD* is the original perspectival schema containing the portrait that is to be distorted. The line cutting across the grid represents the distance point, ending at *D*. This diagram is transformed into trapezoid *abcd*, where *f* is the vanishing point and *g* the distance point. In the anamorphic grid, the viewpoint is now no longer located in front of the composition, but near point *g* in the margins of the schema. Moxon's anamorphic drawings are directly adapted from Jean-François Niceron's *La Perspective Curieuse* (figs. 10 & 11), which will be discussed at further length in chapters three and four.

While anamorphic imagery was experimented along with the developments of perspective in the fifteenth century, it took another two centuries before the term was first coined by German Jesuit Gaspar Schott (1608-1666) in *Magia universalis naturae et artis* (1657). 'Anamorphosis' is based upon the Greek *morphe*, meaning 'form,' along with the presupposition 'ana' (re-, or again), loosely translating to 'reform' or 'distortion.'[44] Almost a century later, Diderot and d'Alembert include a definition of the term in their *Encyclopaedia* of 1751:

In painting, anamorphosis refers to the projection of an unnatural

[42] Grootenboer, *Rhetoric of Perspective,* p. 130.
[43] Grootenboer, *Rhetoric of Perspective*, p. 130.
[44] J. Baltrušaitis, *Anamorphic Art*, trans. W.J. Strachan (Cambridge, 1976), p. 118.

> image or a distorted representation of an image which is made on a plane, and which, nevertheless, seen from a certain viewing-point, appears normal and executed with the correct proportions.[45]

One of the earliest extant demonstrations of anamorphosis can be found in Leonardo da Vinci's *Codex Atlanticus* (1478-1519) (fig. 12). On the left is the distorted rendition of a child's face, and on the right, a stretched drawing of an eye. The images are re-aligned when the viewer places her eye along the outermost reaches of the paper. Glancing sideways, the face and eye reform and assume their proper shape. In art historical writing, anamorphic images have been given little attention, and were mostly relegated to the domain of games or curiosities. Exception to the rule is Jurgis Baltrušaitis' seminal work *Anamorphic Art* (1955), which shone a new light on the subject by stressing anamorphosis' merits as a laudable area of study all its own. Through anamorphosis, perspective is no longer seen as a science of reality, but instead as a mathematically based method that concocts apparent hallucinations; it is, writes Baltrušaitis, the 'absurd side of perspective.'[46]

The impulse to toy with the precepts of a perspectival grid may have solely originated as a visual exercise for artists like Leonardo, though some hold that anamorphosis developed out of more practical concerns. Kim Veltman contends that the method originated out of a need to address the viewing position of those kneeling in prayer in front of church chapels, as the frescoes adorning them would have largely only accommodated the viewpoint of standing members of congregation. Thus, anamorphic

[45] As translated in J. Baltrušaitis, *Anamorphic Art,* trans. W.J. Strachan (Cambridge, 1976), p. 118. See also D. Diderot and J. le Rond d'Alembert, *Encyclopédie, ou dictionnaire raisonné des sciences, des arts et des métiers, etc.* (17 vols., 1751), I, pp. 404-405. A web edition, Robert Morrissey (ed.), ARTFL Encyclopédie Project (Chicago, 2013), accessed June 2013, at http://artflsrv02.uchicago.edu/cgi-.
[46] Baltrušaitis, *Anamorphic Art*, p. 1.

elements were construed and added in order to satisfy the oblique sight lines of those kneeling in prayer.[47] Beyond religious pragmatism, anamorphosis can also be said to reflect the cultural imperatives of the early modern period, as 'an intellectual metaphor for the age.'[48] Citing developments in early modern science, Paula Findlen writes that the methods of anamorphosis sprung up in a milieu where the borders of the natural world were increasingly stretched and pegged as cause for alarm for various religious sects. The earliest developments in anamorphosis were seen as frightening apparitions to those not familiar with the methods of perspective, and were hence characterised as demonic and sinister. Indeed, Jesuit scholar Athanasius Kircher's (1601-1680) anamorphic and magic lantern demonstrations led to accusations of witchcraft in the burgeoning years of his career (fig. 13).[49] Kircher was ultimately propelled to explain the exact methods behind his demonstrations in order to avoid penalties. As we will see in more detail in chapter three, the Jesuits had much interest in the awe-inspiring effects of anamorphosis, and were adept at bewildering their audiences into religious subjection, for they were skilled at demonstrating how even the most irrational, possibly sinister, 'tricks' could be explained scientifically.[50]

In addition to inducing thoughts of the supernatural, early modern anamorphosis was also an effective method of conveying political or religious messages. As will be demonstrated in subsequent chapters, a pervasive trend in anamorphic art is the recurring use of portraiture, or segmented features of the face, in both illustrative studies or

[47] K. H. Veltman, 'Perspective, Anamorphosis and Vision', *Marburger Jahrbuch für Kunstwissenschaft* (1986), p. 98.
[48] P. Findlen, 'Jokes of Nature and Jokes of Knowledge: The Playfulness of Scientific Discourse in Early Modern Europe', *Renaissance Quarterly* 43, no. 2 (1990), p. 323.
[49] Findlen, 'Jokes of Nature', p. 324.
[50] Findlen, 'Jokes of Nature', p. 324.

finalised paintings. Such portraits were often rife with political or religious connotations. A fitting example of anamorphosis' role in political allegory is William Scrots'[51] *Anamorphosis of Edward VI* (fig. 14). On the frame of the painting, a groove is cut in order to accommodate Edward VI's (1537-1553) re-aligned portrait (fig. 15). When seen from the extreme right of the painting, Edward's likeness appears to jut out from the canvas and hover parallel to the viewer.[52] The groove cut into the frame assures that no part of the portrait is eclipsed when seen obliquely. As the long-awaited heir to Henry VIII, this anamorphosis alludes to Edward's succession to the throne as rightfully advancing the Tudor dynasty. What is more, the distorting qualities of the portrait foretell Edward's demise at the age of sixteen, after being rendered swollen and disfigured from lung disease.

It is alleged that William Shakespeare alludes to Scrots' skewed perspective in *Richard II*. He writes how when seen 'awry,' certain 'perspectives' reveal their form:

> For Sorrowes eye, glazed with blinding teares,
> Diuides one thing intire, to many obietcs,
> Like perspectiues, which rightly gaz'd vpon
> Shew nothing but confusion, ey'd awry
> Distinguish forme [sic][53]

Indeed Scrots' anamorphic portrait was on public display at Whitehall, London, precisely when Shakespeare performed in this venue between 1591 and 1592.[54] This coincidence re-

[51] Scrots (1537-1553) was of Dutch descent, but was appointed as King's Painter to Henry VIII in 1546.
[52] See L. Wright, *Perspective in Perspective* (London, 1983), p. 153. Lawrence Wright notes that the effects of anamorphosis are not convincingly translated in a reproduction. The proper distance from which to see the illusion align is dramatically reduced rendering the effect less startling. It is the 'floating' quality of anamorphic works that is lost in reproduction.
[53] W. Shakespeare, *Richard II* 2.2, 16-20. As quoted in A. Shickman, '"Turning Pictures" in Shakespeare's England', *The Art Bulletin* 59, no.1 (March, 1977), p. 67.
[54] Shickman, '"Turning Pictures"', p. 67. Shickman cautions that Shakespeare may have in fact been referencing a corrugated form of anamorphosis, emphasizing the line 'divides one thing entire, to many objects.' Corrugated anamorphoses will be discussed in more detail in chapter three.

affirms Findlen's discernment that anamorphosis metaphorically embodies the intellectual and cultural climate of the early modern period, as pictorial allegories laden with meaning.

Central to the potency of these visual games is the strict vantage point where the illusion coheres. Anamorphosis can 'hide' its message in large part because we simply cannot distinguish what the mess of lines is attempting to convey before we have aligned ourselves with its oblique point of view. In order to assist in the aligning of our bodies before it, several demonstrations of anamorphosis in perspective treatises like Moxon's used peepholes to assist the observer. These demonstrations point to the fact that anamorphosis, as well as perspective, works best when placed within a three-dimensional structure as a peepshow.

IV. Perspective as Peepshow

While English books on perspective like Moxon's *Practical Perspective* were scarce in early modern England,[55] his three-dimensional flip-up panels were evidently inspired by several perspectival studies found in early modern treatises from the continent. In a section of Vignola's treatise *Le due regole della Prospettiva Pratica* (1583), entitled '*Of those things I Cannot See*', an anamorphically rendered drawing (fig. 16) is fitted within the confines of a box (fig. 17).[56] Two apertures have been cut into the side of the

[55] England adapted the methods of linear perspective much later than other European countries such as Germany and France. As Alison Thorne has noted, before the seventeenth century, perspective remained a somewhat 'alien discourse.' A. Thorne, *Vision and Rhetoric in Shakespeare: Looking through Language* (London, 2000), p. 40.

[56] Vignola's treatise centres on two rules of perspective: the *construzione legittima* (the Albertian method), and the distance-point method. For more on Vignola's perspective theory, see T. K. Kitao, 'Prejudice in Perspective: A Study of Vignola's Perspective Treatise', *The Art Bulletin* 44, no. 3 (September 1962), pp. 173-194.

structure (*R* and *S*), which are designed to accommodate the eye of the observer.[57] Looking through these peepholes, it is assumed that the anamorphic distortion will be corrected. However, it is doubtful that when peeping within a true re-alignment would occur, for the distorted illustration within the confines of Vignola's box is not constructed in a proper anamorphic fashion; the portrait is simply stretched longitudinally. Thus, while the viewer would be privy to an image rendered in a more intelligible fashion, it would likely not produce the kind of effect later anamorphic illusions achieved.[58] Nonetheless, Vignola's intent to produce a seemingly magical image is felt, as he exclaims that here 'appears something extravagant.'[59] Several decades later, Mario Bettini (1582-1657) adapted Vignola's design for his treatise *Apiaria universae philosophiae mathematicae* (1642) (fig. 18).

Another example of anamorphosis' peepshow-based character is found in a rare and peculiar treatise on perspective by German perspectivist Andreas Albrecht, presenting one of the earliest examples of peephole anamorphoses after Vignola (figs. 19 & 20). Albrecht was the first to publish an explication of the anamorphic method in German, entitled *Zwey Bücher. Das erste von der ohne und durch die Arithmetica gefundenen Perspectiva* (1623).[60] In two such examples, Albrecht demonstrates the technique through

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[57] J. Barozzi da Vignola, *Le due regole della Prospettiva Pratica di M. Iacomo Barozzi da Vignola con Commentari del Reverendo Padre Maestro Egnatio Danti* (Bologna, 1583), p. 96. 'Si porta ancora disegnare cosi fatte pitture in un'altro modo da quelli che hanno la mano sicura nello schizzare. Affettato che si sara il fondo della cassetta PQ, con il gesso, o imprimitura, o carta, si mettera l'occhio al finestrino RS, e si disegnera di practica tutto quello che si vorra nel preffato fondo PQ, il che mirato in faccia, apparira una cosa stravagante, e dal finestrino sara visto giustamente, siccome nello schizzare si vedeva: ed io n'ho fatta la prova, e riesce gentilissimemente, siccome il primo modo ancora m' e riuscito benissimo con la graticola in proporzione quintupla, sestupla, e settupla…'

[58] Massey, 'Configuring Spatial Ambiguity', p. 169. Massey goes so far as to argue that Vignola's anamorphic rendering is 'extremely rudimentary', citing Jean-François Niceron's anamorphic configurations as far more systematic.

[59] Vignola, *Le Due Regole*, p. 96. '…apparira una cosa stravagante.'

[60] This treatise was later translated into Latin as *Duo Libri Prior de Perspectiva Cum & Preter Aritmetica inventa Posterior de umbra* (Nürnberg, 1671). I consulted the Latin version.

peepshow arrangements: an anamorphically distorted coat of arms, as well as a word puzzle that when seen from the correct angle reads: 'ora et labora' ('pray and work'). Like Moxon's pop-up panel through which the reader can peep, Albrecht's anamorphoses also demonstrate that this method is best perceived in a peepshow-like display.

In all of the former examples, it is evident that there was interest in presenting anamorphic imagery within a three-dimensional structure that required monocular peeping. Moxon's flip-up panels provide an additional plane through which to peer through, and as such, reify Vignola and Albrecht designs, rendering them accessible for the reader. Although it is entirely possible to move Moxon's book about—or your body about the book—the mobile panels hasten the process and arguably oblige participation. Furthermore, whereas the examples previously outlined stand as imagined constructions that can be actualised if the reader so chooses, Moxon's constructs exist as both objects of study and realised artefacts.

I have thus far omitted a crucial antecedent to Moxon, Vignola, and Albrecht's peepshow-based arrangements. In light of the fraternity between the anamorphic and perspectival methods, it should come as no surprise that the monocular foundations of anamorphosis developed out of the monocular origins of linear perspective itself, as evidenced in a peepshow demonstration conducted by architect Filippo Brunelleschi (1377-1446) in the early fifteenth century, to which I now turn.

Brunelleschi's innovative demonstration was devised to give the illusion of three-dimensional space on a two-dimensional plane. This experiment involved two painted panels, one of the Baptistery of San Giovanni in Florence and the other of the Piazza della Signoria, both painted in a highly realistic manner prior to the publication of a

codified method of linear perspective by Alberti. The Museo Galileo has created a model of the first experiment involving the Baptistery of San Giovanni (fig. 21), the smaller of the two panels, which Brunelleschi contrived as a sort of 'portable peep-show.'[61] I base the following observations in this section on this first panel demonstration, for the second, of the Piazza della Signoria, was not constructed in the form of a peepshow, despite its similar illusionistic effect.[62]

Because both panels have since been lost, contemporary studies of these demonstrations are based upon descriptions found in historical texts. In *Lives of the Artists* (1550), Giorgio Vasari lauds Brunelleschi's efforts for managing to achieve what had not previously been done, and shares how the architect

> …gave considerable attention to the study of perspective, the rules of which were then very imperfectly understood, and often falsely interpreted; and in this he expended much time, until at length he discovered a perfectly correct method, that of taking the ground plan and sections by means of intersecting lines, a truly ingenious thing, and of great utility to the arts of design.[63]

This 'ingenious thing' that proved a 'great utility to the arts' is described in more detail in Brunelleschi's *Vita* (1480) by his biographer Antonio Manetti (1423-1497), written several decades after the demonstration was constructed. Following Manetti's account, the innovative demonstration proceeded as follows. First, Brunelleschi positioned himself

[61] M. Kemp, *Seen, Unseen: Art, Science and Intuition from Leonardo to the Hubble Telescope* (Oxford, 2006), p. 15.
[62] White, *Birth and Rebirth*, pp. 116-121. As White discerns through Manetti's biographical account, the second panel painting of the Piazza della Signoria was larger than the first, for it depicted a larger area and could not be held up in front of the observer and peered through, as in the Baptistery panel.
[63] Giorgio Vasari*, Lives of the Most Eminent Painters, Sculptors and Architects: translated from the Italian of Giorgio Vasari. With Notes and illustrations, chiefly selected from various commentators by Mrs. Jonathan Foster* (5 vols., London, 1850-1852), I, p. 58.

three *braccia* [64] inside the central portal of the Florence Cathedral, which would have provided a full view of the baptistery through the portal, serving as a framework of kinds. From within the shadowed porch, the bright light falling upon the baptistery would have made the building stand out against the sky, in turn revealing a pattern. Brunelleschi then painted the lit building from this position on a small panel half a *braccia* in size. Afterwards, he cut a hole the size of a lentil in the centre of the painting. This hole was conical in shape and could accommodate the contour of a person's eye on the reverse side, thus providing a peephole for the viewer to peer *through* the painting.[65] Facing the baptistery, Brunelleschi then held the painting up to his face, looked through it, and with his other hand held up a mirror in parallel with the painting. By moving the mirror around, the painted scene of the baptistery was juxtaposed with the actual space of the baptistery and piazza.[66] What was so breath-taking for Brunelleschi and other observers was the seamless continuum between disparate media; they were taken with the amalgamated image that juxtaposed a feigned, painted scene, as reflected in the mirror, with the real view of the building and surrounding periphery. In this way, Brunelleschi was able to prove that his painting achieved a realistic effect through his empirical studies in what would later be known as perspective.

By adding burnished silver to the top areas of the panel, Brunelleschi's painting also reflected the sky and movement of the clouds outdoors.[67] This, coupled with the three-dimensional illusion of the peepshow made the observer feel as 'he saw the actual

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[64]Antonio di Tuccio Manetti, *The Life of Brunelleschi*, trans. C. Enggass (2 Vols., University Park and London, 1970), I, p. 42. 'Braccio' is a historic Italian unit of measurement, and equates to our present-day standards as eleven and half inches, or roughly an arm's length.
[65] Manetti, *Life of Brunelleschi,* I, p. 44: 183-191.
[66] Manetti, *Life of Brunelleschi,* I, p. 44: 190-199.
[67] Manetti, *Life of Brunelleschi,* I, p. 44: 180-184.

scene when he looked at the painting.'[68] Brunelleschi's experiment provided a means for the observer to enter pictorial space and confirm the uniformity between the two-dimensional space of the painting and the three-dimensional space of his surroundings. According to Martin Kemp the importance of Brunelleschi's demonstration centred on his having uncovered an effect that artists had been striving to achieve since the time of Giotto.[69] In his view, this operation was 'practical,' in that it developed out of Brunelleschi's skills in building surveying, as a means of solving a pictorial problem that he would have come up against previously in his work.[70] Although the skills involved in constructing the painted panel may not have required skills more advanced than surveying, it is still important to underscore how novel Brunelleschi's painted panel experiment was, if only in terms of the number of media involved. As Lorens Holm writes, this demonstration was 'part scientific experiment, part smoke-and-mirrors act.'[71] Brunelleschi relied on very modern strategies, for the image the viewer sees through the peephole is a complicated amalgamation of painted surface, mirrored surface, and the reflection of the miniscule peephole—as vanishing point—that would 'otherwise have remained outside the representation as its unacknowledged sponsor.'[72]

In one of the most recent scholarly interpretations of this peepshow demonstration, Samuel Edgerton questions whether the drilled hole in the centre of the painted panel, accommodating the viewer's eye, was originally intended to serve as the vanishing point, or whether Brunelleschi fell upon this point inadvertently. Edgerton

[68] Manetti, *Life of Brunelleschi,* I, p. 44: 198-203.
[69] M. Kemp, *Behind the Picture: Art and Evidence in the Italian Renaissance* (Connecticut, 1997), p. 94.
[70] Kemp, *Behind the Picture*, p. 94.
[71] L. Holm, 'Reading through the Mirror: Brunelleschi, Lacan, Le Corbusier: The Invention of Perspective and the Post-Freudian Eye,' *Assemblage* no. 18 (August 1992), p. 23.
[72] Holm, 'Reading through the Mirror,' p. 36, note 9.

concludes that Brunelleschi discovered the vanishing point unintentionally 'because he would not immediately have conceived of it as purely abstract geometric function.'[73] Instead, this point would have served as a 'visual certification' of the verisimilitude between his painting and real space.[74] He surmises that the hole would have served a didactic purposes as well, allowing viewers to gain an understanding of how the eye functioned optically, for as the line of sight passes through the hole toward the baptistery, it likewise passes through, or exits, the pupil.[75]

The significance of the vanishing point as hole in Brunelleschi's demonstration carries a double meaning when paired with the fact that this peepshow is no longer extant. In Hubert Damisch's thought-provoking book on the genesis of the perspectival method, *The Origin of Perspective* (1994), he theorises that perspective has lost its prototype, its origins, in Brunelleschi's missing panel paintings. As such, all theorisation on perspective circles around a void, a missing root. Like the vanishing point in the centre of a perspectival composition that regresses into infinity and eludes our grasp, perspective's progenitor, too, functions as a chasm in our historical understanding.

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[73] S. Edgerton, *The Mirror, the Window and the Telescope: How Renaissance Linear Perspective Changed Our Vision of the Universe* (Ithaca, 2009), p. 48.
[74] Edgerton, *Mirror, Window, Telescope*, p. 48.
[75] Edgerton, *Mirror, Window, Telescope*, p. 48. In addition to the optical and perspectival underpinnings of this method, Edgerton argues that Brunelleschi may have been motivated by personal concerns in placing the vanishing point in its prescribed location. The artist Ghiberti quite famously beat Brunelleschi in a competition for the commission to design the *Gates of Paradise* cycle on the east side of the Baptistery doors. By positioning the peephole within the doors on the painted side of the representation, Brunelleschi was implicitly asking his viewers to look through his competitor's work. In addition, Edgerton argues that the viewer would have likely been more compelled by the reflection of their own eye in the mirrored representation than by the doors of the Baptistery itself. In this way he could undercut the achievements of his rival. I do not agree with Edgerton that this would have been one of Brunelleschi's top concerns when constructing his demonstration. What is more, the entirety of the observer's eye would not be reflected in the mirror as the hole was 'the size of a lentil', truly only as large as a pupil. In turn, the observer is only privy to a darkened hole at the centre of the panel. Intriguingly, the pupil is of course an opening in the eye, a darkened peephole all its own.

Another significant claim made by Damisch is that the visual impact of Brunelleschi's panel demonstration lay in the alignment of the spectator's eye with the central point (vanishing point) in the Baptistery. The spectator's eye thus comes to occupy two crucial points in the perspectival schema, as the viewpoint before the painting as well as the vanishing point behind it.[76] For Damisch, Brunelleschi's demonstration carried with it important theoretical consequences for the involvement of the spectator in the history of painting. By conflating these two principal points, Brunelleschi's peepshow inhibits and restrains the boundless features of perspectival depth through the very eye of the spectator.[77] The mirroring of the viewpoint with the vanishing point allows for the spectator to ground themselves 'within the painting as if it were inside it.'[78] By reversing the painting and piercing it with a peephole, this demonstration allows one to grasp perspective from perspective's point of view.

Further still, as demonstrated in this arrangement, perspective also engages with different spectators' bodies in precisely the same manner. Referring to Manetti's description of Brunelleschi's painted panel, Damisch remarks upon the possibility of repetition for interested viewers. Any spectator could peer through the peephole and experience the very same spectacle as the previous. As a result, perspective treats every spectator uniformly, and hence, controls and predetermines how the space will be perceived.[79]

Pushing Damisch's analysis further, I would add that the peephole is central to the success of Brunelleschi's panel demonstration. One may wonder why Brunelleschi did

[76] H. Damisch, *The Origin of Perspective* (Cambridge, 1994), pp. 120-121.
[77] Damisch, *Origin of Perspective*, p. 122.
[78] Damisch, *Origin of Perspective*, p. 127.
[79] Damisch, *Origin of Perspective*, p. 133.

not simply compare the baptistery with his painting by merely holding the painting up in front of him. This is due to the peephole's capacity to ground the relations between the two-dimensional space of the painting and the three-dimensional space of the baptistery before it. In a sense, the peephole accommodates disparate observers' bodies and focuses solely on what the eye can see, irrespective of height. Moreover, in limiting the viewer's visual mobility, the illusion of depth is far more compelling in peepshow perspectives, considering the reduction in peripheral distractions.[80]

V. Perspective in Theory vs. Perspective in Practice

After Brunelleschi's empirical demonstration, and following the codification of the method in Alberti's *Della pittura,* most fifteenth- and sixteenth-century painters aimed to imbue their works with three-dimensional effects through the mathematical principles of perspective. Artists were largely competent in the methods of perspective and the need for elementary geometrical education was satisfied through the growing availability of mathematical treatises.[81] While the growth of perspective theory helped to elevate the status of the painter's skill above mere craft, this new 'philosophical context' of painting was also 'responsible for the ultimate removal of advanced perspective theory beyond the artists' grasp.'[82] Indeed, while it is easy to assume that early modern artists followed perspective theory meticulously in the schematic planning of their paintings, this is not the case. As Judith Field has argued, early Renaissance painters were interested in demonstrating a pictorial truth in painting, but this truth was more visual than

[80] R. Arnheim, 'Brunelleschi's Peepshow', *Zeitschrift für Kunstgeschichte* 41, no. 1 (1978), p. 58.
[81] J.V. Field, *The Invention of Infinity: Mathematics and Art in the Renaissance* (Oxford, 1997), p. 117.
[82] M. Kemp, *Geometrical Perspective from Brunelleschi to Desargues: A Pictorial Means or an Intellectual End? From the Proceedings of the British Academy, London, Volume LXX* (Oxford, 1984), p. 90.

mathematical.[83] As an example, while visually correct in its recession into feigned depth, Masaccio's (1401-1428) *The Holy Trinity* (1427-28, fig. 22) is in fact 'mathematically faulty' in its application of perspective.[84] The use of perspective in Renaissance painting was not normally applied as a strict mathematical rule; concessions were made and principal vantage points were not always located in a position the viewer could physically occupy. The uninhabitable location of vantage points in perspective's strict schema is seen in a number of Renaissance paintings such as Raphael's (1483-1520) *The School of Athens* (1509, fig. 23) in the Stanza della Segnatura, Piero della Francesca's (1415-1492) *Resurrection* (1463-65, fig. 24), and Leonardo's (1452-1519) *The Last Supper* (1495-98, fig. 25).[85] Such discrepancies stand as a 'warning sign against confusing artist with mathematician.'[86] What is more, these examples are not isolated incidences. On the contrary, a 'very high proportion indeed of the whole of renaissance painting' did not follow perspective to the letter.[87] Why is this so? What problems arise when perspective theory is put into practice?

Kemp has shown that problems with perspective's theoretical tenets are 'as old as the theory of imitation itself.'[88] Leonardo was one of the first early modern artists to bemoan the restrictive quality of one-point perspective.[89] In sum, Leonardo wrote of numerous unsatisfactory aspects of the perspectival method: that it could not accommodate such elements as smoke or water, that tone and colour play a large role in shaping our visual understanding of distance and the size of objects, and finally that the

[83] Field, *Invention of Infinity*, p. 61.
[84] Field, *Invention of Infinity*, p. 61.
[85] White, *Birth and Rebirth*, p. 193.
[86] Field, *Invention of Infinity*, p. 61.
[87] White, *Birth and Rebirth*, p. 193.
[88] Kemp, *Science of Art*, p. 165.
[89] M. Kemp, 'Leonardo and the Visual Pyramid', *Journal of the Warburg and Courtauld Institutes* 40 (1977), pp. 128-149.

'painter cannot cope with binocular vision.'[90] Leonardo was disappointed with the fact that in order to enjoy a geometrically-strict perspective painting optimally, the viewer must look through a peephole towards the canvas, and moreover, those not positioned in the precise location miss out on the effect:

> The observer should situate himself with his eye at a small aperture, and then through this hole the perspective will be well displayed. But because many spectators will strive to see at the same time the one work made in this manner- and as only one can see well how such perspective functions- all these other people will find it confusing.[91]

This poses, of course, a problem for the artist who wishes to accommodate more than one observer at a time. John White explains the issue thusly:

> Artificial perspective can, in any sense, take no account of the effects of normal, binocular vision, and only by the provision of a peephole, or through the observer conscientiously closing one eye, can the system's fundamental assumptions be given practical reality. Once the method had been demonstrated, such elaborate games were, from the beginning, seen to lie outside the realms of art and the interests of the artists.[92]

Leonardo's *Last Supper* is an excellent case study of the disparity between perspective as theory and perspective put into practice. When standing before the painting, the recession of the space gives a clear impression of three-dimensionality and depth. Optically, this painting appears as a true masterpiece of the mathematical principles of perspective. However, as pointed out by Kemp, 'closer analysis reveals a series of ambiguities and artifices which save the appearance of optical legitimacy while acknowledging the inbuilt

[90] Kemp, *Science of Art*, p. 50.
[91] M. Kemp and M. Walker, *Leonardo on Painting: An Anthology of Writings* (New Haven, 1989), p. 60; K. Andersen, *The Geometry of an Art: The History of the Mathematical Theory of Perspective from Alberti to Monge* (New York, 2007), p. 87.
[92] White, *Birth and Rebirth*, p. 194.

problems and contradictions of perspectival illusion in a given situation.'[93] Leonardo was mindful of the loss of effect that perspective suffered when seen from disparate positions. Thus, his painting does not follow perspective in a strict, or 'accurate' fashion, but nonetheless retains a powerful illusory effect. From the overlapping positions of the men at the table, to the somewhat squished appearance of the men at the far left and right, there are a number of ambiguities in the painting that are left undefined.[94] Most notably, and central to the concerns of this thesis, is the *Last Supper*'s ideal viewpoint. If following the tenets of perspective theory, and in keeping with the story of the scene, the point of view is located above the Disciples' heads. As Kemp explains, this point of view is uninhabitable, at more than double the average height of a person.[95] In this sense, Leonardo implicitly acknowledges in this work that while a painting can achieve optical success, it will likely contain ambiguities and will often need to challenge the strictures of geometrical theory.

Perspective is but one of many considerations of realism that a painter must accommodate in order for a painting to exhibit the desirable aesthetic. A perspectival painting can connote depth and naturalism without having to follow perspective to its geometrical end. What is more, asking the viewer or the artist to accommodate perspective through appendages such as peepholes and apertures is an impractical request when the illusion of three-dimensionality and recession of depth can be achieved regardless. In point of fact, perspective can work adequately when seen from a position distinct from the preferred vantage point, or when appreciated binocularly.

[93] Kemp, *Science of Art*, p. 47.
[94] Kemp, *Science of Art*, p. 49.
[95] Kemp, *Science of Art*, p. 49.

In light of such impracticality, after the turn of the sixteenth century, the theorisation of perspective began to be divorced from pictorial application, and was instead embraced by mathematicians and instrument-makers. On this divergence, Kemp writes:

> This professional mathematicizing of perspective stretched to a breaking point a series of tensions which had been apparent from the first—tensions between theory and practice, or more particularly between men of letters and men of the brush.[96]

Throughout the early modern period, mathematical perspective became excised from the painter's practice, existing instead as a 'five-finger exercise' for artists—a required component for their practice, 'but one which should be so much a natural part of an artist's skill and judgment that it is not an apparent part of the finished performance.'[97]

While the majority of perspectival art works created in the early modern period were perceived without the need for monocular accoutrements, there were several isolated instances where artists, instrument makers, and theorists strove to manifest theory robustly in their practice. Kemp has argued that such instances are the most prevalent in Dutch and French art of the seventeenth century, where practice and theory come the closest to realising the acute illusory potential of perspective as demonstrated in Brunelleschi's peepshow experiment.[98] In the following chapters, I address these special classes of art forms and instruments that follow the theoretically prescribed monocular character of perspective. In these examples, such as Moxon's insistence that one should 'winck' with their other eye towards the picture plane, the optical foundations of perspective are taken quite literally, and to a pictorial extreme.

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[96] Kemp, *Geometrical Perspective*, p. 90.
[97] Kemp, *Science of Art*, p. 99.
[98] Kemp, *Science of Art*, p. 99.

In the next section, I question the difference between perceiving perspectival art binocularly, as with normal perception, and monocularly, as with the peepshows outlined in this chapter. When peeping into Brunelleschi's peepshow, or Moxon's pop-up panels, is vision hindered or heightened in any way? While this thesis does not attempt to make any claims towards the psychology of perception, it is nonetheless important to define, in a general manner, the differences between these two modes of vision. I offer the following section as a review of the literature that has examined how we perceive perspectival works of art that follow the tenets of the method very closely. Moreover, a discussion concerning the ways in which peepshows have been used in more contemporary studies and art practices will help illuminate the visual dynamics that are imagined to occur when peeping within more historical (or even theoretically imagined) devices. While these paintings may be marginal in the history of perspective in painting, they are nonetheless instructive in demonstrating how the observer is invited to conform to relate to their geometry.

VI. Binocular vs. Monocular Modes of 'Looking'

Technically speaking, binocular vision carries several distinct advantages in relation to everyday seeing, the most often cited being the process of stereopsis: the ability to detect fine differentiations in visual depth. Due to the fact that our two eyes are located in different positions, unified vision actually consists of two separate retinal images taken from distinct vantage points. The disparity between the point of view of the left eye versus the point of view of the right eye (also known as horizontal disparity, binocular disparity, or parallax) allows the mind to perceive the three dimensionality and

distance of objects before it. A simple experiment is often used to demonstrate the effect of parallax: placing a pencil several centimetres from your eyes, examine it first with your right eye and then with your left. You will notice that the pencil appears to shift its position horizontally more so than objects at a distance.[99] Specific cells in the cortex of the brain then translate this disparity into relative depth. Thus, objects closer to our eyes have a larger degree of parallax versus objects at a distance.

The judgment of relative depth perception is most apparent at near distances and most useful in performing fine, manipulative tasks such as threading a needle.[100] In addition to relative depth judgment, seeing with two eyes also has the distinct advantage of offering an expanded field of vision. Furthermore, our comprehensive visual abilities are heightened through the use of two eyes, for as Kenneth Ciuffreda and Kimberely Engber have noted, our ability to detect objects binocularly in the dark is increased by forty percent, and our ability to see in daylight is enhanced by ten percent.[101]

While binocular vision is largely responsible for our apprehension of the third dimension, monocular vision also plays an important role. Whereas binocularity relies upon the processes of stereopsis, monocularity capitalises upon a variety of other visual cues to detect depth such as linear perspective, aerial perspective, relative size, shading and shadows, and texture gradients.[102] Under normal circumstances, binocular and monocular depth cues work in tandem toward providing the viewing subject with a comprehensive understanding of space. However, there are circumstances under which conflicts can arise between monocular and binocular visual cues resulting in false

[99] K. Ciuffreda and K. Engber, 'Is One Eye Better Than Two When Viewing Pictorial Art?', *Leonardo* 35, no. 1 (2002), p. 37.
[100] Ciuffreda and Engber, 'Is One Eye Better', p. 37.
[101] Ciuffreda and Engber ,'Is One Eye Better', p. 37.
[102] Ciuffreda and Engber ,'Is One Eye Better', pp. 37-38.

perception. In our present day context, an apt example would be virtual reality demonstrations. Here, the subject is led to believe in the presence of a third dimension where there is none due to conflicting visual information.

Another unique instance of cue conflict is found in the viewing of pictorial art—specifically, painting or drawing that has been created via the methods of linear perspective. When looking at a painting that is composed following a strict perspective schema, monocular and binocular cue conflicts abound. Take for instance a painting by the perspectival master, Paolo Uccello, *Miracle of the Desecrated Host* (fig. 26). When we approach the work binocularly, the stereoscopic cues indicate that all of the objects represented in the painting belong to a uniform surface and are contained within the same field of depth. However, all of the monocular depth cues indicate that the objects within the scene are at disparate distances; the figures appear to inhabit a space closer to us than the shelves on the left, or the fireplace in the centre. The presence of cue conflict when viewing a work of art that has been constructed with strict attention to the geometry of perspective such as Uccello's reduces the overall binocular, three-dimensional appreciation of the surface space, 'effectively "flattening" the scene.'[103] It is this 'perceptual truth' that physiologist M.H. Pirenne investigates in *Optics, Painting and Photography* (1970). He urges that mathematically accurate single-point perspectival projections are valid 'only for one single eye placed at the right position with regard to the perspective or to the objects depicted in the perspective.'[104] When it comes to monocular pictorial seeing, if the head is kept motionless and the eye is free to move

[103] Ciuffreda and Engber, 'Is One Eye Better', p. 38.
[104] M.H. Pirenne, *Optics, Painting & Photography* (Cambridge, 1970), p. 95. See also M. Hagen, *Varieties of Realism*: *Geometries of Representational Art* (Cambridge, 1986), chapter 6 'Station Point Options: Analysis of Style', pp. 116-141.

about, the central projection of linear perspective made specifically for this eye will provide retinal images that are quite identical to those given by the objects themselves.[105] For Pirenne, illusionistic agency lies in the representation itself, if perceived under ideal, monocular conditions.

In light of this, certain concessions must be made in the rendering of three dimensions on a two-dimensional surface. A loss of information in the visual field is inevitable; our visual experience is far too rich and complex to isolate and condense. As Ian Gordon has noted, any attempt to mimic three dimensions in two is somewhat 'doomed to failure.'[106] For example, our nose is always present in our visual field, yet we do not expect illusionistic art to imitate its silhouette.[107] Furthermore, as Margaret Hagen shares, the scope of the binocular visual field, while predominantly oval in shape, varies from person to person.[108] It would seem, then, that our bodies 'get in the way' of perspectival illusion. The concessions taken into account when translating the third-dimension into the second are precisely those of our individual, phenomenological states. Perspectival illusion, convincing as it may be, can only go so far. If the agency lies in the method, as Pirenne would have it, then we as viewers must conform and contort our bodies to make ourselves amenable to the illusion set before us. If the illusion isn't working for you, you must work for the illusion.

In the discipline of art history, Ernst Gombrich takes the role of perception in visual illusions to task in his seminal work, *Art and Illusion: A Study in the Psychology of Pictorial Representation* (1960). Gombrich holds that the viewer's role in the dynamics

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[105] Pirenne, *Optics, Painting & Photography*, p. 95.
[106] I. Gordon, 'Gombrich and the psychology of visual perception', in R. Woodfield (ed.), *Gombrich on Art and Psychology* (Manchester, 1996), p. 61.
[107] Gordon, 'Gombrich and Psychology', p. 61.
[108] M. Hagen, *Varieties of Realism*, pp. 12-13.

of illusionism has not to do with issues of embodiment, but rather expectation, past experience, and prior knowledge. In a chapter entitled 'Ambiguities of the Third Dimension,' he stresses that despite the abundance of scholarly attention paid to the methods of linear perspective, the 'beholder's share in the illusion of space' remains to be tackled.[109] The real thrust of Gombrich's theories on perspective lies in his insistence that perspective is a valid (as in scientifically valid) means of depicting illusory space. For Gombrich, despite the existence of different conventions for representation, this does not 'subvert the possibility of realism' for perspective.[110] In Gombrich's view, there are certain standards of depiction that overcome and overtake conventions where illusionism is concerned.[111]

For the purposes of this chapter, I am interested in several perceptual demonstrations that Gombrich uses to back his claims on the effect perspective has on our interpretation of illusory space. Specifically, the work of American psychologist Adelbart Ames (1880-1955) serves to ground Gombrich's theories, and is of interest to the arguments of this chapter for they involve the use of peepholes and monocular vision in order to fool the spectator. I find it particularly intriguing that in studies on perceptual illusionism, peepshows figure prominently, and I hold that monocularity is central to the success of these demonstrations. The following discussion will limit itself to a number of *trompe l'oeil* demonstrations that Ames developed for laboratory analysis, which involved the use of monocular peepholes to confine and direct the viewer's gaze. According to Gombrich, these demonstrations reify the fact that the perspectival method

[109] E. Gombrich, *Art and Illusion: A Study in the Psychology of Pictorial Representation* (New York, 1960), p. 205.
[110] D. Topper, 'Perspective on Perspective: Gombrich and his Critics' in R. Woodfield (ed.), *Gombrich on Art and Psychology* (Manchester, 1996), p. 81.
[111] Topper, 'Perspective on Perspective', p. 81.

is a (and arguably *the*) valid means of depicting three-dimensional space on a two-dimensional plane. In addition to proving the verisimilitude of perspective, Ames' demonstrations provide scientific ground for Gombrich's thesis that illusionistic art behooves the viewer's collaboration. In what follows, Ames' enterprise and selected demonstrations will be outlined, in addition to the proposed consequences of each, as theorised first by Ames and then by Gombrich.

VII. Ames and Gombrich's Demonstrations in Perception

As a perceptual psychologist and the founder of the Dartmouth Eye Institute (DEI) in the 1930s, Adelbert 'Del' Ames (1880-1955) invented approximately two-dozen laboratory demonstrations now commonly known as the Ames Demonstrations in Perception.[112] These large-scale demonstrations were initially erected in the basement of the Choate House at Dartmouth University, and were later published by William H. Ittelson in 1952.[113] The first experiment outlined in Ames' interpretative manual is the 'chair demonstration,' which functions as a means of entry into specific optical phenomena Ames explores throughout the breadth of his work. Ames begins by remarking that this demonstration will allow the participant to experience 'a perceptual situation which strikingly discloses that what you see does not correspond to what is "out

[112] R. R. Behrens, 'Eyed Awry: The Ingenuity of Del Ames', *The North American Review* 282, no.2 (March- April 1997), p. 26.
[113] In 1955, Princeton University published Ames' interpretative manual posthumously. This publication contains pertinent information as to the inferences Ames derived from each experiment, but does not include as much technical detail as Ittelson's guide. R. R. Behrens, 'The Life and Unusual Ideas of Adelbert Ames, Jr.' *Leonardo* 20, no. 3 (1987), p. 276.

there," does not exist out there, and therefore cannot of itself be due to what is out there.'[114]

As seen in figure 27, the chair demonstration consists of a large wooden box containing three peepholes. When looking through each peephole, the viewer sees one of three different arrangements of white strings, which are arranged at different distances and heights (fig. 28). What these seemingly nonsensical arrangements hold in common is the similar shape they convey when seen through the peepholes. The bottom half of figure 28 illustrates what the participant witnesses monocularly when looking through the peepholes: three chairs, hovering in space, seemingly constructed out of wires.[115] After the observer has taken notice of the chairs, Ames asks that she move behind the screen in order to observe what was just seen through the peepholes. 'Much to your surprise' writes Ames, 'you will notice that what you saw as chairs are quite dissimilar in size and shape and distance.'[116] When viewed from any other point, except those of the peepholes, the three groups of strings appear strikingly dissimilar. Only one of these groupings corresponds to the shape of a chair from all angles (located on the far left of figure 28), as it is the only grouping of strings constructed in a three-dimensional, rectilinear manner. Looking back through the peepholes again, Ames attests that the observer will be surprised once more, witnessing the presence of chairs where there are none.[117]

For Gombrich, the chair demonstration exposes that 'perceptions are not disclosures,' for what we are privy to within the confines of this peephole does not

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[114] A. Ames, *An Interpretative Manual: The Nature of our Perceptions, Prehensions and Behavior.* (New Jersey, 1955), p. 17.
[115] W. H. Ittelson, *The Ames Demonstrations in Perception: A Guide to their Construction and Use* (New Jersey, 1952), p. 26. According to Ittelson, the small size of each peephole ensures monocular observation.
[116] Ames, *Nature of Our Perceptions,* p. 17.
[117] Ames, *Nature of Our Perceptions,* p. 17.

necessarily reflect external phenomena.[118] Concerning the spectator's collaboration with the experiment, he asserts that what grounds our certainty of the chairs' presence has as much to do with our knowledge of 'chairs' as the shape seen through the peephole. The illusion lies specifically in the assuredness that there is only one way of interpreting the image before us. 'We are blind,' writes Gombrich, 'to the other possible configurations because we literally "cannot imagine" these unlikely objects.'[119] We, quite literally, do not see a random arrangement of wires because there is only one way of interpreting the shapes before us; perceptually, we are incapable of reading 'mess of tangled rods', but capable of reading 'chair.' Even after we step around the peepshow, and are made aware of the fallacy, we will still perceive the same shape when looking through.

Gombrich is quick to assert that when it comes to perspectival illusion, the image's need for our collaboration does not contradict the validity of this method.[120] Quite the opposite, for the anamorphic and thereby perspectival make-up of these tangled wires proves that perspective as a representational method manages to fool the eye.[121] As such, perspective fulfils its purpose in the Ames' demonstrations. Once this has been achieved, writes Gombrich, perspective 'makes its bow and retires.'[122]

At the end of Ames' section on monocular vision in his interpretative manual, he details several demonstrations involving small and large-scale illusory rooms. The first consists of a distorted four-foot-cubed space, where all of the panels are exactly proportioned so as to appear like a balanced interior (figs. 29 & 30); baseboards, windows and painted tiles are all constructed with this end in mind. A light is hung from

[118] Gombrich, *Art and Illusion,* p. 210.
[119] Gombrich, *Art and Illusion,* p. 210.
[120] Gombrich, *Art and Illusion,* p. 211.
[121] Gombrich, *Art and Illusion,* p. 211.
[122] Gombrich, *Art and Illusion,* p. 211.

the ceiling in order to illuminate the space. As detailed in Ames' manual, this room is to be viewed monocularly from a specific point at the front end. Interestingly, Ames did not include a peephole in this demonstration, but instead asked the viewers, led by an instructor, to approach the space with their eyes closed. If done carefully, upon opening her eye, the viewer will see what appears to be a perfectly proportioned room. However, if the participant were to open both eyes, the distortion would become readily apparent, the illusion destroyed.[123]

Ittelson clarifies that binocular awareness of this space does not taint the monocular effect or illusory appreciation. After looking into the space with both eyes, if the viewer were to close one eye again, the proportions of the room will quickly realign, the illusion reinstated, despite the participant's current knowledge of the distortions.[124] Showcasing a similar illusory trick, Ames' large-scale distorted room relies on the same principles as the laboratory version. As demonstrated in figure 31, this room is large enough to accommodate several people, and he remarks that the effects produced by this demonstration are more compelling than its miniature counterpart.[125]

While both of these demonstrations rely upon the same principles inherent in the monocular peepshows discussed throughout the body of this chapter, they arguably best showcase the participatory nature of optical illusions. Here the body is drawn in and becomes an integral component of the deceit. The inclusion of disproportionate faces peering into the room is not pure whimsy; bodies are used as a means of measure in order to contradict the illusion set forth. Indeed, the outlandish proportions of the figures reveal

[123] Ittelson, *The Ames Demonstrations in Perception,* p. 30.
[124] Ittelson, *The Ames Demonstrations in Perception,* p. 30. Ittelson remarks that the length of time involved in the reinstatement of the illusion varies from person to person, 'sometimes lasting thirty seconds or more.'
[125] Itellson, *The Ames Demonstrations in Perception,* 30.

the fallacy of the space. These rooms encapsulate the tension that lies between the illusory space of monocular vision and the embodied observer. On the other side of the peephole, pulled into the illusion itself, the body is made to conform to the distorted schema.

Gombrich was explicitly indebted to Ames' enterprise and utilised his experiments to extrapolate on the nature of perspectival vision as well as the role that expectation plays in the shaping of perception. In Ames' demonstrations, attention is largely focused on how these peepshow illusions bring presence to feigned objects, how size, shape, and distance can be mimicked and issued forth. While these peepshows render inexistent objects 'visible', occlusion is actually key to their deceit. As Gombrich remarks, perspective relies upon the unequivocal fact of experience that we 'cannot look round a corner' without the affordance of movement. So long as we perceive space with 'one stationary eye', we have to guess as to 'what lies behind.' [126] It is this perceptual fact that Gombrich sought to enliven through a monocular peepshow experiment of his making, designed for the Royal Society of London (fig. 33).

Gombrich's demonstration, like Ames', is constructed in the form of a peepshow. It contains three paper cut-outs of trees, arranged at equal distances and placed along the same receding axis. The cut-outs not only differ in size, but also in shape and orientation. The branches are carefully measured to ensure that from the peephole, all three appear as one, occluding one another in such a way as to mimic the semblance of one sparse tree. Interestingly, while the viewer sees only one tree from the peephole, she also bears witness to inferences of cut-outs placed behind; because the trees are aligned several

[126] Gombrich, *Art and Illusion,* p. 211.

inches apart, the observer catches a glimpse of distinct shadows cast on the box's interior panel.[127]

Discussed at length in *The Image and the Eye: Further Studies in the Psychology of Pictorial Representation* (1982), Gombrich stresses that this tree demonstration illustrates how occlusion is unaffected by 'subjective appearance.'[128] It does not matter if, through the peephole, the viewer wishes to roll their eye around, look at the trees straight on, or glance to the sides. If the eye is kept in the peephole, the two furthest trees remain obscured. However, should the viewer decide to remove her eye from the peephole and move her head about, the binocular effects of parallax would break the illusion.[129]

Both Gombrich and Ames use their monocular peepshow demonstrations as physical evidence of their theories on perception and cognition. Whether the viewer is privy to chairs or trees, the monocular nature of these experiments reveal key facets of perspectival illusionism. In these peepshow demonstrations, vision is limited, extensively controlled, and directed. By restricting vision to one eye, these demonstrations avoid stereoscopic parallax, thus assuring that the illusion put forth remains fixed and opaque, not blurred by the disparity of our left and right eyes. Should we view the chairs or the trees binocularly, traces of their deceptive magic would be revealed.

Furthermore, these demonstrations expose that what is hidden is often more integral to an illusion than what is shown. We cannot see the incongruous strings that make up Ames' chairs, nor are we privy to the other trees that lie hidden from view in Gombrich's peep-box. Peephole illusions thus rely extensively on occlusion and stasis.

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[127] E. Gombrich, 'Standards of Truth: The Arrested Image and the Moving Eye,' *Critical Inquiry* 7, no. 2 (Winter, 1980), p. 253.
[128] E. Gombrich, *The Image and the Eye: Further Studies in the Psychology of Pictorial Representation* (London, 1982), p. 202.
[129] Gombrich, *Image and the Eye*, p. 202.

The shadows cast by Gombrich's trees serve as visual referents to what lies just out of view in a perspectival conceit. As it applies to linear perspective and anamorphosis, monocular vision has also been shown to heighten the depth cues responsible for mimicking the third dimension on a flat surface. By evacuating stereopsis, and preventing binocular parallax, monocular peeping allows us to believe in the feigned rendering of depth, or in the jarring apparition of an anamorphic portrait. As a means of conclusion, I turn to a large-scale, anamorphically-rendered installation piece that successfully demonstrates how despite the restrictive character of peephole illusions, they nonetheless oblige physical participation. Truly, part of the thrill of an optical illusion lies in its undoing.

VIII. Conclusion: *The Room* and Peripatetic Appreciation

Peering into Jan Beutener's large-scale installation piece aptly entitled *The Room*, (fig. 34) the viewer is privy to a rather banal, grey-scale interior in the process of being filled or perhaps emptied. [130] Two windows flank the back wall, the right partially covered by a stained cloth, while a stepladder enters the space to the left, a folded sheet perched on its peak. A lone, looming light fixture illuminates a large crate to the right, while a jacket hangs from a chair on the left. After looking through the peephole, the viewer is asked to stroll peripherally around the room, and is permitted additional visual

[130] Beutener's work was first displayed as part of a 1975 exhibition on the vast and diverse history of anamorphosis, entitled 'Anamorphoses: Games of Perception and Illusionism in Art'. The first leg of this tour took place at the Rijksmuseum in Amsterdam. Aided by a mathematical engineer, Beutener spent the majority of a year on the design, layout and installation of the piece. Beutener's piece took to the stage alongside notable works by such historic illusionists as Hans Holbein, Samuel van Hoogstraten, and Jean-François Niceron. However, unlike his predecessors, Beutener's anamorphic rendition did more than cunningly feign depth, as it used the techniques of perspective to skew and manipulate motifs within the third dimension itself. See F. Leeman, J. Elffers, and M. Schuyt (eds.), *Hidden Images: Games of Perception, Anamorphic Art, Illusion: From the Renaissance to the Present* (New York, 1976); E. Reitsma, *Jan Beutener* (Amsterdam, 1999), pp. 114-115.

access from several openings in the wall. From these additional angles, all aspects of the room are made visible, exposing the fallacy of the peephole-view. As figure 35 illustrates, *The Room* does not in actuality contain a stepladder, crate, or chair, but an odd, surreal arrangement of contorted forms. The stepladder is shown to consist of a curious assemblage of parts that echo a ladder's form; the crate is revealed as a 'cock-eyed' arrangement of wooden boards; the chair is exposed as a grouping of sticks on the floor; while the leather jacket, the viewer comes to see, hangs from hidden supports in the ceiling.[131]

In *The Room*, the leather jacket stands as a particularly perturbing aspect of the deconstructed interior. Hinting at human presence, and recalling a pictorial trope recurrent in early modern Dutch interior painting, the jacket hovers and balances on the detached back end of the chair, supported by wires, while the seat and front legs of the chair lie in fragments beneath it as if broken by the weight of a heavy guest. The looming jacket speaks to the necessity of the observer's involvement in Beutener's work. Proper appreciation of this piece unfolds once the viewer has withdrawn him eye from the peephole and has walked peripherally around the installation. The peephole-view is arguably of lesser import than the peripatetic appreciation of the feigned interior space. In *The Room,* the deconstruction of the illusion, not the illusion itself, manifests the pleasure derived from deception.

The Room references the tradition of artistic and perceptual demonstrations that have been outlined throughout this chapter.[132] By imploring the viewer to question,

[131] Behrens, 'Eyed Awry: The Ingenuity of Del Ames', p. 33.
[132] While Ames' demonstrations are mentioned numerous times in conjunction with Beutener's piece, the artist was apparently unaware of Ames' experiments, and thus neglected to make this attribution himself. In a review of the *Anamorphosen* exhibition, Samuel Edgerton states that 'such 'distorted rooms' were

probe, and move about the piece, this installation beseeches a mobile observer just as Moxon's reader is implored to manoeuvre and toy with *Practical Perspective's* pop-up features. Indeed, monocular 'peeping' does not posit a viewer who is not physically engaged with the demonstration before him. While the eye may be immobilised in the process of peering through a peephole, the anamorphic, *trompe l'oeil*, and perspectival demonstrations discussed in this chapter have proven that monocular illusions in fact require a fair amount of participation, contortion, and mobility on behalf of the observer before and after he has peeped within. These demonstrations implore us to question their premises, verify their structures, and look in, again, to enjoy their deceit. What is more, as Moxon's, Albrecht's, Vignola's, and Brunelleschi's demonstrations have shown, perspectival and anamorphic illusions function effectively when arranged as a three-dimensional structure. This early modern trope is picked up again in the mid-twentieth century with Gombrich and Ames who in turn solidify this very fact by proving that optical illusions, too, achieve tremendous results within confined to a room or a box.

Leaving the twentieth century behind, the next chapter investigates how the illusory prowess of monocular vision and three-dimensional peepshow displays were pushed to their extreme in seventeenth-century Holland. As we will see, Dutch perspective boxes capitalise on monocular vision as art forms that rely exclusively on focused 'peeping,' and stand as the most consummate, painterly reifications of perspective's theoretically-based monocular principle.

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devised for the purpose of studying visual perception many years ago by Adelbert Ames, Jr. Unfortunately, that ingenious researcher of illusionistic trickery was not credited in the Dutch work either.' S. Edgerton, 'Review [Untitled]', *Art Bulletin* 61, No. 1 (March, 1979), p. 134. See also Behrens, 'Eyed Awry: The Ingenuity of Del Ames', p. 33; D. L. Collins 'Anamorphosis and the Eccentric Observer: History, Technique and Current Practice', *Leonardo*, 25, No. 2 (1992), p. 181.

Chapter 2

ILLUSIONISM, INTERIORITY, AND SPACES OF DOMESTIC INTIMACY: PEEPING INTO SEVENTEENTH-CENTURY DUTCH PERSPECTIVE BOXES

> In this dynamic rivalry between house and universe, we are far removed from any reference to simple geometrical forms. A house that has been experienced is not an inert box. Inhabited space transcends geometrical space.
>
> —Gaston Bachelard, *The Poetics of Space*

I. Introduction

When peeping into *A Box with a Dutch Antechamber* (figs. 36-39), located in Copenhagen's National Museum, you are met with a number of characters scattered about the home's interior. Directly in front of the peephole's point of view stands a white lapdog, eyes affixed to your gaze, behind whom stands a man, one arm outstretched clutching a sword (fig. 37). Two small children occupy space near the gentleman's feet, one in the midst of spinning a pinwheel. To the left stands a woman just outside the confines of the antechamber's perimeter looking out toward the home's garden and neighbouring land (fig. 38). To the right, an attentive cat is perched in the intermediary space between the antechamber's tiled floor and the room receding behind it, where a man, facing the viewer, stands akimbo in the middle of the room (fig. 39). The antechamber itself is decorated in an upper-class manner, with paintings hung about the walls, coats of arms enmeshed in the windows' panes of glass, and the ceiling fitted with mouldings and ornamental medallions. To the left, the tiled floor appears to stretch beyond the line of sight, and we are privy to an ascending staircase indicated by a wooden balustrade. The space as a whole appears to be in remarkable order, nothing stray

or out of place. The characters milling about the interior further connote a calm decorum, as if pausing for the viewer's benefit. However, as one gazes about the perspective box's interior, an aspect of disruption begins to emerge. The black and ash-grey tiles that permeate the interior are disjointed and in conflict with the room's otherwise meticulously ordered appearance. Though streamlined with the back-most panel, the square tiles break with the orientation of those leading off to the right and betray any form of cohesion (as seen in fig. 37).

If this were one's first interaction with a perspective box, the disjointedness of the tiled floor may not necessarily deter from the overall experience of peeping into the private dwellings of this home; the perspectival accuracy of the individual panels still provides the viewer with a sense of receding depth. However, to those familiar with the handful of extant examples of this unique art form, the disjuncture in the tiled floor seen through the peephole is slightly discouraging. Perspective boxes[1] are three-dimensional structures that are painted on their interior in an illusionistic fashion, and are to designed to be seen only through a peephole. These boxes are known to inspire awe in their spectators through expansive and astonishing feats in perspectival and anamorphic arrangements. When peering through the peephole of a perspective box, all levels of illusion are meant to align, providing the effect of three-dimensionality.

A Box with a Dutch Antechamber belongs to a total of six extant perspective boxes housed in the National Gallery, London, Museum Bredius in The Hague, The National Museum of Denmark, and the Detroit Institute of Arts. A seventh perspective

[1] I will be using the term 'perspective box' in lieu of 'peep-box' throughout this chapter because 'perspective box' is precisely the term used to describe these art forms by one of their makers, Samuel van Hoogstraten (the only instance of a perspective box artist discussing these works). Van Hoogstraten refers to his work as a *perspectyfkas*. S. van Hoogstraten, *Inleyding tot de Hooge Schoole der Schilderkonst: anders de Zichtbaere Werelt* (Rotterdam, 1678), p. 274.

box was known to be housed in Japan, where there was great enthusiasm for peepshows in the seventeenth and eighteenth centuries.[2] The National Museum of Denmark owns *A Box with a Dutch Antechamber* as well as two triangular perspective boxes (fig. 40), one depicting the interior of a Catholic church (figs. 41-43), the other the interior of a Reformed church (figs. 44-46). The remaining three are a triangular *View of a Dutch Interior* (circa 1678), attributed to Dutch artist Pieter Janssens Elinga, which is located in the Bredius Museum in The Hague (figs. 47 & 48);[3] a pentagonal *View of a Vaulted Vestibule* in the Detroit Institute of Arts (fig. 49);[4] and the rectangular *View of a Dutch Interior* by Samuel van Hoogstraten located in the National Gallery, London (figs. 50 & 51).[5]

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[2] M. Fukuoka, 'Contextualising the peep-box in Tokugawa Japan', *Early Popular Visual Culture* 3, no. 1 (May 2005), pp. 17-42.

[3] The attribution of this perspective box to Elinga was first made by Hofstede de Groot in 1891 in H. de Groot *Schilder Janssens: een navolger van Pieter de Hooch* (Amsterdam, 1891). De Groot points to a note found in an inventory of Johan Rigo of Amsterdam from 1670 in which is written '*schilderyencamer, perspectiff van Janssens*,' (a painted room in perspective by Janssens). Subsequently, this attribution was negated by Clotilde Brière-Misme, who argues that the fashion of dress of the cavalier descending the staircase assigns this work closer to the year 1630, and thus could not have been made by Elinga. See C. Brière-Misme, 'Dutch Intimist: Pieter Janssens Elinga', *Gazette des Beaux Arts* (Paris, 1947-1948), p. 159. In the Bredius Museum's catalogue, it is noted that the vogue for tea service in Holland only occurred after 1678, corresponding to a book on tea published around this time. Noting the centrality of the tea service in the centre of the perspective box, the Bredius Museum concludes that it would have been made around 1678, though not much later as the tea pot is an early design. For details see A. Blankert, *Museum Bredius: Catalogus van de schilderijen en tekeningen* (The Hague: Bredius Museum, 1978), pp. 79-80.

[4] The artist of this perspective box is unknown. Edgar P. Richardson has surmised that Samuel van Hoogstraten is the artist behind this piece, though this attribution has since been denied. The Detroit Institute of Fine Arts indicates that the perspective box was acquired from a private collection '(possibly London, J. Mellaert (dealer-1928); Amsterdam, Gebroeders Douwes (dealer--1934-1935),' from whom the DIA purchased the box in 1935. This particular perspective box bears the marking of the exact year in which it was created, 1663. While the dates of the other perspective boxes are speculative, here it is affirmative. See E. P. Richardson, 'Samuel Van Hoogstraten and Carel Fabritius', *Art in America and Elsewhere* 25, no. 4 (October, 1937), p. 141.

[5] Of the six extant perspective boxes, van Hoogstraten's is in the best condition. As such, it is the most thoroughly discussed in the literature. It has two peepholes instead of one, which adds to the inherent difficulty in mapping out the anamorphic and perspectival illusions on the painted panels. See C. Brown, D. Bomford, J. Plesters, and J. Mills, 'Samuel van Hoogstraten: Perspective and Painting', *National Gallery Technical Bulletin* 11 (1987), pp. 60-85; C. Brusati, 'Self as Eye: The Perspective Box', in *Artifice and Illusion: The Art and Writing of Samuel Van Hoogstraten* (Chicago and London, 1995), pp. 169-217; S. Alpers, *The Art of Describing: Dutch Art in the Seventeenth Century* (Chicago, 1983), pp. 62-64.

Looking through the peephole of each perspective box, the interior appears as a self-contained, frozen living scene; human figures, assorted furniture, and house pets not only inhabit these spaces, but actively take up space as three-dimensional characters, as they 'pop up', seemingly detached from the two-dimensional surfaces of the painted panels. The overall effect of three-dimensionality is a striking feat that is made even more pronounced when 'peeping' monocularly; in all extant examples, the size of the perspective box's peephole insists that the space within the box be perceived solely with one eye. As discussed in the preceding chapter, the viewer's sense of scale and depth is affected when looking with one eye only. The perspective box capitalises on this visual handicap in order to render the illusions presented within that much more convincing.

This chapter takes the perspective box as its central subject of study and examines the design, provenance, and collection of these pieces before moving towards a discussion of the visual intimacy espoused when peeping within. The contents of this chapter can be roughly divided into two sections. In the first half of my analysis, I will discuss the theories behind the perspective box's make and design and will also consider the alleged possibility of other extant examples. Because three out of the six extant perspective boxes were acquired by the Royal Danish Kunstkammer in the seventeenth century, I will extrapolate on the perspective box's place within this specific collection, as well as its position within the Kunstkammer tradition more generally. Seventeenth-century Danish court culture was apparently infatuated with these optical experiments, as a room within the Kunstkammer confinement was assigned as the 'Perspective Chamber', and specifically devoted to housing the boxes. Thus, I argue that the perspective box was collected for its consummate and atypical application of the perspectival method, which

rendered it befitting as an object of illusionistic marvel. Further, within the Kunstkammer tradition, the perspective box offers a moment of visual respite for the visitors perusing a public collection. Following, in order to contextualise the perspective box further, I will suggest that their use of perspective is similar to that of the painter Pieter Jansz. Saenredam, who not only studied perspective theory, but taught the method to a keen ruling elite. Subsequently, I will argue that the connections between perspectival theory and practice in the Netherlands, as evidenced through the work of Hans Vredeman de Vries (1527-1607), Samuel Marolois (1572-1627), and Hendrick Hondius (1573-1650), complicates the theories set forward by Svetlana Alpers in her influential book, *The Art of Describing: Dutch Art in the Seventeenth Century* (1983).

The second part of this chapter explores the visual dynamics enacted in the perspective boxes through the lens of twentieth-century critical theory. These analytic frameworks aim to enliven elements of the visual dynamics involved when peeping into a perspective box that cannot be fully emphasised employing a historical approach. First, I explore how the perspective box engages with its observers who peep within by focusing on the way in which our gaze is met by the figures inhabiting the interior, specifically the pet animals. This clash of gazes, I argue, renders the furtive act of peeping a fairly jarring experience that instigates self-awareness. I will find further support for this argument in the theories of Jacques Derrida, in particular his meditations on animal gazes, as well as Jean-Paul Sartre's exploration of voyeuristic peeping in *Being and Nothingness* (1943). Furthermore, my discussion will include the visual pleasure derived in peeping into a perspective box, and how it is directly related to the boxes' subject matter: the private dwellings of a home. This chapter ultimately argues that the perspective box enlivens

particular fantasies relating to inhabitation and miniaturisation, as demonstrated in the like vogue for miniature dollshouses in seventeenth-century Holland. Gaston Bachelard's theories on the home and solitude in *The Poetics of Space: The Classic Look at How We Experience Intimate Places* (1958) will be explored in order to expand on the idea of the perspective box as a reification of this desire. Finally, this chapter concludes with a discussion of a puzzling aspect of *A Box with a Dutch Antechamber*, where areas of peeling paint raise questions about the box's intended function.

II. Dutch Perspective Boxes: Provenance and Design

The first written account of Dutch perspective boxes is found in the writings of English diarist John Evelyn (1620-1706). The box he describes is no longer extant, but it was said to be triangular in shape and depicted a view of the Great Church of Haarlem in Holland. In his diary entry dated February 5, 1656, Evelyn notes enthusiastically:

> Was shown me a pretty perspective and well represented in a triangular box, the Great Church of Haarlem in Holland, to be seen through a small hole at one of the corners and contrived into a handsome cabinet. It was so rarely done that all the artists and painters in town flocked to see and admire it.[6]

As we see from Evelyn's passing note, this particular peepshow attracted a lot of attention and we can assume that, likewise, similar boxes would have done the same. Dutch perspective boxes differ from peepshows created later in eighteenth-century Holland in their perspectival acuity and monocular structure, as the latter were comprised of painted glass panels lined within the confines of a box and lit from behind (fig. 52). Moreover, Dutch perspective boxes also stand in contrast to the peep-boxes that became popular in eighteenth-century England. These structures were often comprised of small-

[6] J. Evelyn, *The Diary of John Evelyn*, ed. A. Dobson (London, 1908), p. 188.

scale painted panels of exotic lands and historic happenings erected within the confines of a box and courted about for popular entertainment, as illustrated in the lower-right quadrant of William Hogarth's *Southwark Fair* (fig. 53).[7] At the turn of the nineteenth century, such large-scale peepshows gave way to miniaturised versions for private consumption.[8]

Scholarship on the design of Dutch perspective boxes has been speculative in nature due to the lack of written source material concerning how such art forms were put together. Susan Koslow's study was the first to explain that perspective boxes alter reality through the methods of linear perspective.[9] Peeping into a perspective box the spectator's sense of scale and depth are dramatically decreased due to the effects of monocular vision. The observer is able to 'enter' the painting as she peers through the peephole and becomes absorbed by the perspective box's complex arrangement of perspectival distortions.[10] Arnold Houbraken (1660-1719), a pupil of Samuel van Hoogstraten, wrote about this effect of enclosure and presence when looking into a perspective box:

> He painted portraits and histories in perspective within rooms (which you could see through a hole that was made in the panel). I have seen several of these paintings where a small room appears as a whole palace with vaulted arches, galleries, and marble columns.[11]

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[7] For details on the history of the peepshow as popular entertainment see O. Cook, 'Peepshows and Panoramas' in *Movement in Two Dimensions: A study of the Animated and Projected Pictures Which Preceded the Invention of Cinematography* (London, 1963), pp. 23-47. For more on the nineteenth-century peepshow as it relates to the history of souvenirs, spectacle, and international expositions, see A. Ogata 'Viewing Souvenirs: Peepshows and the International Expositions', *Journal of Design History* 15, no. 2 (2002), pp. 69-82.

[8] A notable example of smaller versions of nineteenth-century peepshows were alabaster 'peep eggs' that often displayed popular locations and were painted on an alabaster stone at the base of the viewer. Peering through the egg, light enters the opposing end and illuminates the miniaturised painting. See A. Fraser, *A History of Toys* (New York, 1966), p. 128.

[9] S. Koslow, 'De Wonderlijke Perspectyfkas: An Aspect of Seventeenth Century Dutch Painting', *Oud Holland* 82 (1967), pp. 36-37.

[10] Koslow, 'De Wonderlijke Perspectyfkas', pp. 36-37.

[11] [hij] maakte voornamentlyk zyn werk van Pourtreten, historiën en perspectiven in kamers (waar toe dan een gat in den muur buiten het vertrek om door te zien gemaakt werd) to schilderen. Ik heb er verscheiden gezien, die in een kleen vertrek geschildert, een geheel paleis, met overwelfde bogen, en Galeryen,

In David Bomford's study of the technical specifics of the perspective box's design, he uses the perspective box of the Catholic church to demonstrate that what we are actually viewing when looking through the peephole are two perspectivally-angled paintings merged together to form an apex (fig. 42).[12] The lines extending along the floor of the representation only appear as straight and horiontal from the point of view of the peephole. This method of corrected distortion is also employed in the triangular Reformed church perspective box (fig. 45) as well as the triangular perspective box located in the Museum Bredius (fig. 48).[13] Figure 46 helps to visualise what a triangular perspective box's interior looks like when viewed through a peephole. This perspectival trick is similar to the Ames demonstrations in perception outlined in the previous chapter (figs. 29 & 30).

In addition to the geometrical intricacies involved in the making of perspective boxes, artists were also interested in heightening the viewing experience by means of reflective surfaces. The pentagonal perspective box located in the Detroit Museum of Fine Arts (fig. 49) boasts an added accoutrement that the other five boxes do not possess. The front panel of the box is split in two sections, with the upper half opening on a hinge that is fitted on the interior with a small mirror.[14] The peephole is located on the lower half of the front panel. Presumably, the viewer would have first opened the hinged half of

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onderschraagt van marmere kolommen vertoonden.' A. Houbraken, *De Groote Schouburgh der Nederlantsche Konstschilders en Schilderessen* (3 vols., 's-Gravenhage, 1753), II, p. 158. As quoted in Koslow, 'De Wonderlijke Perspectyfkas', p. 38. Translation from Dutch is my own.

[12] D. Bomford, 'Perspective, Anamorphosis, and Illusion : Seventeenth-Century Dutch Peep Shows', in I. Gaskell and M. Jonker (eds.), *Vermeer Studies* (New Haven, 1998), p. 126. According to Bomford, if two lines meet at an angle, they will appear linear and straight if they are viewed from along the plane in which they are both contained.

[13] Regarding the Bredius museum's box, the front panel has not survived, and thus a sheet of plexi-glass has been fitted on the front end, into which a peephole has been cut.

[14] Richardson, 'Samuel Van Hoogstraten and Carel Fabritius', p. 141.

the box, permitting light to enter the scene, and then would have used the mirror as a spotlight, reflecting the incoming light upon the desired areas.

In addition to the six extant perspective boxes discussed above, Carel Fabritius' *View of Delft* (fig. 54) has spurred scholarly debate as a seventh potential example.[15] This painting presents a nearly panoramic wide-angle view of Delft with a close-up vignette of a man resting next to a lute, engaged in a moment of repose. The curved angle of the townscape scene in the middle of the painting has served as the cornerstone of the deliberation over the original conditions under which this painting was to be viewed. Kemp argues that despite the curved angle in the centre, Fabritius' painting would have been viewed frontally, as a regular easel painting. Because of its curvilinear perspectival design, he contends that this painting may have been executed as an experiment in 'natural perspective.'[16] Walter Liedtke has proposed that Fabritius' painting would have originally been fitted within the confines of a curved perspective box. Accommodating the curvilinear perspective in the middle of the painting, he explains that when bent in a semi-circular shape, the proper form of the painting takes shape.[17] The design of this perspective box would have encouraged the observer's eye to glance from left to right, 'as in natural vision.'[18] Liedtke links this concept of the roving eye to a perspective instrument by Baldassare Lanci (1510-1571) found in Jacopo Barozzi da Vignola's treatise on perspective, *Le Due Regole Della Prospettiva Pratica* (1583) (fig. 55). Here, a mobile pin in the bottom half of the hemi-cylinder marks specific points on a sheet of

[15] See M. Kemp, *The Science of Art: Optical Themes in Western Art from Brunelleschi to Seurat* (New Haven, 1989), p. 213; W. Liedtke, 'The 'View in Delft' by Carel Fabritius', *The Burlington Magazine* 875 (February, 1976), p. 69; Liedtke, *The View of Delft: Vermeer and His Contemporaries*, (Zwolle, 2000), 61; and K.G. Hulten, 'A Peep Show by Carel Fabritius', *Art Quarterly* 15 (1952), pp. 279-90.
[16] Kemp, *Science of Art*, p. 213.
[17] Liedtke, 'The "View in Delft"', p. 69.
[18] Liedtke, *The View of Delft,* p. 61.

paper that are seen through the monocular sighting device above. Despite the purported relationship between Lanci's device and Fabritius' image, Liedtke cautions that Fabritius' work would have been painted on a flat surface and transferred to a cylindrical frame.[19]

Intriguingly, Fabritius is also at the centre of another debate concerning the attribution of one of the six extant boxes. In his monograph on Fabritius, Christopher Brown makes the point that the perspective box depicting the interior of a Reformed church in Copenhagen has been erroneously attributed to Fabritius, in light of the inventory of the Danish Kunstkammer in 1690.[20] In a 1952 study, K.G. Hulten attributes this perspective box to Fabritius, arguing that the church depicted was that of a church in Purmerend, Holland, where Fabritius' grandfather was *predikant* (pastor).[21] However, Brown declares that the perspective box directly attributed to Fabritius in the inventory is more likely to be that of the Dutch Antechamber, noting that this particular box is the only one to have retained its original pedestal.[22]

Despite the meagre quantity of extant perspective boxes, there is evidence to suggest that they were known beyond the confines of European culture. In Timon Screech's study on Western scientific influence on the art of Edo Japan (1603-1868), he shares that the development of Japanese peep-boxes, or peeping *karakuri,* may have been informed by interactions with a Dutch perspective box (fig. 56). Focusing largely on the Dutch East India Company's station in Nagasaki Japan, Screech asks how imported European goods affected and informed Japanese artistic practice. While peeping *karakuri*

[19] Liedtke, *The View of Delft*, p. 61.
[20] C. Brown, *Carel Fabritius: Complete Edition with a Catalogue Raisonne* (Oxford, 1981), p. 135.
[21] See K.G. Hulten, 'A Peep Show by Carel Fabritius', *Art Quarterly* 15 (1952), pp. 279-90. Walter Liedtke has also previously suggested that Hendrick Van Vliet had in fact created the Reformed Church perspective box between the years 1660-1665. However, this remains unconfirmed. Liedtke, 'The "View in Delft"', p. 69.
[22] Brown, *Carel Fabritius*, p. 135.

had been known in Japan for some time, Screech asserts that a progenitor of these viewing devices may have been of Dutch origin, for a VOC diary entry dated 'winter, 1746', notes the arrival of a *perspectief cas* (perspective box).[23] While this box does not survive, and evidence to support the correlation is scant, Screech still deems it safe to assume that Japanses *nozoki-karakuri* originated from interaction with this *perspectief cas* 'even if undergoing subsequent adaptations.'[24] Indeed, Japanese peepshows gained popularity in the period spanning 1780-1820, and were most often referred to as *nozoki megane,* or 'peeping spectacles.' In her study, Maki Fukuoka expands that these eighteenth-century peep-boxes were also referred to as *oranda megane* or 'Holland spectacles,' which validates the Dutch influence on Japanese art-making, and further evinces its impact on Japanese peep-box culture.[25]

III. The Perspective Box in the Danish Kunstkammer

A Box with a Dutch Antechamber as well as the triangular perspective boxes displaying the Reformed and Catholic church interiors were acquired in 1674 to be housed in the Royal Danish Kunstkammer*,* now the National Museum, Copenhagen.[26] The Danish Kunstkammer was a relatively late arrival in the history of Kunstkammer

[23] T. Screech, *The Western Scientific Gaze and Popular Imagery in Later Edo Japan* (Cambridge, 1996), p. 19.
[24] Screech, *Western Scientific Gaze,* p. 272, footnote 71.
[25] See Fukuoka 'Contextualising the Peep-box', p. 19. Fukuoka is dubious as to the intended visual trickery involved in Japanese peep-boxes. She ascertains that while several scholars have likened the use of one-point perspective with *uki-e* pictures (floating pictures which can be seen as stand-alone prints, or within the confines of a peep-box), she does not necessarily see the end goal of a *uki-e* picture placed within the confines of a peep-box as visual trickery, or intended to fool the spectator into believing a feigned representation of an actual scene. Indeed, she problematises this conflation by arguing that looking through a Japanese peep-box instigates a feeling of tunnel vision, and the viewer's body must move about in order to see all aspects of the interior. Looking at a picture within the confines of a Japanese peep-box 'is to construct an image that resembles a mosaic fresco rather than a cohesive, unified representation of a view.'
[26] I have visited Denmark's National Museum as well as their off-site storage facility where *A Box with a Dutch Antechamber* is housed. All of the photographs of Copenhagen's three perspective boxes are my own.

collections, as it dates to the seventeenth century.[27] Kunstkammern, or cabinets of curiosity, contained objects of marvel made by man or found in the natural world, and were popular amongst European royal families and elite collectors in the early modern period. In the Kunstkammer, collectors strived to produce a microcosm of natural wonders and ingenious art forms. The development of the Kunstkammer in the mid- to late- sixteenth century in Europe marks a unique moment in the history of collecting. At this point in time, art objects and natural rarities such as fossils and stuffed animals, which were normally dispersed throughout a prince's residences, were gradually collected and presented together. Kunstkammern, such as those in Prague, Dresden, Munich, and Vienna, comprised of paintings, sculpture, and books that were mixed 'at times in apparently haphazard manner,' in and amongst scientific instruments, clocks, automata, as well as stuffed animals and fossilised flora.[28] This odd juxtaposition of man-made objects, *artificialia*, with natural wonders, *naturalia*, has been viewed as a means of mindful control over the chaotic natural world that is subject to chance.[29]

Inventories of the Danish collection were conducted in 1674, 1689, 1690, and 1737, and show that the contents of the Kunstkammer were divided into rooms organised by categories such as: weapons and antiques; mathematical and scientific instruments;

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[27] B. Gundestrup, *Det kongelige danske Kunstkanner 1737/The Royal Danish Kunstkammer 1737* (Copenhagen, 1991), p. 154. See also Bente Gundestrup's earlier article on the history of the Danish *Kunstkammer,* 'The Royal Danish Kunstkammer', *Museum International* 40, no. 4 (January/December 1988), pp. 186-189; M. Bencard, 'Museerne og Verdensordenen, Kunstkammerets opståen og grundide', *Nordisk Museologi* 1 (1993), pp. 3-16; and J. Hein 'Learning Versus Status? Kunstkammer or Schatzkammer?' *Journal of the History of Collections* 14, no. 2 (2002), pp. 177-192.

[28] T.D. Kaufmann, *Court, Cloister, and City: The Art and Culture of Central Europe, 1450-1800* (Chicago, 1995), p. 171.

[29] See H. Bredekamp, *The Lure of Antiquity and the Cult of the Machine,* trans. Allison Brown (Princeton, 1995), pp. 69-80; and H. Bredekamp '*Kunstkammer*, Play-Palace, Shadow Theatre: Thee Thought Loci by Gottfried Wilhelm Leibnz', in H. Schramm, L. Schwarte, J. Lazardzig (eds.), *Collection, Laboratory, Theater: Scenes of Knowledge in the 17th Century* (Berlin, 2005), pp. 266-283, for a discussion on Leibniz's invented 'play-palaces,' which, like Kunstkammern, are characterised as vast exhibitions on *naturalia* and technology that are built for the purposes of games and play.

and perspectival paintings and anamorphic displays.[30] Previously housed in the Copenhagen castle, the Danish Kunstkammer soon became overcrowded and plans were laid, under King Frederick III's (1609-1670) reign, to build an entirely new space for the collection. Architect Laurids de Thura (1706-1759) was commissioned to design a space that would not only sufficiently display the Kunstkammer collections, but could further incorporate the collections of the Royal Arsenal Museum and Royal Library.[31] With this expansion, the intended audience of the Kunstkammer shifted as well. Whereas the collections were previously kept for private consumption within the Copenhagen castle, the new Kunstkammer was to be open to the public.

The relocation of the Kunstkammer also carried with it the addition of an entirely new room devoted to deceptive representation. The 'Perspective Chamber', as it became known, was completed by 1689-90, and was a uniquely Danish innovation (fig. 57, room #6).[32] In Laurids de Thura's lengthy volume on Copenhagen from 1748, he boastingly describes the experience of walking through his newly renovated building, which was now split onto three levels. After guiding the reader through each room on the first floor, he ushers him up the stairs and describes the first room therein:

> From the staircase one first enters an antechamber, called a Perspective Chamber because it houses several cabinets in which one may see cunningly crafted perspective illusions of all manners of churches, be they Lutheran, Reformed, Roman-Catholic or other. One also finds a plethora of paintings with artful perspectives, yet others that are still lifes, as the painters term them…[33]

[30] Gundestrup, *Det kongelige danske Kunstkanner*, p. 154; See also Gundestrup, 'The Royal Danish Kunstkammer', p.188.
[31] Gundestrup, *Det kongelige danske Kunstkanner*, p. 154.
[32] Gundestrup, *Det kongelige danske Kunstkanner*, p. 155.
[33] L. Thura, *Hafnia Hodierna* (Copenhagen, 1748), p. 107ff. As translated in Gundestrup, *Det kongelige danske Kunstkanner*, p. 153.

An inventory of the newly renovated Kunstkammer dating to 1690 confirms Thura's description, as the first five entries listed in this document have been identified as perspective boxes. The first item in the inventory describes 'a box, in which a Roman-Catholic church painted in the Perspective Manner'; the second as 'A box, in which a Reformed church painted in the same Manner'; the third lists 'A box, in which a large Optical Perspective'; the fourth describes 'A box, in which a Dutch Antechamber'; and finally, the fifth is listed as 'Do ['Ein ditto', 'the same']. With a Long Gallery.'[34]

Three boxes from the royal Kunstkammer's 'Perspective Chamber' have survived and are now permanently housed in The National Museum Denmark. The Reformed church (fig. 44) and the Roman Catholic church (fig. 41) are constructed in a triangular fashion, the Reformed box decorated with a *trompe l'oeil* exterior mimicking the appearance of an actual cabinet, replete with open drawers and personal accoutrements. The fourth perspective box listed in the inventory describes that of the Dutch antechamber, discussed above (fig. 36), which stands atop a wooden pedestal. In addition to the fifth perspective box, the third piece is no longer extant and is listed in the inventory as the work of 'Fabricio of Delft.'[35] According to the inventory, this particular box depicted a scene of architecture, however no further details are known about its design. After the dissolution of the Danish Kunstkammer, Fabritius' perspective box was sold at auction in 1824, and its current whereabouts are unknown.[36]

In addition to perspective boxes, the 'perspective chamber' was also home to a number of still-life and *trompe l'oeil* paintings that deceptively fool spectators with

[34] Gundestrup, *Det kongelige danske Kunstkammer*, p. 158.
[35] 'Et stort optisk stykke, staaende paa et Postament, gjort af en fornem mester Fabricio til Delft.' ('a large optical piece standing on a pedestal and made by a distinguished master, Fabricio of Delft.'). Brown, *Carel Fabritius,* p. 135.
[36] Gundestrup, *Det kongelige danske Kunstkammer*, p. 158.

uncanny renditions of letter racks, breakfast tables, and easel paintings by such artists as Fabritius, Georg Hinz. (1630-1700), Jacob Biltius (1633-1681), and Cornelius Gijsbrechts (1630-1683).[37] The grouping of perspective boxes with such deceptive art forms is fitting, for these genres are very akin in their experimentation with optical illusions and feigned realism. One such *trompe l'oeil* painting housed in the chamber was Gijsbrechts' *Easel with Fruit Piece* (1670) (fig. 58). Gijsbrechts' *trompe l'oeil* is an impressive feat consisting of a cunningly painted still-life painting seated on an easel, with brushes and a palette resting along the ledge, and a cameo self-portrait of the artist placed in front of the painting. [38] Beneath the still-life is a second painting leaning against the easel and facing the opposite direction, its back facing towards the viewer. This unassuming 'back of a painting' is a separate piece, compelling the spectator to turn it around in order to see what is painted on the other side.[39] When the painting is turned around, the supposed 'front' reveals nothing but the backside of canvas. This is a painting of the reverse side of a painting; there is simply nothing more to see. The very materiality of canvas, wood, and nails is here exploited in the name of cunning deception. Gijsbrechts' work stands as the zenith of a true *trompe l'oeil*, as a 'painted surface behind

[37] Strictly speaking, *trompe l'oeil* painting is a sub-genre of still life. Both types of painting took up similar subject matter, and artists often specialised in both areas. See, A. Veca, 'Honest Lies', in S. Ebert-Schifferer (ed.), *Deceptions and Illusions: Five Centuries of Trompe L'oeil Painting* (Washington, 2002), p. 72.

[38] For more information on Gijsbrechts' oeuvre, see O. Koester, 'Cornelius Norbertus Gijsbrechts: An Introduction,' in O. Koester (ed.), *Illusions: Gijsbrechts, Royal Master of Deception* (Copenhagen, 1999), pp. 1-33.

[39] Part and parcel with the stunning effects of a *trompe l'oeil* painting is the way in which it compels the observer to touch the canvas to verify the truth of its makeup. This is effectively demonstrated in Michael Leja's essay on the *trompe l'oeil* paintings of nineteenth-century English artist William Harnett. While *trompe l'oeil* paintings cannot always entirely convince viewers that the objects they portray are real, it is often the painting's marginal aspects, such as 'a curled corner of paper, a chipped board', that most compel physical scrutiny. M. Leja, '*Trompe l'oeil* painting and the deceived viewer,' in R. Maniura and R. Shepherd (eds.), *Presence: The Inherence of the Prototype within Images and Other Objects* (Aldershot and Burlington, 2006), p. 177.

which lies neither truth nor meaning,' only the materiality of its very makeup.[40] In this way, it functions similarly to Ames' chair demonstration, where our perceptual understanding is so intertwined with an illusion that it simply cannot be disentangled.

Gijsbrecht's work epitomises a 'chantourné': a sub-genre of *trompe l'oeil* painting characterised as cut-outs of ersatz objects—often found around the home—that through their form and representation attempt to appear as duplicates of the objects themselves.[41] His *Reverse Side of a Painting* manages to deceive through both its skilled arrangement and sheer banality, as the apparent exposure of a painted backside in fact hides the actual painting in plain sight. Once turned about, Gijsbrecht's work is stripped of any potential reading, as it is the very materiality of the painting as canvas that is showcased, back as front. Unlike other *trompe l'oeil* paintings arranged in the perspective chamber's vicinity that fool the spectator into seeing a letter rack or open cabinet, here the 'object of this painting, is the painting as an object.'[42] *Reverse Side of a Painting* was likely intended to lean against a wall within the Perspective Chamber. This stresses the deceptive game it was intended to instigate, as the observer was likely to believe that that the painting had yet to be hung. In toying with our expectations, this *trompe l'oeil* confirms the tradition view that painting's central purpose is to deceive and surprise by pushing it to extremes.

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[40] Grootenboer, *Rhetoric of Perspective*, p. 58.

[41] For a discussion of the distinct categories of *trompe l'oeil* painting in the Netherlands in the seventeenth century, see C. Brusati, 'Honourable Deceptions and Dubious Distinctions', in O. Koester (ed.), *Illusions: Gijsbrechts, Royal Master of Deception* (Copenhagen, 1999), pp. 54-56; and S. Ebert-Schifferer, 'Trompe L'oeil: The Underestimated Trick', in S. Ebert-Schifferer (ed.), *Deceptions and Illusions: Five Centuries of Trompe L'oeil Painting* (Washington, 2002), p. 33.

[42] V. Stoichita, *The Self-Aware Image: An Insight into Early Modern Meta-Painting* (Cambridge, 1997), pp. 277-279. Stoichita argues that Gijsbrechts's painting presents a paradox. As stated above, *Reverse Side of a Painting* is the depiction of nothing in that it negates narrative by presenting a blank (albeit reversed) slate. However, it also defines, in its very makeup, the very materials that comprise painting as a whole. Stoitchita concludes that Gijsbrecht's painting epitomises a 'self-aware image' for it is cognisant 'of its being and of its nothingness.'

The placement of the perspective boxes within the Perspective Chamber alongside paintings such as Gijsbrechts' is indicative of how they were to be experienced and understood. Arranged within a room where painted deceptions were paramount, the perspective box was primarily there to be considered as a skilful achievement in artful illusion. Indeed, as the first room into which the public entered, the perspective chamber was intended to dazzle its visitors with art that was considered new and innovative.[43] Stepping into the perspective chamber was intended to spark ideas about the role of artifice and the ordering of the world. The perspective box falls under the category of *artificialia*, as man-made artifice that is a wonder to behold as an eccentric feat in perspective and anamorphosis. Like specimens of *naturalia* that are often revered for their small or large size as a wonder of nature,[44] the perspective box is presented here surrounded by optical instruments as an exceptional instance of perspectival painting, from which it draws its allure. The illusionistic feats of Gijsbrechts' cut-out and the perspective boxes act as showpieces for the esteem and glory of the monarchy for they infer that the ruling elite is mindful of the types of optical knowledge required to create such artful deceptions. This point is driven home by the fact that a portrait of King Frederick III and Queen Sophie Amalie (1628-1685) awaits revelation in the Perspective Chamber, within the reflection of a catoptric mirror (fig. 59).[45]

In addition to the unique illusionistic quality of the perspective boxes, their monocular structure facilitates a distinctive viewing experience for the Kunstkammer

[43] Gundestrup, *Det kongelige danske Kunstkammer*, p. 159.
[44] H. Watanabe-O'Kelly, *Court Culture in Dresden: From Renaissance to Baroque* (New York, 2002), p. 71.
[45] A. MacGregor, *Curiosity and Enlightenment: Collectors and Collections from the Sixteenth to the Nineteenth Century* (New Haven, 2007), pp. 47-48.

visitor. Enclosed from all sides, the perspective box elicits curiosity by urging the spectator to step closer and peep within. As a self-contained box that can only be peered into by one person at a time, the perspective box provides a private moment of visual respite for the spectator. After its relocation, the Danish Kunstkammer was open to the public, and thus could not guarantee private moments of visual contemplation to select visitors. In a way, we could argue that the monocularity of these art forms facilitates such respite. Privacy was indeed a concern amongst nobility and their collections. It has been shown that Rudolph II's (1552-1612) Kunstkammer in Prague was kept mainly for private consumption, and the emperor was very secretive about its contents.[46] While similar in organisation and scope to Denmark's, Rudolph's collection could not be seen by common people, and was used strictly in the service of diplomatic events; only visiting dignitaries or ambassadors were given the privilege of perusing the Kunstkammer.[47] In this sense, Rudolph's collection was intended primarily as a means of demonstrating his virtue and worth to visitors.[48] In contrast, the Copenhagen Kunstkammer became a public space where contact with strange, curious objects facilitated learning. The public was invited to marvel at the objects on display and learn through looking, questioning, and —with regard to the perspective boxes—peeping within.

While valued for their deceptive appeal in the Danish Kunstkammer, it is uncertain how popular these art forms were in the seventeenth century. Arguably, perspective

[46] R.J.W. Evans, *Rudolph II and His World: A Study in Intellectual History, 1576-1612* (Oxford, 1973), pp. 178.
[47] T. D. Kaufmann, 'Remarks on the Collections of Rudolph II: The *Kunstkammer* as a Form of *Representatio*', in D. Oreziosi and C. Farago (eds.), *Grasping the World: The Idea of the Museum* (Burlington, 2004), pp. 526-537, p. 527. On Rudolph's collection see also T. D. Kaufmann, 'From Treasury to Museum: The Collections of Austrian Hapsburgs', in J. Elsner and R. Cardinal (eds.), *The Cultures of Collecting* (London, 1994), pp. 137-154.
[48] Kaufmann, 'Collections of Rudolph II', p. 527.

boxes had a longer life as peepshows in the eighteenth century as evidenced by their exportation to Japan. The question still remains: why was the vogue for perspective boxes so short-lived in Europe? If the dates of the extant perspective boxes do not surpass the 1690s, can this particular time period provide clues as to the perspective box's brevity? I propose that Thomas DaCosta Kaufmann's theories on the dissolution of the Kunstkammer provide a speculative explanation for the discontinuity of perspective boxes at the turn of the eighteenth century.

While Kunstkammer collections existed steadily throughout the fifteenth and sixteenth centuries in southern and northern Europe, by the eighteenth century interest began to waver. According to Kaufmann, the near complete dissolution of the Kunstkammer in the latter half of eighteenth century was a symptom of a paradigmatic shift occurring in the appreciation, collection, and presentation of art. The ushering in of an era of specialisation and compartmentalisation would be the unmaking of this unique form of collecting.[49] In the early modern Kunstkammer, much attention is paid to synthesising the contents with their surroundings. The Kunstkammer is a comprehensive space where every component belongs to a larger whole. However, as Kaufmann explains, at the turn of the eighteenth century, paintings and art objects began to be displayed and organised according to a visual history of art. To illustrate this development, he points to Vienna's imperial painting collection in the 1770s and 1780s.

[49] Kaufmann remarks that this historical shift occurs earlier than the historic epistemes set forth by Michel Foucault in *The Order of Things: An Archaeology of the Human Sciences* (1966). Here, Foucault sets the episteme responsible for the classification and compartmentalisation of knowledge at the end of the eighteenth and beginning of the nineteenth centuries. For Kaufmann, Foucault sets the development of classification too late. The activities and processes Foucault brings to bear 'had already occurred in the course of the earlier eighteenth century.' The steady decline in royal Kunstkammer collections serves as a prime example of this shift. T.D. Kaufmann, *The Eloquent Artist: Essays on Art, Art Theory and Architecture, Sixteenth to Nineteenth Century* (London, 2004), p. 316-320; M. Foucault, *The Order of Things: An Archaeology of the Human Sciences* (New York, 1973), 'The Limits of Representation', especially pp. 243-249.

Here, unlike princely Kunstkammern where paintings were displayed in and amongst natural artefacts, the Austrian imperial collection was to be exhibited with no attention paid to the relational juxtaposition of painting, woodwork, architecture, and sculpture. Instead, the paintings were organised according to school: 'the synthesis now reached is an intellectual, historical one.'[50] In lieu of ornate stucco and woodwork, the paintings now stood on their own merits and were interrogated for their narrative, historical, and moral properties. This shift in modes of display presents a challenge to the idea that ultimate harmony can be achieved through the synthesis of visual materials. The notion of the 'Gesamktkunstwerk', or 'total work of art', ushered in in the eighteenth century, presented a different idea of totality than that of the Kunstkammer.[51] Here, harmony is achieved through visual impressions and not necessarily through the juxtaposition of little pieces of the world.

Kaufmann's theories on the dissolution of the Kunstkammer in the eighteenth century elucidate the brief vogue for perspective boxes, collected in both Kunstkammers and private collections. Perspective boxes are, in essence, self-contained, microcosmic displays, where each motif and scene belongs to an aesthetic whole. They contain an entire interior space, whether home or church, on a number of disparate surfaces, therefore scrupulous attention must be paid to the synthesis of detail. There is no evidence to suggest that Dutch perspective boxes were fashioned after the turn of the eighteenth century. Thus, it is safe to assume that the epistemic point at which Kunstkammern were dismantled—in favour of chronological display and

[50] Kaufmann, *The Eloquent Artist,* p. 320.
[51] Kaufmann, *The Eloquent Artist,* p. 322.

particularisation over aesthetic synthesis—is when perspective boxes, as comprehensive works of art, began to lose significance in the cultural landscape.

Thus far I have outlined the role that the perspective box played in the tradition of the Kunstkammer. I have shown that their monocularity provides a visual respite for a viewer perusing a public collection and as a means of inciting curiosity on behalf of the Kunstkammer spectator. There is a third way in which the monocularity of the perspective box affects the viewer's perception: as a means of priming our vision to enjoy the interior display as an amorous voyeur, a point to which I now turn.

IV: The Perspective Box as Emblem of Artistic Desire

It can be said that the privacy granted by the peephole forms an intimacy between the painted object and the viewer. As a lone voyeur peering into a microcosmic world, the observer participates in an act of looking that is charged with desire. Indeed, the motifs painted on the interior and exterior of van Hoogstraten's box in the National Gallery, London offers tremendous insight into how the perspective box was to be interpreted and enjoyed. Prior to discussing the symbolism of van Hoogstraten's perspective box, it is first important to extrapolate on his program of self-representation that carried him through his career.

In 1651, during a stay in the royal court of Ferdinand III (1608-1657), van Hoogstraten presented the monarch with a trompe l'oeil painting he believed surely would impress. The monarch was so taken with the painting that he presented van Hoogstraten with a medal of honour, which van Hoogstraten began incorporating in his

subsequent paintings in order to promote his status as a true talent in his field.[52] For instance, a gold medallion can be seen beneath a white towel in his painting *Feigned Cabinet Door* (fig. 60). In the same painting, tucked into the pockets of a leather case, van Hoogstraten incorporated a copy of the receipt for his services at court: 'Received by Samuel van Hoogstraten the 12th of February 1655 in Vienna.'[53] The successes achieved at court in Vienna served van Hoogstraten for the rest of his career. By including clever references to his successes as a painter in his works, the artist was able to attract prospective patrons through a campaign of self-representation.[54] This approach is best seen in his perspective box where he has painted motifs related to his personal and professional life. For instance, in the front end of the box, resting on a chair, lies a self-addressed letter bearing his name; the van Hoogstraten family crest is incorporated in a portrait hanging next to the two bedrooms; and, finally, the family coat of arms of van Hoogstraten's wife is painted within a stained glass window in the left end of the box.[55]

No surface of the perspective is left untouched. Indeed, van Hoogstraten incorporated a symbolic program on the exterior panels of the perspective that point to his professional accomplishments. Van Hoogstraten is one of a handful of Dutch artists to have authored a lengthy and very well-written treatise on painting, *Inleyding tot de hooge schoole der schilderkonst* (Introduction to the Academy of the Art of Painting, 1678). Each exterior panel of his perspective box is painted with a symbolic scene representative of his theories on artistic ambition discussed in this book. On the title page to the ninth

[52] C. Brusati, 'Still Lives: Self-Portraiture and Self-Reflection in Seventeenth-Century Netherlandish Still-Life Painting,' *Simiolus* 20 (1990-1991), p. 181. Despite his successes in Vienna, van Hoogstraten was not able to gain a permanent position at court and later returned to Holland.
[53] Brusati, 'Still Lives: Self-Portraiture', p. 181.
[54] Brusati, *Artifice and Illusion*, pp. 52- 53.
[55] Brusati, *Artifice and Illusion*, p. 177.

chapter he illustrates an allegorical scene concerning the accolades the artist will receive in pursuing his craft (fig. 61).[56] This chapter is devoted to Urania, the muse of astronomy, whom van Hoogstraten explains inspires the artist 'to climb the stairway to the stars.'[57] On the left, three putti carry about disparate activities symbolic of the desires that inspire the artist: one gathers laurel branches representing artistic honour or *gloria*, the second holds a number of coin purses in his left hand signifying *lucrum* or wealth, while another, seated by a basket of apples signifies—according to the text—love, or *amor*, that derives from the 'satisfaction of the mind' obtained by pursuing one's craft.[58] As van Hoogstraten writes:

> [The painter] has threefold fruits from his work: one is the satisfaction of his mind, which he receives through the perfection of his work; the other is reputation; and the third is the benefit that shall come to him either by gift, by sale or by other remuneration.[59]

Van Hoogstraten also incorporates the three urges of painting, illustrated in the title page to chapter nine, on the side panels of his perspective box. On the first panel, he depicts *amor* through an artist engaged in the act of painting a portrait of Urania (fig. 62). The next panel illustrates the artist's desire for remuneration through a depiction of a crowned putto holding a sceptre and a bag of gold coins (fig. 63). The last panel represents the artist's desire for reputation by means of a putto bestowing a gold chain and crown of laurel to an artist (fig. 64). This symbolic program on the perspective box's exterior creates a direct correlation between van Hoogstraten's practices as an artist and his theoretical ideals as laid out in his *Inleyding.* Further proof of this correlation is seen in

[56] Brusati, *Artifice and Illusion*, p. 213.
[57] Brusati, *Artifice and Illusion*, p. 213.
[58] T. Weststeijn, *The Visible World: Samuel Van Hoogstraten's Art Theory and the Legitimation of Painting in the Dutch Golden Age* (Amsterdam, 2008), p. 91.
[59] As translated in Weststeijn, *The Visible World*, p. 91.

the parallels between the structure of the book and the structure of the perspective box's fictive household. The home is split into a total of nine rooms, while the book is organised into nine chapters. Van Hoogstraten writes that the nine chapters of his books, devoted to the nine muses, are akin to classrooms through which he will guide the reader: 'as if we were to take pupils by the hand and lead them around our Academy, which we have divided into nine rooms of learning, and indicate to them…which parts of painting they should be practising at each stage.'[60] It could be argued that the space of the perspective box is to a certain extent a pedagogical space that 'teaches' observers about the art of perspective just as his treatise guides the reader through the art of painting.

In addition to the putto painted on the side panels of the perspective box, the top panel is painted with a suggestive anamorphic portrait of Erato, the Greek muse of lyric poetry (notably erotic poetry), laying in bed with a putto dressed as Eros, the Greek god of love (fig. 65). In the *Inleyding*, van Hoogstraten states that Erato is the muse of 'procreative pairings in nature.'[61] The anamorphic illusion can only be resolved if the observer stands at the left end of the perspective, at the corner near the open end. This scene, seen prior to peeping into the box by the observant viewer, foreshadows the experience of the interior display in two ways. First, the anamorphically-composed double portrait foretells the numerous anamorphic designs that make up the interior; it provides a glimpse of the skills involved in the box's making. Second, the symbolism of Erato and Eros, sprawled out across the top of the box, implies that the act of peeping is an erotic act. The interior scene exists solely for the peeping observer who can gaze as a voyeur into a private space. To draw further attention to the charged eroticism of our

[60] As translated in Weststeijn, *The Visible World*, p. 41.
[61] As translated in Brusati, *Artifice and Illusion*, p. 213

gaze, van Hoogstraten has included a silhouette of a Peeping Tom, seen from the left peephole, spying on a woman seated by a window at the far end of the home reading a book (fig. 66). The Peeping Tom mirrors our illicit activity as we peruse the interior and forces us to question the urge that entices us to look in again and again.

The enjoyment of a painted scene as an erotically-charged activity finds literary basis in Dutch painter and writer Philips Angel II's (1616-1683) treatise, *Lof der Schilder-konst* (*Praise of the Art of Painting,* 1642). In it, Angel characterises the appreciation of art as a lustful conquest.[62] Indeed, he writes that the very power that art holds is its ability to arouse and excite, as the viewer is presented with an 'endless (yet pleasant) maze' as his eyes move over the painting, 'constantly seeing a new and different wish springing from the end of one desire' to the next.[63] The numerous avenues in which the eye is invited to peruse in van Hoogstraten's perspective box are in keeping with Angel's characterisation of painting. To this point, the peephole ensures that the viewer looking in can peruse the interior alone, as a voyeur. The pleasure derived in peeping is thus qualified as an erotic act driven by our vision.

While the motifs painted on and within van Hoogstraten's perspective box point to the amorous and voyeuristic nature of our 'peeping', the repeated tropes of the church interiors housed in Denmark prompt inquiry into the similarities they share with contemporary Dutch painting. In the next section, I aim to extrapolate on the connections between the perspective boxes and the practice of perspective in early modern Dutch art.

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[62] E. Sluijter, *Seductress of Sight: Studies in Dutch Art of the Golden Age* (Zwolle, 2000), p. 199.
[63] P. Angel, 'Praise of Painting: Translated by Michael Hoyle, with an Introduction and Commentary by Hessel Miedema,' *Simiolus* 24 (1996), pp. 1-2.

V: The Practice of Perspective in Dutch Painting: Saenredam, Perspective, and Artists' Education

The repeated use of church interiors in perspective boxes, whether Catholic or Protestant, speaks to a popular sub-category of genre painting in seventeenth-century Holland. Specifically, the architectural detail in the perspective boxes depicting church interiors is reminiscent of the oeuvre of the Dutch artist Pieter Jansz. Saenredam (1597-1665), who painted numerous church interiors with extensive detail and perspectival acuity. His paintings of the interior of St. Bavo's (figs. 67 & 68) with their whitewashed walls and miniscule human figures are similar in subject matter and style to the perspective boxes. Angela Vanhaelen's recent study of paintings of churches in the Dutch Republic demonstrates that the defining feature of church interior paintings such as those by Saenredam is their mastery of three-dimensionality. In point of fact, this sub-genre of painting was often referred to as 'perspectives' in seventeenth-century inventories.[64]

It is important to note that Gothic churches were often re-appropriated and 'white-washed' to eliminate any traces of Catholic idolatry after the Reformation. Fig. 42 (the Catholic church interior) exhibits such 'white-washing' as the church is rendered far more barren than it likely had been prior.[65] What is most intriguing is that after the French occupation in 1672, Catholicism was largely restored in the Netherlands, thus in light of the fact that both the Reformed and Catholic perspective boxes have been dated within the period of 1650-1674, the Catholic church interior may in fact point to the restored practices of the faith, as the interior is bustling with activity.

[64] A. Vanhaelen, *The Wake of Iconoclasm: Painting the Church in the Dutch Republic* (University Park, 2012), p. 60. Such paintings are often referred to as 'perspectives' in seventeenth-century inventories. See p. 60.
[65] Vanhaelen, *Wake of Iconoclasm,* pp. 133-135.

I present Saenredam as an important case study through which to show that while written documentation on perspective boxes remains scarce, their use of perspective theory can be traced through corollary evidence. There are several indications in Saenredam's work that perspectival study was a central concern of his. First, as Kemp has shown, in many of Saenredam's paintings, he paid careful attention to the overall spatial impression, despite the fact that the viewpoints are quite unusual in that they are often asymmetrical and low.[66] Second, his studies for *The Interior of St. Bavo's* have evidently been punctured by a marking pin, which shows that Saenredam sought to plot the distance points in his works carefully.[67] Kemp explains that this indicates that 'Saenredam makes conscious and virtuoso play on the concept of the painter's individual location in relation to the subject.'[68] Saenredam's process was flexible as he made adjustments to the strict perspective of the painting by judging with his eye. While geometry was evidently an important aspect of the process, the artist made certain concessions to the perspective of his paintings if he saw that they rendered the representations more visually sound.[69]

Saenredam's knowledge of perspective can be traced in the collection of his library, where he owned a Dutch translation of Euclid by Dou (1606), in addition to a Dutch translation of Frans van Schooten's *Exercitationes mathematicae libri quinque* (*Five Books of Mathematical Exercises*, 1657), as well as treatises on military engineering, architecture, politics, and land-metering by the Flemish mathematician

[66] M. Kemp, 'Simon Stevin and Pieter Saenredam: A Study of Mathematics and Vision in Dutch Science and Art', *The Art Bulletin* 68, no. 2 (June 1986), p. 246.
[67] Kemp, 'Simon Stevin and Pieter Saenredam', p. 246. See also W. Liedtke, 'The New Church in Haarlem Series: Saenredam's Sketching Style in Relation to Perspective', *Simiolus* 3 (1975-1976), pp. 145-164.
[68] Kemp, 'Simon Stevin and Pieter Saenredam', p. 246.
[69] Kemp, 'Simon Stevin and Pieter Saenredam', p. 247.

Simon Stevin (1548-1620).[70] The presence of Stevin's work is particularly significant. His books on perspective and military engineering were written in large part thanks to his relationship with the Stadtholder of the United Provinces, Maurits van Oranje (1567-1625), previously Count of Nassau.[71] While the origin of their acquaintance is unknown, Stevin was Maurits' tutor in mathematics and natural science.[72] In 1592, the mathematician was appointed as Quartermaster in the state army in 1593, through which he would join Maurits on military trips.[73] As the prince's educator, Stevin was in charge of composing textbooks on every topic Maurits wished to learn.[74] After completing his study materials, he set about publishing them together in a joint edition, *Wisconstighe Ghedachtenissen (Mathematical Memoirs,* 1605-1608).[75]

Under the tutelage of Stevin, Maurits developed a keen interest in perspective drawing. In *Vande deursichtighe*, part three of *Wisconstighe Ghedachtenissen,* Stevin discusses the Stadtholder's growing interest in perspective:

> As his *Princely Grace* frequently exercised himself in drawing ground and vertical plans for fortification, which he erected in the lands under his government, he found it useful to exercise himself as well in the third species of drawing, to wit perspective or painting, such mainly of landscapes, with cities, rivers, roads, and woods situated therein, thus to explain more easily to others his views, as required by the matter.[76]

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[70] Kemp notes that most of the books collected within Saenredam's library were not necessarily collectibles, but were more than likely bought to be studied. Kemp, 'Simon Stevin and Pieter Saenredam', p. 239.
[71] E.J. Dijksterhuis (ed.), *The Principal Works of Simon Stevin*, vol. I (5 vols.) (Amsterdam, 1955), p. 8.
[72] Dijksterhuis, *Works of Simon Stevin*, p. 9.
[73] S. Dupré, 'The Historiography of Perspective and *reflexy-const* in Netherlandish Art", *Nederlands Kunsthistorisch Jaarboek*, vol. 61 (2011), p. 42.
[74] Dijksterhuis, *Works of Simon Stevin*, p. 10.
[75] *Wisconstighe Ghedachtenissen* was later translated in French and Latin.
[76] As translated in Dupré,'*reflexy-const* in Netherlandish Art', p. 43. After *Wisconstighe Ghedachtenissen*, Stevin published two more works in one volume in 1617: *Castrametatio (Marking out of army camps)* and *Nieuwe Maniere van Sterctebou door Spilsluysen (A new manner of fortification with the help of pivoted locks)*.

Maurits would have used perspective drawings in order to communicate with engineers and architects involved in constructing military fortifications. In *Vande deursichtighe*, Stevin portrays Maurits as a keen and engaged student. The Stadtholder was fond of drawing in perspective with the help of an instrument that employed a glass plane on which one would trace the outlines of an object by looking through a monocular eyepiece. For Maurits, the drawing instrument served as an educational tool. Discussing the device, Stevin writes,

> We wanted to describe this form of the glass (by means of which his Princely Grace drew perspective images both of men and of other things in such a way that it seems it may be said in truth that postures of men cannot possibly be drawn so perfectly at sight, without a glass)…it promotes a thorough knowledge of perspective.[77]

The function of instruments like the one here mentioned will be discussed in more detail in chapter four, in addition to the relationship between the ruling elite and mathematical education. In regard to the concerns of this chapter, the thread connecting Maurits' keen interest in perspective, Stevin's role as perspectival educator, and Saenredam's study of the perspectivist's work, indicates that an interest in the more theoretical aspects of perspective existed among Dutch artists as well as the ruling elite. Moreover, the reading of perspective treatises was evidently integrated into the education of Dutch artists and those interested in drawing in perspective. Before discussing the ramifications of Dutch perspectival theory and practice in the art historical discipline, I would like to outline the conditions under which most Netherlandish artists learned their craft.

Dutch artists were trained under the direction of trade organisations, specifically the Guild of Saint Luke. The guild's role was mainly to regulate the education of up-and-coming artists and artisans and to oversee the buying and selling of art by ensuring that

[77] As translated in Dupré,'*reflexy-const* in Netherlandish Art', p. 49

foreign art production did not affect local markets. Dutch artists usually came from middle class families, and their fathers were often members of guilds. Young apprentices, who normally began between the ages of ten and twelve, were matched with masters who were older artists with the skills and expertise to train students. Apprenticeship contracts that have survived provide useful details on the form of education apprentices received, as well as the expense of training which varied depending on how established the teacher was.[78] Training normally lasted six years, and could cost anywhere between two and one hundred guilders per year, depending on the master and if the student required room and board.[79] An artist's training largely centred on reproducing his master's work.[80] Depending on the genre, the apprentice would normally begin by copying a print or drawing and would then move on to plaster casts and small figurines. After their skills had developed, young artists were encouraged to draw from a live model. Subsequently, if their drawing skills met with expectations, the student was permitted to paint copies of their master's works, or the work of other artists. It is important to stress that seventeenth-century Dutch artists were, for the most part, highly literate.[81] In the Guild of St. Luke, nearly all masters (save for the furniture painters) were literate, as were their apprentices.[82] Literacy, even at the most elementary level, was required in order to enable the budding artist to become a full-fledged master in his field.[83]

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[78] M. North, *Art and Commerce in the Dutch Golden Age* (New Haven and London, 1997), 64. See also M. Prak 'Painters, Guilds, and the Art Market during the Dutch Golden Age', in S.R. Epstein and M. Prak (eds.), *Guilds, Innovation, and the European Economy*, *1400-1800* (Cambridge, 2010), pp. 143-171.
[79] North, *Art and Commerce*, p. 65.
[80] North, *Art and Commerce*, p. 66.
[81] North, *Art and Commerce*, p. 73.
[82] J. M. Montias, *Artists and Artisans in Delft: A Socio-economic Study of the Seventeenth Century* (Princeton, 1981), p. 114.
[83] North, *Art and Commerce*, p. 74.

VI. Perspective Boxes as Reification of Theoretical Exercises

The connections I have drawn between the perspectival acuity of the perspective box and the study and application of perspective in Saenredam's paintings complicates the theories set forth by Svetlana Alpers in *The Art of Describing: Dutch Art in the Seventeenth Century* (1983). Through an examination of the 'cultural ambiance of realism' in Dutch painting, Alpers argues that Dutch art stands in opposition to the Italian tradition primarily through its emphasis on description as opposed to narration, or idealised spatial organisation.[84] Referring to van Hoogstraten's text, Alpers points to the painterly approach of study, as opposed to the Italian emphasis on *disegno*, and the attention given to the effects of light and textures. As she writes,

> While the Italians moved—as Panofsky skilfully demonstrated—to distinguish between what we can simply refer to as the real and the ideal, or between images done after life and those also shaped by judgment or by concepts in the mind, the Dutch hardly ever relaxed their representational assumptions.[85]

The descriptive approach adopted by the Dutch is, according to Alpers, similar to the aesthetic of photographs: attention to the fragment, arbitrariness around how to frame the picture or organise its contents, as well as the 'immediacy that the first practitioners expressed by claiming that the photograph gave Nature the power to reproduce herself directly unaided by man.'[86] As it follows, Alpers concludes that there are two ways of picturing the world. The first, after the Italian approach, sees pictures as a framed object, a window unto a world (after Alberti), 'to which we bring our eyes.'[87] In the second, the

[84] S. Alpers, *The Art of Describing: Dutch Art in the Seventeenth Century* (Chicago: University of Chicago Press, 1983), p. 39.
[85] Alpers, *Art of Describing*, p. 40.
[86] Alpers, *Art of Describing*, p. 43.
[87] Alpers, *Art of Describing*, p. 45.

picture comes to stand in for the eye, and does not consider our place, nor a frame, before it.

Dutch perspective boxes, by contrast, exist solely as objects 'to which we bring our eyes.' They are framed, microcosmic worlds that greatly consider the viewer's position before it and the overall organisation of the scene. I think it too polarising to contrast the Dutch and Italian traditions as different means of picturing. The amount of drawing and consideration of the viewer's position within Saenredam's works, and the perspective box's implementation of perspectival theory, paints a more complicated picture than Alpers' theories allow for. To stress the latter, I aim to flesh out the relationship between the theorisation of painting and perspective in published treatises accessible to Dutch artists, and the application of these theories within perspective boxes. This will show that 'idealised' forms of painting, or images that are 'shaped by concepts of the mind', were in fact made in the North. While marginal in their number, these connections complicate Alpers' stylistic dichotomy. As a point of entry, I return to van Hoogstraten's *Inleyding.*

The *Inleyding* was an ambitious treatise that drew upon a bevy of philosophical, literary, and historical source material, and stands as a cross-section of artistic views and practices in seventeenth-century Holland. As a man of letters, van Hoogstraten's treatise is written with keen awareness of the literary tradition that precedes his work. Specifically, he declares himself successor to Karel van Mander, whose *Het Schilder-boeck* (Book on Picturing, 1604) was the first comprehensive thesis on art-making in the Netherlands.[88] In the opening pages of his treatise, van Hoogstraten addresses his readers

[88] Walter Melion states that every subsequent treatise on the art of painting after van Mander, from van Hoogstraten's, to Philip Angel's *Lof der Schilder-Konst* (1642), to Gerard de Lairesse's *Groot Schilderboek*

and states that the necessity of his work stems from a marked wane of interest in art theory in his day. This, writes van Hoogstraten, has led the art of painting to be viewed as a 'common art or craft,' which he sees as the reason many artists have ventured into this trade without understanding the vast difficulties that lay behind it.[89] In doing so, these artists are ignoring the fact that art 'encompasses the entire Visible World; and there is scarcely a single art or science of which it is fitting for a Painter to ignore.'[90] In writing this treatise, van Hoogstraten aimed to elevate the status of painting through a didactic text aimed at painters and art lovers alike.

While the *Inleyding* is atypical in the depth of its exploration, compared to Italian art treatises, it nonetheless presents a key resource that can help elucidate the types of perspectival sources artists could have referred to at this time. In the introduction to his first chapter, he stresses the import of art theory, and after naming numerous ancient texts that have not survived to this day, he lingers specifically on the Italian tradition:

> In regard to the Italians, the Florentine, Leon Battista Alberti, wrote three books on the art of painting in Latin, as well as ten books on the art of architecture, along with many others who, as we can say, who were better at this practice.[91]

Notwithstanding van Hoogstraten's mention of Alberti, it is very difficult to pin down the precise relationship between Dutch and Italian art theory in practice, for Dutch authors

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(1707), and Arnold Houbraken's *Groote Schouburgh* (1718), cites and borrows from van Mander's treatise, 'either to revise his theory or to update his history of painters.' W. S. Melion, *Shaping the Netherlandish Canon: Karel van Mander's Schilder-Boeck* (Chicago, 1991), p. xvii.

[89] The following translations are my own and are based on the French translation. S. van Hoogstraten, *Inleyding tot de hooge schoole der schilderkonst (Introduction à la haute école de l'art de peinture, Rotterdam, 1678)*, trans. J. Blanc (Genève, 2006), p. 69. '…la plupart des homes ont fini par considerer que l'art de peinture n'était pour ainsi dire qu'un art ou un métier ordinaire.'

[90] Van Hoogstraten, *Introduction*, p. 69. 'Conséquence: des milliers en sont venus à l'art, ou y ont été amenés, sans sans envisage ne serait-ce qu'une fois toutes les difficultés qu'il suppose, tout comme s'ils abordaient le métier de cordonnier, sans savoir seulement que cet art embrasse le monde visible dans son ensemble, et qu'il n'y a guère d'art ou de science qu'un peintre ne doive ignorer.'

[91] Van Hoogstraten, *Introduction*, pp. 77-78. 'Chez les Italiens, le Florentin Leon Battista Alberti a ecrit trois livres sur l'art de peinture, en latin, ainsi que dix sur l'art d'architecture, avec de nombreux autres qui, comme on a pu le dire, ont ete meilleurs que ce qu'il a pu faire.'

very rarely quoted Italian texts verbatim.[92] However, texts of art theory published in Latin (as many Italians texts were) could easily gain an authoritative position in the European republic of letters. Such is the case with Alberti's *De Pictura*, which would have been a seminal text at this time. In Arthur Wheelock's analysis of perspective and optics in the Delft school, he argues that despite van Hoogstraten's mention of Alberti's name in this treatise, the perspectivist's direct influence on art practices at this time would not have been great.[93] However, Alberti's theories were often incorporated in the perspectival treatises available to the Dutch and 'were an integral component of seventeenth century attitudes towards art.'[94]

In *Inleyding*, van Hoogstraten has very little to say about the practice and methods of perspective, as he focuses more on the effects of the method rather than detailed explanations. In the first section, he discusses the illusory ends that this method can achieve, and marvels that corners and walls can be made to disappear in an astonishing manner through tricks of perspective incorporated in paintings.[95] Furthermore, perspective can change the apparent size of objects or interiors, by giving the impression that something small is quite large and vice versa.[96] Moreover, in order to showcase and

[92] Weststeijn, *The Visible World,* pp. 38-45. Van Hoogstraten may have familiarised himself with Alberti's text outside of Italy, for *De Pictura* was published in Amsterdam in 1649 in a joint edition together with Vitruvius's books on architecture and Gauricus's *De Statua* (1504). As Thijs Weststeijn has discussed in his comprehensive analysis of the *Inleyding*, the subtitle of van Hoogstraten's work, *The Visible World*, corresponds not only to the subject matter of this book, as all that can be rendered in the world in painting, but also differentiates this treatise from its unpublished successor, *De onzichtbare werelt* (*The Invisible World*). Van Hoogstraten's pupil, Arnold Houbraken, writes in the biography of his master that he had in his possession the manuscript of a second treatise. Houbaken states that he planned to publish this work after he had completed his biographies, however this never came to pass and the manuscript was lost.
[93] A. K. Wheelock, *Perspective, Optics, and Delft Artists around 1650* (New York, 1977), p. 25.
[94] Wheelock, *Perspective, Optics, and Delft*, p. 25.
[95] Van Hoogstraten, *Introduction*, p. 414. 'On peut meme peindre les coins et les murs raccourcis de façon à les faire disparaître.'
[96] Van Hoogstraten, *Introduction*, p. 414. 'Grâce à cette connaissance, il est également possible de donner l'impression qu'une pièce petite est très grande…' Van Hoogstraten cites a specific work created by Carel

boast about his skill as a perspectivist, he notes the remarkable effects perspective can achieve when employed in the making of a perspective box: 'By means of perspective,' he writes, 'one can fashion marvellous perspective boxes that when painted wisely, make a figure the size of your finger appear to be life-sized.'[97] Thus, one of the central principles of perspective for van Hoogstraten has not to do with realism or illusionism, but with its potential to adjust visual dimensions. When peering through a perspective box, the inhabitants within are seen as life-size figures, further evincing this art form's deceptive appeal. Like Ames' demonstrations in perception in which participants' bodies are made to look rather gigantic, or comparatively petite, the seventeenth-century perspective box generates the same effect.

While the art of perspective for van Hoogstraten is both necessary and useful for the artist's craft, he writes that because many before him have written about it, he will not spill more ink on the subject. Instead, a list of books on the subject of perspective 'that are resting under my hand' will have to suffice: 'Read if you will Albrecht Durer, Hans Vredeman de Vries, Marolois, Guidobaldo del Monte, or the new work of Desargues.'[98] Two such publications, by Vredeman de Vries and Marolois, are essential to my argument, as in these books I have found compelling evidence of materials that perspective box artists could have drawn inspiration from. After discussing these two works in greater depth, I will also look to several illustrations by Dutch publisher and

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Fabritius that was hung in a brewery owned by Theodorus Vallensis, a Delft surgeon. Jan Blanc has clarified that this piece is no longer extant.

[97] Van Hoogstraten, *Introduction*, p. 415. 'Avec cette connaissance, on fait également de merveilleuses boîtes de perspective qui, lorsqu'elles sont bien peintes et avec sagacité, montrent une figure longue d'un droigt comme si elle était grandeur nature.'

[98] Van Hoogstraten, *Introduction*, p. 416. 'Toutefois, d'autres en ont parlé si largement et de façon si circonstanciée, que cela m'ennuie d'y retrancher ou d'y ajouter ici quelque chose. Et il suffira dans cette *Introduction* mienne que je vous cite tout d'abord une partie des livres que j'ai sous la main. Lisez alors, si cela vous plait, Albrecht Dürer, Hans Vredeman de Vries, Marolois, Guidabaldo del Monte, ou la nouvelle découverte de Desargues.'

engraver Hendrick Hondius, whose work undoubtedly shaped the design of these art forms as well.

Hans Vredeman de Vries' treatise *Perspectiva: die weitberühmte Kunst* (1583) was crucial to the development of perspective boxes due to its original approach to perspectival space. In the latest study on de Vries, Chrisopher Heuer characterises *Perspectiva* as 'a rare Netherlandish source on not just how to make pictures, but how to teach other people about them.'[99] Vredeman De Vries' book presents perspective as syncopated, multi-faceted and as capable of encompassing a bevy of vantage points in one representation, as demonstrated in his print of an imagined interior (fig. 69). This diagram presents a rectangular room with open doors, windows, and a variety of orthogonal lines traversing the space. Two men are in the midst of crossing the thresholds of the doorways while another lies motionless on the ground. Heuer notes how each figure within the space reaches out towards the lines extending throughout the drawing: 'Just as these models are seeing—and being seen—within Vredeman de Vries' diagram, they are also visibly touching the lines and grid that envelop them.'[100] The human figures interact with the perspectival room in a tactile manner: 'This is perspective rooted in the book as experience.'[101]

Alpers has pointed to Vredeman de Vries' sequential treatment of perspectival space as representative of the visual dynamics enacted in van Hoogstraten's perspective

[99] C. Heuer, *The City Rehearsed: Object, Architecture, and Print in the Worlds of Hans Vredeman de Vries* (New York and London, 2009), pp. 167- 168. *Perspectiva* was translated into French, Latin, and German editions, which ensured a wide readership. Particularly, Rembrandt may have owned a copy, and Peter Paul Rubens listed the treatise in his library.
[100] Heuer, *The City Rehearsed*, p. 180.
[101] Heuer, *The City Rehearsed*, p. 180.

box.[102] The method of perspective that Vredeman de Vries and van Hoogstraten espouse is synoptic and encompasses a breadth of vantage points in one representation. The addition of a second peephole in van Hoogstraten's design exponentially increases the number of vanishing points required on the painted panels in order to accommodate the doubled points of view. There is no single point from which the viewer can grasp the entirety of the space. It is as if the observer has stepped into Vredeman de Vries' fictive interior where a multitude of vistas entice the eye to peruse the space in every direction. The multiple vanishing points extending beyond open doors and windows fracture any sense of homogeneity. For Alpers, this is indicative of the polarising methods of Northern and Southern European traditions; the Dutch example presenting multiple points of view, as opposed to a static and fixed perspectival schema as would be demonstrative of an Italian Renaissance painting. [103]

While Vredeman de Vries' treatise was key to enlivening an interest in perspective in the Netherlands in the early modern period, it was not a solitary endeavour. Perspectivist and mathematician Samuel Marolois was responsible for editing Vredeman de Vries' treatise along with publisher Hendrick Hondius. Like Vredeman de Vries', Marolois' treatise, *La Perspective Contenant la Théorie et la Practique d'icelle* (1614), also became one of the most widely read books on perspective in the Netherlands.[104] By the year 1622, the treatise appeared in French, Dutch, Italian, Latin, and German editions,

[102] Alpers, *The Art of Describing*, pp. 58-59. In addition to Alpers, Celeste Brusati has further expanded on the connections between van Hoogstraten's oeuvre and that of Vredeman de Vries', noting that van Hoogstraten is known to have made several paintings reminiscent of Vredeman de Vries's work for English collectors. Brusati, *Artifice and Illusion,* p. 102.
[103] Alpers, *The Art of Describing*, p. 62.
[104] In addition to offering his own theories on the practice of perspective, Marolois also re-published Vredeman de Vries' thesis in the second half of the treatise along with his corrections.

and was re-printed at least nine times.[105] The popularity of Marolois' work on perspective is also evidenced in the writings of English landscape painter Joshua Kirby (1716-1774), who later emphasised its engaging quality despite the dry subject matter: 'This work… though tedious in its Operations, is nevertheless a very curious Performance.'[106]

While *La Perspective* was successful in distributing theories on perspective to a wide Netherlandish audience, it is Marolois' second treatise (which included *La Perspective*), *Opera Mathematica* (1614), which arguably had the most direct impact on perspective box design. In it, Marolois published an innovative technique to mime a flat or curved wall in the corner of a room (fig. 70). We see this technique applied to the two triangular perspective boxes now located in Copenhagen, as well as to the triangular perspective box from the Museum Bredius.[107] In these boxes, the triangular apexes where the side panels meet are made to appear as rectangular. Figure 45 demonstrates the look of the actual spaces from any other vantage point other than the peephole. Figure 46 shows that when looking through the peephole, the tiled floors align and appear linear, lending the interiors a rectangular appearance.

Opera Mathematica also explores the more general approach of the anamorphic technique, and the specific figure Marolois chooses to demonstrate the method speaks to the possibility that the perspective box functions as a treatise of its own, worked out in practice. Marolois uses the portrait of a dog to demonstrate how a figure drawn in

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[105] Wheelock, *Perspective, Optics, and Delft*, p. 12. Marolois prevailed at synthesising many sixteenth century perspectival texts of French, Italian, and German nature. His primary source material included: Jean Cousin's *Livre de la Perspective* (Paris, 1560); Daniel Barbaro's *La Pratica della perspettive* (Venice, 1569); Barozzi da Vignola and Egnatio Danti's *Le due Regole Della Prospettive* (Rome, 1583); Guidobaldo del Monte's *Perspective* (Pisa, 1600); and Albrecht Dürer's *Underweysung der Messung mit dem Zirckel un Richtscheyt* (Nuremburg, 1525).

[106] J. Kirby, *Dr. Brook Taylor's Method of Perspective Made Easy, Both in Theory and in Practice* (Ipswich, 1754), second book, p. 81. As cited in Andersen, *The Geometry of an Art,* p. 309.

[107] See K. Veltman, 'Perspective, Anamorphosis, and Vision', *Marburger Jahrbuch für Kunstwissenschaft* 21 (1986), pp. 99-100.

perspective can be stretched anamorphically (fig. 71). Let us now consider the anamorphic motifs in several of the extant perspective boxes. When looking through the right peephole of van Hoogstraten's perspective box, one encounters the gaze of a small dog, staring up at the viewer as if we have just encroached upon his space (fig. 72). The bottom half of van Hoogstraten's dog is anamorphically stretched, and thus seemingly pops up in the centre of the room when looking through the left peephole. Likewise, when peeping about the Catholic interior of Copenhagen's triangular perspective box, we come across a dog in the left-hand corner lying dotingly beside a desk (fig. 73). The blank space beneath the desk speaks to our position within the scene; it is as if we have pushed back our chair and have turned to our right to face the church interior.

This canine motif is repeated in another treatise on perspective by prominent Netherlandish perspectivist, Hendrick Hondius.[108] As an accomplished engraver and etcher, Hondius has been consistently acknowledged for his authorship of one of the three main perspective treatises available to Dutch artists in the first half of the seventeenth century: *Institutio Artis Perspectivae* (1622).[109] This treatise appeared in both Dutch and French editions, and was attuned to the Dutch artists' want for a more applied and practical guide to the methods of perspective. [110] This book would have likely been used as a hand-held guide for artists, a 'how-to' book replete with examples that a working Netherlandish artist would have come up against repeatedly in the course of their work:

[108] N. Orenstein, *Hendrick Hondius and the Business of Prints in Seventeenth-Century Holland* (Rotterdam, 1996), p. 106. Hendrick Hondius was an especially prominent figure in the realm of early modern Netherlandish publishing, and was responsible for publishing Vredeman de Vries' *Perspectiva* as well as Marolois' *Opera Mathematica,* in addition to engraving several illustrations in both. Orenstein surmises that Hondius and Vredeman de Vries would have become acquainted in Leiden when Hondius was visiting in 1604. This date also corresponds to their first major collaboration.

[109] Curiously, Van Hoogstraten does not mention the likes of Hendrick Hondius in his treatise. However links can be drawn between Hondius' work in the area of perspective and the Netherlandish tradition, both directly through his writing and indirectly through his work with other perspectivists.

[110] Orenstein, *Hendrick Hondius*, p. 116.

household interiors, furniture, and pets, all drawn in perspective, or in a few instances, anamorphically (fig. 74).[111] Placing Hondius' pup next to the dog painted in the Catholic church interior, one notices a very striking resemblance. Amusingly, Hondius' namesake is a Latinised version of the Dutch surname 'De Hondt', which translates as 'dog.'

Portraits of household pets were evidently a popular and highly useful motif to demonstrate the devices of the anamorphic method in seventeenth-century Holland. Thus it should come as no surprise that artists responsible for the illusionistic interiors of perspective boxes would want to imitate these affable creatures. This choice may have carried added meaning, given the role that these pets play in each interior scene. Perspective boxes present the moment when the interior world of representation has been opened to view through a tiny perforation in its encasement. As we peep inside this miniature space, our lone eye goes largely unnoticed save for the attentive animals mirroring our gaze.

VII. The Perspective Box's Perturbed Pets

In the interior scenes of several perspective boxes, the focused gaze of animals greet our eye, such as: a hissing cat who arches her back in aggravation in Detroit's pentagonal box (fig. 75); the dog who stands in the middle of van Hoogstraten's perspective box, seen through the left peephole (fig. 72); and, finally, the cat perched betwixt the voorhuis and the side room in the Copenhagen box (fig. 76). The role of these animals within the perspective box is to call attention to the viewer's presence as voyeur within the scene, and to mirror her interrogative gaze as she peruses these spaces of domestic intimacy. The only other figure within a perspective box who arguably calls

[111] Orenstein, *Hendrick Hondius*, p. 118; Wheelock, *Perspective, Optics, and Delft,* p. 13.

attention to the viewer's status as voyeur is the Peeping Tom. However, as peeping viewers ourselves, we do not meet eyes with this Peeping Tom. He may duplicate our illicit activity, but he does not interrogate us the way the animals do. As the alerted reactions of the animals convey, the viewer is treated as an intruder stepping into a world that existed independently of her. Perspective boxes convey the fragile moment when painted figures within an illusory space catch sight of the spectator's presence, which fosters a level of self-awareness that merits expansion.

The perspective box's inquisitive pets are akin to a number of perspective paintings that van Hoogstraten created throughout his career. A prime example is his full-scale *trompe l'oeil* piece *View from a Threshold* (fig. 77), which originally hung behind a door in the home of Thomas Povey, Secretary to the Duke of York and a member of the Royal Society.[112] This painting was intended to hang behind a closed door in Povey's dwellings, and could therefore only be enjoyed when the door was opened; the deceit 'hinged quite literally' upon Povey's action.[113] By opening the door, Povey would amaze his guests with this fabricated world. As such, this *trompe l'oeil* functions as a kind of box in need of opening before the painting can enchant the guests with trickery. In this way, van Hoogstraten situates the spectator on the threshold of the world seen and the world of the artist's making.

The black columns framing van Hoogstraten's scene outline the boundaries between these two worlds. Moving up along the sides of the painting, they meet at a rounded ornate arch from which a birdcage hangs. The parrot perched on the edges of its enclosure exemplifies the larger contextual meaning of the piece as a whole, bestriding a

[112] Brusati, 'Honourable Deceptions', p. 55.
[113] Brusati, *Artifice and Illusion,* p. 201.

threshold. Paired with the attentive dog beneath the columns and the alert cat near the doorway of the second room, van Hoogstraten's *trompe l'oeil* returns the gaze of the viewer. Aware of our presence, the figures in these pieces stop to look, as in the perspective boxes, which implicates us 'within the picture's representational fiction.'[114]

Indeed, the silent gazes of beings incapable of speech serve a key purpose. In *The Animal That Therefore I Am* (1997), Jacques Derrida's sustained meditation on the role of the animal in philosophy, he addresses a humorous conundrum in regard to the feelings of shame and modesty before a household pet. How, 'when, caught naked, in silence, by the gaze of an animal, for example the eyes of a cat, I have trouble, yes, a bad time overcoming my embarrassment.'[115] Derrida explains how the 'impropriety' felt when standing naked before another animal that is—by its very nature—naked at all times, is, of course, self-imposed. For once reason has dictated that the animal is unaware of his or her own nakedness, and hence not at all cognisant of any behavioural line dividing proper and improper, we realise that the onus of impropriety is self-inflicted:

> ...one might call it a kind of animalseance: the single, incomparable and original experience of the impropriety that would come from appearing in truth naked, in front of the insistent gaze of the animal, a benevolent or pitiless gaze, surprised or cognizant. The gaze of a seer, visionary, or extra-lucid blind person. It is as if I were ashamed, therefore, naked in front of this cat, but also ashamed for being ashamed.[116]

It is this moment of interaction that spurs Derrida's questions on the line drawn between human and animal, between consciousness and unawareness. I propose that a similar

[114] Brusati, *Artifice and Illusion,* p. 203.
[115] J. Derrida, 'The Animal That Therefore I Am', trans. D. Willis, *Critical Inquiry* 28 (Winter 2002), p. 372.
[116] Derrida, 'The Animal', p. 372.

dynamic occurs when looking into these perspective boxes; we are made to feel ashamed of our indecent peeping.

The reflex of shame and embarrassment that incites Derrida to question the very foundations of self and other are reminiscent of Jean-Paul Sartre's theories of looking in *Being and Otherness* (1943), which he primarily bases on the voyeuristic model of peephole vision. For Derrida, the animal acts as the third party that calls the viewer's impropriety into question, and renders her aware of her status as a voyeur. For Sartre, the shame one feels when caught by the Other in an inappropriate scenario functions as recognition: 'I recognize that I *am* as the Other sees me.'[117] This awareness derives from a specific phenomenological act; it derives from the 'Look.' Sartre concretises this point by means of an intriguing example. He asks us to imagine a moment of furtive looking, such as peeping through the keyhole of a closed door. Behind the door a spectacle is presented 'to be seen,' and a conversation 'to be heard.' [118] He notes that the physical attributes of the door and the keyhole form an interesting duality as 'instruments and obstacles' lying between his gaze and the spectacle beyond the walls. By looking through and listening in as a lone voyeur, the solitude negates self-awareness. Sartre's character loses sight of the space he currently occupies while engrossed in the act of peeping. What is more, the peephole physically signifies the observer's departure from the world he currently inhabits in order to occupy the hidden, secret space beyond. In this scenario, peeping is defined as:

> …a pure process of relating the instrument (the keyhole) to the end to be attained (the spectacle to be seen), a put mode of losing myself in the world, of causing

[117] J.P. Sartre, *Being and Nothingness*: *An Essay on Phenomenological Ontology,* trans. H. E. Barnes (London, 2001), p. 222.
[118] Sartre, *Being and Nothingness*, p. 222.

> myself to be drunk in by things as ink is by a blotter in order that an instrumental-complex oriented toward order is the reverse of causal order.[119]

All-consumed by the spectacle before his eye, and compelled by the keyhole before him, Sartre's voyeur is both physically absorbed in this act and also absolved from the moral implications that accompany it.

In Sartre's scenario, this moment of furtive looking is eclipsed by the sound of footsteps down the hall. The presence of another person awakens self-awareness in the voyeur, which he was previously shielded from when solitary: 'I see *myself* because somebody sees me—as it is usually expressed.'[120] The shame that follows from another's presence, or look, is not necessarily caused by the realisation that the person has been caught in the act of spying. Instead, the significance of the Other's look is 'that of an action,' in that I am now made aware that I, too, am an object to be seen, an object under the gaze of the look from the Other.[121]

The knowing stare on the part of the animals scattered within the perspective boxes imparts a self-reflective dynamic that is akin to Sartre's peeping moment at the keyhole. The animals emit a look that startles the viewer, which mirrors their perturbed behavior as we catch them unawares. However, in contrast to Sartre's peeping observer, the perspective box's viewer attains an awareness of her status as 'object to be seen' when looking into the confines of the box. The Other that calls into question our own impropriety does not exist in the realm of our physical world, but in the space of the painted representation, in the realm of artifice. Moreover, while the perspective box may first appeal to a viewer's desire for solitary gazing and voyeuristic peeping, she is never

[119] Sartre, *Being and Nothingness*, p. 222.
[120] Sartre, *Being and Nothingness*, p. 260.
[121] S. Gardener, *Sartre's 'Being and Nothingness': A Reader's Guide* (London and New York, 2009), p. 136.

far from the unsettling effects of the aural presence of others. When looking inside the box, the sounds of footsteps of those waiting to take a peek, or those within the vicinity, would no doubt be heard. While viewers are guaranteed visual solitude when peeping into the box, they are in no way freed from the audible world in which they inhabit. The disturbed pets within each scene hint to this, and arguably rattle any pre-conceived notions of privacy and illicit peeping one may have had before looking in.

Driving this point home, the inclusion of a second peephole in van Hoogstraten's perspective box invites a potential second observer to enjoy the interior scene concurrently. Peering through both peepholes simultaneously, the viewers' eyes would be figuratively mirrored by the eye of the opposing spectator. Akin to Brunelleschi's painted panel demonstration, where the device of the mirror reflects the pupil of the peeping spectator back towards herself, a similar dynamic occurs when looking through van Hoogstraten's perspective box when eye-to-eye with the second onlooker. While Brunelleschi's painted panel experiment assured a unification of surfaces within the space of the peephole, here, too, the perspectival and anamorphic illusions align through a hole cut into a (multi-panelled) painting.

If startled characters meet your gaze when peeping into a perspective box, what precisely compels the viewer to peek into such intimate spaces? As the next section of this chapter argues, the appeal of the home in miniature form offers a compelling visual respite for the viewer, and enlivens a particular fantasy that is both comforting and desirable. As will be shown, the impulse towards creating, acquiring, and gazing within miniature versions of private dwellings is expressed in the popularity of Dutch

dollshouses in this period. The significance of these spaces of miniaturised domestic intimacy will be analysed through the theories of philosopher Gaston Bachelard.

VIII. Miniaturization and Interiority: Perspective Boxes as Emblems of Bachelard's 'Hut Fantasy'

When gazing into the domestic interior of a perspective box, it is easy to draw comparisons between the miniaturised world presented and the microcosmic, stunningly intricate interiors of early modern Dutch dollshouses. Popular amongst upper-middle and merchant classes in the second half of the 17th century, dollshouses were made—despite what one might assume—for adult women, not for children.[122] Like perspective boxes, the exteriors of these pieces were often adorned to look like cabinets. Inside, meticulously arranged rooms convey down to the minutest of detail the interior spaces of a seventeenth-century Dutch home. Interestingly, like perspective boxes, there exist only six extant examples of large-scale Dutch dollshouses to date.

An example of this art form belonged to Petronella Oortman (1656-1716) and is currently housed in the Rijksmuseum (fig. 78 & 79). The cabinet was likely constructed between the years 1686-1690, with the miniature furniture taking an additional fifteen years to complete. In regard to the figurines accompanying the piece, only the baby has survived.[123] In and amongst ornate golden frames and intricate wallpaper patterns, are fragile objects made from such expensive materials as ivory, porcelain, and glass. The

[122] J. Pijzel-Dommisse, *The 17th Century Dolls Houses of the Rijksmuseum* (Amsterdam, 1994), p. 6.
[123] Pijzel-Dommisse, *Dolls Houses*, p. 8.

contents of these dollshouses are attributed to a combined workforce of skilled craftsmen such as painters, cabinet-makers, glassblowers, and sculptors.[124]

Oortman's dollshouse contains a total of nine rooms, centered on a small entry-way, or *voorhuis*, which acts as a conduit to more private spaces of the home.[125] The *voorhuis* contains four doors that give access to the other nine rooms of the home. According to Martha Hollander, scenes of the *voorhuis* were extremely popular among Dutch artists in this time period due to its unique character as both public and private space.[126] Indeed, the *voorhuis* was designed for both comings and goings, connecting the deep interior of the home with the public street beyond, delineating the boundaries of exterior and interior. It is this liminal space that Copenhagen's perspective box of a Dutch interior and van Hoogstraten's London perspective box adopt as their central motif. The *voorhuis* is quite suitable for perspective boxes for it offers both a central scene, or room, as well as peeks of more private rooms within the recesses of the home. In Copenhagen's domestic interior, we are greeted by the home's occupants, and are also privy to views into the courtyard on the left, the open door at the front of the home, and a view into two rooms on the right. The space is vast and quite barren, dominated largely by the tiled floor. This is not a room to be dwelled in, but a space of passing through.

The Dutch artist Jacob Appel painted Oortman's dollshouse shortly after its completion in 1710 (fig. 80). This piece is an inimitable rendition, and exhibits the number of figurines and the arrangement of furniture within the home. As a painted

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[124] J. Pijzel-Dommisse, *Het hollandse pronkpoppenhuis: interieur en huishouden in de 17de en 18de eeuw* (Zwolle, 2000), pp. 247-329. Pijzel-Dommisse offers a detailed investigation of Oortman's dollshouse, including detailed images of each piece of furniture. Due to the tremendous labour required for their construction, dollshouses were expensive and hence only commissioned by upper-class Dutch families.
[125] Pijzel-Dommisse, *Dolls Houses,* p. 18. Intriguingly, this *voorhuis* displays a number of grisaille paintings, likely painted by a pupil of Gerard de Lairesse
[126] M. Hollander, *An Entrance for the Eyes: Space and Meaning in Seventeenth-Century Dutch Art* (Berkeley, 2002), p. 184.

portrayal of a miniaturised space, Appel's painting evinces the level of intrigue and absorption existing around miniature representations of the home in this period. In *On Longing: Narratives of the Miniature, the Gigantic, the Souvenir, the Collection* (1993), Susan Stewart characterises the dollshouse as the most consummate of miniatures: 'Occupying a space within an enclosed space, the dollshouse's aptest analogy is the locket or the secret recesses of the heart: center within center, within within within.'[127] Stewart discloses that what we as viewers ultimately seek when perusing these interior spaces is the dollshouse within the dollshouse. We yearn for impeccable, impenetrable interiority:

> As private property marked by the differentiations of privacy and privatizing functions (bathrooms, maids' rooms, dining rooms, halls, parlors and chambers) and characterized by attention to ornaments and detail to the point of excruciation (the hand of the artisan, the eye of the beholder), the dollshouse erases all but the frontal view; its appearance is the realization of the self as property, the body as container of objects, perpetual and incontaminable.[128]

As a house within a home, a miniaturised world mirroring the very space in which it inhabits, it could be said that the dollshouse is the perspective box's sister art form, materially demonstrating the vogue in this particular time period for spaces of domestic intimacy. As Hollander argues, both dollshouses and perspective boxes profited from 'a basic visual craving' to look inside a home.[129] Hollander's analysis of the relationship between perspective boxes and dollshouses also extends to the early modern collector's cabinet. The basis for this connection is found in the collector's cabinet's hidden drawers and exterior painted perspectives; in this case a large part of the viewer's enjoyment

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[127] S. Stewart, *On Longing: Narratives of the Miniature, the Gigantic, the Souvenir, the Collection* (Durham and London, 1993), p. 62.
[128] Stewart, *On Longing,* p. 62.
[129] Hollander, *Entrance for the Eyes,* p. 126. For a comprehensive visual study of home interiors in the history of painting see also, F. Borzello, *At Home: The Domestic Interior in Art* (London, 2006).

derives from handling the pieces within, whereas the perspective box and dollshouse's viewers delighted largely in the three-dimensional rendition of the home itself.[130]

What distinguishes the perspective box from the dollshouse is the inclusion of a peephole, which works to exclude other spectators and the observer's second eye. Hence, vision is reduced in a two-fold manner: first, by limiting perception to a monocular mode, and second, by prohibiting movement of the head. Looking into a perspective box is dually an enjoyable and frustrating experience. There is only so much the observer can see before she is compelled to switch eyes, tilt her head, or curse her protruding nose that is inevitably squished flat on the exterior panel in an effort to get a closer look. Despite these inconveniences, the peephole lends the perspective box a certain level of appeal. Due to the constriction of the eye in the peephole there is no room for juxtaposition or comparison between the lived space the viewer inhabits and the microcosmic world that opens up before her. When gazing within, the perspective box's interior scene is hers alone. By isolating the eye in the peephole, the viewer is, likewise, isolated.

It is this particular combination of delight and privacy fostered by the restrictive quality of the peephole that I see as a reification of Gaston Bachelard's theories on the 'hut fantasy' in *The Poetics of Space* (1958). Through an investigation of poetry, folktale, and psychology, Bachelard meditates on the desire to 'inhabit' secluded sites of refuge such as our childhood home or secluded cabins, often in our daydreams. As Bachelard writes, 'When we are lost in darkness and see a distant glimmer of light, who does not dream of a thatched cottage or, to go more deeply still into legend, of a hermit's hut?'[131] For Bachelard, the essence of the hut fantasy is synonymous with the verb 'to inhabit': it

[130] Hollander, *Entrance for the Eyes,* pp. 126-127.
[131] G. Bachelard, *The Poetics of Space: The Classic Look at How We Experience Intimate Places,* trans. Maria Jolas (Boston, 1994), p. 31.

is quite simply the desire to seek out intimate, private sanctuaries. The hut is 'centralized solititude,' for, in this imaginary space, there is no 'adjoining hut', here the hermit is alone before God.[132]

The 'hut fantasy' is distinguishable from escapist forms of daydreams that involve the desire to be elsewhere, of looking beyond the confines of one's own surroundings. As such, it is qualified by a movement inwards, as a yearning for refuge within a space currently occupied. In order to illustrate this distinction, Bachelard points to a story written by twentieth-century French author Henri Bachelin, who reflects upon an afternoon seated in the living room of his childhood home:

> I delighted in imagining that we were living in the heart of the woods, in the well-heated hut of charcoal burners; I even hoped to hear wolves sharpening their claws on the heavy granite slab that formed our doorstep. But our house replaced the hut for me, it sheltered me from hunger and cold; and if I shivered, it was merely from well-being. [133]

The daydream of this secluded and secure hut is re-integrated into the presently occupied domestic interior. This imaginary space is an incorporation of the exterior 'site of refuge' within the confines of the home itself. How many dwellings would there be, asks Bachelard, 'fitted one into the other, if we were to realise in detail, and in their hierarchical order, all the images by means of which we live our daydreams of intimacy.'[134]

Integral to Bachelard's description of the hermit's hut, is the light set by its window that reveals the hut's presence to those at a distance. This singular light, this

[132] Bachelard, *Poetics of Space*, p. 32.
[133] Bachelard, *Poetics of Space*, p. 31.
[134] Bachelard, *Poetics of Space*, p. 31.

candle or lamp, which glows in the window, 'stands as the house's eye.'[135] As he articulates, by means of this light the hut keeps vigil and is, in turn, vigilant:

> When I let myself drift into the intoxication of inverting daydreams and reality, that faraway house with its light becomes for me, before me, a house that is looking out—its turn now!—through the keyhole.[136]

The hut of Bachelard's daydreams, like the consummate illusion set forth by the perspective box, is illuminated, revealed, and uncovered by means of a keyhole (or, in the perspective box's case, the peephole). One's desire to seek refuge and inhabit a cloistered domestic space is facilitated by an illuminating aperture that seeks us in return.

As shown, four out of the six extant perspective boxes specifically depict the interior of a seventeenth-century Dutch home. In two instances, the space represented is that of the *voorhuis*, or entrance-way, where the viewer is privy to slices, or peeks of more intimate spaces such as the bedrooms and living area beyond the front room. In the other two instances, we have permeated further into the home, and are either welcomed to tea, or are responsible for startling the domestic pets lurking about the dinner table. In these instances, a doubling or mirroring is taking place, for it is highly likely the owner of such pieces inhabited similar dwellings. While there is scant evidence available to attribute these interiors, it has been argued that in the case of van Hoogstraten's perspective box, he has in fact cleverly codified this space as *his* home by means of certain motifs: under the chair in the left hand corner rests a letter addressed to van Hoogstraten himself; a portrait containing the van Hoogstraten family crest hangs just to

[135] Bachelard, *Poetics of Space*, p. 31.
[136] Bachelard, *Poetics of Space*, p. 34.

the left of the bedroom door; and he has included his wife's family's coat of arms in the window visible in the room at the far left beyond the bedroom.[137]

For Bachelard, visual representations of homes offer means of reprieve for those seeking solitude. Contemplating the significance of the descriptions or 'pictures' of houses found in his reading, he writes that these spaces are more than mere representation for they invite habitation:

> And so I am cheered by the pictures I find in my reading. I go to live in the 'literary prints' poets offer me. The more simple the engraved house the more it fires my imagination as an inhabitant. It does not remain a mere 'representation.' Its lines have *force* and, as a shelter, it is *fortifying.* It asks to be lived in simply with all the *security* that *simplicity* gives. The print house awakens a *feeling for the hut* in me and, through it, I re-experience the *penetrating gaze* of the *little window.*[138]

Seventeenth-century Dutch perspective boxes as well as their sister art-forms, Dutch dollshouses, assuage the desire enlivened in our daydreams to inhabit a miniaturised version of 'home'. The perspective box and dollshouse appeal can be linked to feelings of comfort and nostalgia that are felt exponentially when the home is presented as a miniature. The combination of an 'impenetrable' enclosed space coupled with the subject matter of a Dutch domestic interior renders the perspective box, like the dollshouse, especially bewitching.

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[137] See Brusati, *Artifice and Illusion,* p. 177; and J. Wooddall, 'Love is in the air—Amor as motivation and message in seventeenth-century Netherlandish painting', *Art History* 19, no. 2 (June 1996), pp. 211-217. Woodall not only points to the manner in which van Hoogstraten has claimed this space as his own, but also connects the exterior panels of the perspective box (presenting the motives of love, profit, and honour, as well as the anamorphically rendered image of Erato and Cupid in bed on the top panel) to van Hoogstraten's motivation as a painter. This 'trinity of motivations' was widespread in early modern Holland, according to Woodall, and points to the import of love as the 'origin and object of pictorial representation' in this period.

[138] Bachelard, *Poetics of Space*, p. 50.

IX. Conclusion: The Perspective Box's Immobile Inhabitants

Despite many commonalities between the dollshouse and the perspective box, one glaring difference is obviously the mobility of the dollshouse's furniture and figurines. Moving figures around, grouping them in different locations and combinations, affords the dollshouse a certain level of flexibility in terms of prescribed meaning. In addition to the meticulous, somewhat obsessive detail adorning both perspective boxes and dollshouses, a particularly intriguing aspect of the Copenhagen perspective box has urged me to scrutinise this kinship. Upon close inspection of the Copenhagen perspective box, I have found that each painted figure has been cut from some primary material and conspicuously glued in place (figs. 81-84). This only holds true for the people and pets; no other object within the scene has been glued in this manner.

This peculiarity adds a puzzling new dimension to this perspective box. It could be said that these pieces were glued on to fix certain 'fudged' or incorrectly painted areas. In Erwin Panofsky's *Perspective as Symbolic Form* (1927), he explains how skewed areas of a pre-perspectival painting were often masked in clever ways:

> Already in Antiquity, but then above all in the late middle Ages, when this construction was revived in many parts of Europe, such awkward discrepancies were concealed by an escutcheon, a festoon, a bit of drapery or some other perspectival fig leaf.[139]

Panofsky's turn of phrase, 'perspectival fig leaf', is noteworthy. Here, geometric discrepancies are treated as areas of the work that should be concealed as the 'private parts of the painting.'[140] The cut out figures added to Copenhagen's perspective box

[139] E. Panofsky, *Perspective as Symbolic Form*, trans. C. Wood (New York, 1991), p. 40.
[140] H. Grootenboer, *The Rhetoric of Perspective: Realism and Illusionism in Seventeenth-Century Dutch Still-Life Painting* (Chicago and London, 2005), p. 115.

could very well have acted as such 'perspectival fig leafs', treated as drapery to cover an error that would have otherwise thrown the comprehensive illusion off.[141]

This argument seems to hold true if we consider the cut out motif of the birdcage (fig. 82). While the chain on which the cage hangs is painted on the original wooden panel, the cage itself is not in accordance with the scene around it. This could have been a second attempt at this particular vignette. However, if we take a closer look at the figures in the foreground of the box, notably the gentleman, we can see that part of his left arm has peeled away, revealing a continuous, neutral space beneath (fig. 83). Evidently, he was glued on after the interior as a whole was painted. Thus, were the human figures, like their dollshouse counterparts, subject to the whims of their fanciful owners? Or were they used to cover aspects of the interior that did not quite fit the illusion? Were they second takes on the perspective of the scene?

It is possible that the artist involved in the construction of the Copenhagen perspective box first presented a bare interior to his clientele and then went about creating figures to match his prospective buyers. Or, that another artist added the figures at a later time. This would explain why the figures seem somewhat out of place in the perspective of the room. Taken in this way, the originally unoccupied Copenhagen perspective box bears a striking resemblance to a painting by the artist of the Bredius Museum

[141] Such perspectival 'cover ups' are also evident in van Hoogstraten's perspective box. As Andersen has noted, the presence of two peepholes in this piece makes for an interesting conundrum when it comes to areas that should remain continuous between the two points of view: that of the ceiling, tiled floor, and back panel. These areas present a geometrical problem since here van Hoogstraten had to create perspectival projections that can be seen from two points of view that are very quite a distance apart. In regard to the bottom panel, van Hoogstraten's means of camouflaging the discrepancy was to use a tiled floor that culminates in the center, thus providing an even appearance from both ends. Furthermore, the furniture in the central room (the first room visible from both peepholes) is largely projected on the right and left panels, not on the bottom, which ensures that when looking from one of the peepholes, the viewer does not see the items directly beneath. Andersen, *Geometry of an Art,* pp. 314- 317.

perspective box, Pieter Elinga. In *Room Without Figures* (fig. 85), Elinga has depicted the interior of a Dutch home void of figures occupying the space. In this painting, a bare room takes centre stage as if abandoned by its dwellers.[142]

Returning to Copenhagen's perspective boxes, it is vital to stress that unlike the dollshouse, the perspective box permits only a handful of possible locations for its figures. They cannot be placed anywhere within the scene for they must follow the prescribed scale of the perspectival schema, receding into depth in a believable, true-to-life manner. Thus, whether glued on as an after-thought, or considered throughout the execution of the piece, these figures are, in every respect, immobilised by geometry, held captive by the exacting quality of the peephole.

The perplexing, ghostly figures, peeling along the walls of the Copenhagen perspective box illuminate the restrictive quality of perspectival peeping. Under the watchful gaze of the lone eye looking through the peephole, the figures within this scene are bound to the confines of their home. In turn, by isolating the eye and offering an experience that is fundamentally individual, the perspective box predetermines, focuses, and controls what is to be seen. In this way, the perspective box further reifies Stewart's theories on the miniature. According to Stewart, the miniature describes what can be seen from a narrow and fixed point of origin, 'a place to begin in this gliding across the unruffled surface of things.'[143] It is in this manner that visual descriptions have the capacity to illustrate depth of field, for 'perspective in narrative is always dependent upon the intrinsically ideological stance of point of view.'[144] While the perspective box itself is

[142] For details on this painting, see L. Kremple, R. Lauter, and J. Nicolaisen (eds.), *Camera Elinga: Pieter Janssens begegnet Jeff Wall*, exh. cat. (Frankfurt, 2002).
[143] Stewart, *On Longing,* p. 51.
[144] Stewart, *On Longing,* p. 51.

not miniature in appearance, it manages to portray a sprawling space punctuated with thresholds, people, and pets, from a restricted point of view from a fixed point of origin. Hence, the perspective box fulfils a collective daydream:

> That the world of things can open itself up to reveal a secret life—indeed, to reveal a set of actions and hence a narrativity and history outside the given field of perception—is a constant daydream that the miniature presents. This is the daydream of the microscope: the daydream of life inside life, of significance multiplied infinitely *within* significance.[145]

By hiding their interior display behind the artifice of a cabinet-like structure, perspective boxes entice and delight their viewers by ensuring that the microcosmic world depicted within is for their eyes, for their *eye*, only.

In the next chapter, we will see how the visual intimacy established between the observer and peep-box-like structures is manipulated to ludic ends when a mirror is integrated into the design. Like the perspective box, catoptric devices were coveted items in many early modern collections. As we will see, there is evidence to suggest that mirrors were sometimes incorporated into peep-boxes to dazzle similar audiences that would have frequented Kunstkammern. The next chapter raises the question: What type of visual dynamic would take place if we were to place a mirror within the confines of something akin to a perspective box? What could one glean by peeping within?

[145] Stewart, *On Longing,* p. 54.

Chapter 3

SPIRITUAL STUDY, COLLECTORS' KEEPSAKES, AND METAPHORICAL WIT: JEAN DUBREUIL'S MONOCULAR OPTICAL ILLUSIONS

I. Introduction

In Jean Dubreuil's (1602-1670) treatise *La Perspective Pratique* (*The Practice of Perspective*) (1649),[1] a set of four unusual boxes compels closer scrutiny (fig. 86). Without referring to the text, there is little one can infer as to the purpose of each piece. While the top pair of boxes contains miniature vignettes, the bottom two are completely empty, rather circumspect in their sheer banality. Perusing the text, it becomes clear that each of these four cabinets sets the stage for a remarkable spectacle. Lined with mirrors on nearly every interior panel, these chests are capable of multiplying any number of objects or painted scenes placed within their confines through the effect of catoptrics: the phenomenon of reflecting light off of mirrored surfaces in the aim of creating a new image or reforming a distorted scheme.

Originating from Book III of *Perspective Pratique,* these pieces demonstrate the mirror's potential for spectacular feats of illusionism. Catoptric illusions rely on the devices of flat, conical, pyramidal, or cylindrical mirrors to reveal a new image, and are sometimes referred to as mirror anamorphoses. The earliest extant illustration designed for catoptric effect was created by Jean-François Niceron, and shows a distorted portrait

[1] While the first and second books of *Perspective Pratique* were translated into English in 1710 and 1743, Book III on catoptric and dioptric illusions published in 1649 has yet to be translated. All of the subsequent English translations from Dubreuil's third book are my own.

of Catholic scholar Jacques d'Auzoles, author of *Mercure Charitable* (1638) (fig. 87).[2] In *La Perspective Curieuse* (1652), Niceron, defines catoptrics as 'the manner of constructing figures which cohere and represent by reflection something completely different from what they appear to be when viewed directly.'[3] Two extant seventeenth-century pieces housed in the Museo Galileo, Florence illustrate the visual game. Figure 88 shows how a cylindrical mirror realigns the chaotic shape placed at its feet, thereby manifesting an ambling peasant struggling to balance two buckets held in each hand. The second catoptric mirror in this collection reflects a series of fifty-six dice fanned out around a cylinder, and reorganises the schema linearly into seven rows of eight upon the mirror's surface (fig. 89). We can presume that this anamorphosis represents a mathematical riddle, as the order of the dice and the amount on each face follow a certain pattern.[4]

Unlike anamorphic, or elongated perspective, the reconstituted catoptric illusion and its distorted sister image can be seen simultaneously, not requiring the viewer to move about or shift his position. Dubreuil's *Perspective Pratique* peruses catoptrics with marked vigour, presenting a particularly rich collection of imagined demonstrations from architectural illusions, to table-top amusements, to peep-boxes lined with mirrors; turning the pages of the treatise is akin to walking through an imaginary funhouse where surprises lurk around every corner or call to you from above. Unlike most extant

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[2] This catoptric design was made when Niceron was just eighteen years old. For more on the image see P.J.S. Whitmore, *The Order of Minims in Seventeenth-Century France* (The Hague, 1967), p. 156; and Baltrušaitis, *Anamorphic Art*, p. 147.

[3] J. F. Niceron, *La Perspective Curieuse du Reverend P. Niceron Minime. Divisée en quatre livres avec l'optique et La catoptrique du R.P.. Mersenne du mesme Ordre, mise en lumiere après la mort de l'Autheur* (Paris, 1652), pp. 147-149. '…la maniere de construire des figures qui rapportent & representent par reflexion tout autre chose qu ce qu'elles paroissent estans veuës directement.'

[4] For a discussion on contemporary designs of mirror anamorphoses and their potential for creating visual games, see H. Hamngren, 'My Anamorphoses: Types That Produce Three Kinds of Images in Circular Cylindrical Mirrors', *Leonardo* 14, no. 3 (Summer 1981), pp. 198-201.

examples, the mirror anamorphoses presented in Dubreuil's treatise are designed to be viewed monocularly. Indeed, *Perspective Pratique* presents the only seventeenth-century publication on perspective to capitalise on the illusory prowess of monocular vision for catoptric purposes, whether through peepholes, sighting devices, or through the observer's own hands. As such, the exercises presented within *Perspective Pratique* offer a poignant case study of the application of monocular methods of viewing when paired with mirrored illusions. In each case, the peepholes and apertures enhance the playful, intimate, and physical quality of the illusion: they stir curiosity, prompt a line of questioning as to how they are constructed, all the while providing the observer with a visually intimate space which obliges movement and tactile interaction.

In this chapter I contextualise Dubreuil's theoretical demonstrations by examining the religious, political, and domestic spheres in which catoptric illusions would have circulated. Catoptric illusions functioned as a form of social and intellectual play in the early modern period and were used as mediums for scientific learning, religious and political didacticism, and as clever purveyors of class and wealth. As I propose, the peep-boxes illustrated in Dubreuil's text functioned as designs for drawers to seventeenth-century art cabinets—pieces of furniture that were used to house one's prized possessions in cabinets of curiosity and Kunstkammern. Dubreuil's monocular amendment to the art cabinet changes the viewing experience of the interior in an intimate manner, similar to Dutch perspective boxes, but with the focus on spectacle and theatricality.

In the first section of this chapter, I demonstrate how the catoptric demonstrations illustrated and discussed in Dubreuil's treatise are a unique case study where monocular viewing conditions are stressed. Following, the religious significance of catoptric

exercises will be shared through an exploration of the Jesuit Order's use of imagery. In regard to the spaces in which catoptric devices were encountered, Athanasius Kircher's museum at the Collegio Romano will be discussed. Following, I demonstrate how optical illusions function as a form of social and intellectual play in the early modern period by comparing Dubreuil's peep-boxes to several examples of mirrored art cabinets that circulated in early modern European markets. In the final section, I explore the role of optical illusions more generally as clever conduits for political allegory by relating the catoptric mirror's potential for metaphor with the dioptric 'perspective tube', an illusory device that relies exclusively on the stationary and occluding character of monocular vision. As I argue, these monocular catoptric and dioptric games stand at the apex of various forms of perspectival wit. In confining the trick within a peep-box or viewing tube, these illusions are distilled forms of perspectival entertainment.

II. *Practical Perspective*'s Monocular Catoptrics

Dubreuil's *Perspective Pratique* reached a wide audience in early modern Europe; it was reprinted three times in French, and subsequently translated into German and English.[5] The goal of the treatise was to teach the discipline of perspective without overwhelming the reader with complicated theory. This does not mean Dubreuil was oblivious to more mathematical theories; in his preface, he pays homage to the perspectivists who influenced his work, calling them 'all my private thefts,' including Dutch artist and perspectivist Hans Vredeman de Vries (1527-1607), Italian architect and theorist Sebastiano Serlio (1475-1554), Dutch mathematician and perspectivist Samuel

[5] The German edition was published in 1672 and the English translation saw two editions: the first in 1710, and the next in 1726.

Marolois (1572-1627), and Italian painter and architect Pietro Accolti (1579-1642).[6] For the most part, unlike many seventeenth-century perspective treatises, *Perspective Pratique* contains a vast number of images over text, indicating that Dubreuil was not only teaching perspective through demonstration rather than explication, but also, as I will show, making a visual argument about it.

The catoptric exercises that populate the treatise prove the mirror's duplicitous potential. It should be noted that historically, early modern mirrors were not as luminous as they are today. Prior to the sixteenth century, mirrors were convex in shape, small in scale, and were mainly fashioned out of dark, greenish glass. By the seventeenth century, advances in glass-blowing technology resulted in mirrors that closely resemble the kind we use presently, both in terms of the quality of their reflection and the variability in size.[7] Despite these advances, the mirror's legacy as a fairly inconsistent reflective technology (in both surface clarity and convexity) meant that it was both trusted as a lucid reflector of the natural world and mistrusted as counterfeit.[8] Hence, the enthusiasm for early modern mirrors stems both from their replicating mimesis and as games that 'enabled imaginative play.'[9] Catoptric mirrors toy with our belief in the mirror's

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[6] J. Dubreuil, *La Perspective Pratique, Necessaire a Tous Peintres, Graveurs, Sculpteurs, Architectes, Opheures, Brodeurs, Tapissiers, & autres qui se mettent de desseigner* (Paris, 1642), p. vii.

[7] In 1507, the Venetians developed a method of clarifying blown glass that quickly proliferated around Europe. This resulted in clearer reflective surfaces. For more on the development of early modern mirrors, see S. J. Schechner, 'Between Knowing and Doing: Mirrors and Their Imperfections in the Renaissance', *Early Science and Medicine* 10, no. 2 (May 2005), p. 151. For an account of the early modern mirror as ornament and as a model of self-fashioning, see D. Shuger, 'The 'I' of the Beholder: Renaissance Mirrors and the Reflexive Mind', in P. Fumerton and S. Hunt (eds.), *Renaissance Culture and the Everyday* (Philadelphia, 1998), p. 21.

[8] See J. Cranston, *The Poetics of Portraiture in the Italian Renaissance* (Cambridge, 2000), pp. 151-152; and F. Tudor, '"All in him selfe as in a glass he sees": Mirrors and Vision in the Renaissance', in J. S. Hendrix and C. H. Carman (eds.), *Renaissance Theories of Vision* (Farnham, 2010), p. 175. Tudor elaborates that the cloudiness of the reflection, paired with spotty surfaces, mean that the mirror was seen simultaneously as a deceitful technology prone to distortions, and as a truthful replication.

[9] A. M. Cohen, *Shakespeare and Technology: Dramatizing Early Modern Technological Revolutions* (New York, 2006), p. 163.

transparency, and in a way speak to its history as both a reflection of reality and a potential source of distortion. These devices are trusted to right the skewed schemas surrounding them, and yet, paradoxically, are also responsible for deforming these designs to such a degree that they appear completely transformed in the mirror's reflection.

The frontispiece to Book III of *Perspective Pratique* acts as an annotated glimpse into the exercises that populate its pages (fig. 90). As if on a playground, a group of putti gleefully engage with a number of illusions strewn about the space. In the left-hand corner, two putti play with a pyramidal mirror, one hovering directly over its apex holding a cupped hand to his eye, the second gazing directly at the first, seemingly imploring him to share what he sees from this point of view (fig. 91). Beneath this scene, another putto holds a monocular viewing device and looks out towards a panel resting against a table, where a pyramidal cone is fixed and erected perpendicularly. In the foreground to the right, two tiny winged figures toy with a pentagonal block fastened to a table (fig. 92). As one looks out towards the block through a viewing device, the other gazes at him as if on the verge of asking, 'what do you see?'

In Book I, Dubreuil outlines the conditions under which these catoptric illusions are to be viewed, and he is forthright in his belief that perspective is a monocular spatial structure. In a section devoted to the principles of perspective, he describes how an image in perspective is best seen with one eye, not two.[10] When looking with one eye, he insists, the illusion will appear more vivid to the viewer:

[10] The subheading of this section is entitled, 'Why a Piece of Perspective is seen better with one Eye than with two.' J. Dubreuil, *The Practice of Perspective: Or an easie method of representing natural objects according to the rules of art a work highly necessary for painters*, trans. E. Chambers (London, 1726), Book I, p. 5.

> Some hold that all Objects appear better with one than both Eyes; alledging that the Sight is render'd more penetrating by the visual Rays of the shut Eye being determined to the other; inasmuch as all Powers become more vigorous when united, than when dispersed. Accordingly, say they, one of the Eyes being closed, the whole visive Virtue before diffus'd thro'both, is now suppos'd to be collected into one; a Re-inforcement must necessarily render it stronger, more piercing, &c. than both.
>
> Be this as it will, 'tis certain, we see a Piece of perspective with one Eye better than with both. The reason is, that the central Ray, in the Case, is directed to the point of Sight where all the Radials of the Piece do meet; which is what shews a Picture in its last Perfection. 'Tis *Point of the Eye*, as insinuating, that Perspective is most pleasing, when viewed by a single Eye. [sic][11]

Looking at a perspectival image with one eye provides for a greater effect due to the fact that all of the visual rays are condensed and therefore made more robust. The use of peepholes and monocular sighting devices on the frontispiece to Book III in fact argues the same point by showing how one-eyed viewing should be carried out.

Further in the treatise, we find a number of exercises that integrate perspective's monocular principle with mirrored surfaces. In figure 93, a spectator crouches before a viewing aperture *A,* and gazes straight ahead at a cylinder placed on a table lined with radiating circles. Dubreuil explains that the efficacy of the illusion is based on the same premise as monocular perspective: to see the image in its proper form, one must look at it, through a hole, from a predetermined location.[12] If you try to perceive the illusion wherever you so choose, the prototype will not appear.[13] It is important to stress that this demonstration does not *require* monocular viewing. Like the extant examples housed in the

[11] Dubreuil, *Practice of Perspective*, Book I, p. 5.
[12] Dubreuil, *Perspective Pratique* (Paris, 1649), Book III, p. 147. 'J'ay des-ja dit au commencement de ce Traité, que pour voir parfaitement toutes les pieces d'Optique, tant de rayon droit, que du reflechy & brisé, il faut les regarder par un trou qui ait la mesme hauteur, & le mesme esloignement que celuy sur lequel on s'est reglé pour dessigner sur la planche.'
[13] Dubreuil, *Perspective Pratique* (Paris, 1649), Book III, p. 147. 'Car si on les regarde à discretion, ells ne paroistront jamais comme ells sont au Prototype. C'est ce qui m'a fait mettre icy ces deux figures; En la premiere, on y void le Cylindre ou le Prisme posé sur la planche où est l'image, qui se verra conforme au Prototyp, si on la regarde par le trou de la lunette A.'

Museo Galileo, Florence, the corrected image would appear upon the surface of mirror with or without the peephole. However, by including a peephole, Dubreuil assures that the observer's eye will meet with the exact spot at which the image is most free of distortions. The monocular peephole also allows the illusion to carry more potency, as surrounding peripheral distractions are kept at bay.

Looking at figure 94, Dubreuil presents a similar set-up to the one prior, replete with a table top and monocular viewing device. However, in this scenario, the spectator looks across the table towards a pyramidal cone that is mirrored on each side. Spanning out from the pyramid is a fragmented image that becomes uniform when looking at the tip of the pyramid from the point of view of the aperture. This illustration is broken into four parts, or four triangles. The distinct illustrations are then reflected on all four sides of the pyramidal mirror. Thus, when looking through the peephole at *D*, the viewer is privy to an amalgamated image that remains unseen from any other angle. Once again, Dubreuil stresses the import of the sighting device by insisting that when viewed from other angles, without the use of the aperture, the separate pieces will not coalesce.[14] Moreover, it is imperative that the viewing aperture be placed directly opposite the tip of the pyramidal cone.[15] The peephole simply helps to align the observer's vision with the mirror's apex, assuring a one-to-one correspondence between the tip and the observer's point of view. The thrill presented in this scenario is seeing a whole image that does not exist as a whole in reality. The mirror amalgamates discrete panels while the peephole primes our vision.

[14] Dubreuil, *Perspective Pratique* (Paris, 1649), Book III, p. 154. 'Car de les regarder à discretion, & sans cette sorte de lunette, c'est ne vouloir rien voir de bien; d'autantque sans cette subjection, l'on ne verra jamais l'image sur le Miroir, conforme à son Prototype.'
[15] Dubreuil, *Perspective Pratique* (Paris, 1649), Book III, p. 154. '…en telle sorte, pourtant, que l'oeil soit directement opposé à la pointe du Miroir…'

In figure 95, Dubreuil expounds upon the use of the monocular sighting device as the principal vehicle with which to enjoy a catoptric illusion. This is the same exercise repeated from different angles, the anamorphic portrait having been placed above, below, and to the right or the left of the mirror, to be seen through a 'lunette.'[16] He cautions that while it is of course possible to see the anamorphic illusion aligned in the mirror without the aid of the sighting device, one must pay careful attention to the angle of the reflection and the height of the viewer's eye. Without care, everything will appear as a chaotic mess. There is but one specific point where the illusion takes shape—one point and one point only.

What if you do not have a viewing aperture at hand? While these catoptric illusions can be appreciated binocularly, Dubreuil nonetheless offers an intriguing suggestion to maximise the visual effect when we look at figure 96. Here we see a slew of characters gaze in delight at a number of exercises. The scene illustrated above is repeated below, with the slight modification of swapping pyramidal for conical mirrors. To see these illusions 'in their perfect form', writes Dubreuil, 'place your eye directly over the apex, and then make a small hole with your forefinger and thumb.'[17] This handmade peephole, to be looked through 'with one eye only', renders the experience an embodied practice, as the observer's body becomes a conduit for illusionism.

While the use of viewing apertures is not necessarily the only way the illusions can be enjoyed, they do play a pivotal role in helping the viewer navigate the fictive spaces

[16] Dubreuil, *Perspective Pratique* (Paris, 1649), Book III, p. 122. '…qui doivent ester regardées par un petit trou, ou une lunette si on les veut voir dans la perfection & semblables au Prototype.'
[17] Dubreuil, *Perspective Pratique* (Paris, 1649), Book III, p. 122. 'Secondement, quand on voudra que ces pieces soient posées à terre, ou attachées, en haut; il faut ester exacte à prendre l'esloignement de l'oeil, avant que de tracer & peindre les figures. Pour les voir dans leur perfection; en cette situation; il faut que l'oeil soit directement vis à vis de la pointe, & la main entre l'un & l'autre, en telle sorte que le pouce & le premier doigt estans pliez, ne laissent qu'un petit trou, qui servira comme de lunette, pour les regarder, d'un oeil seulement, comme on void aux figures D E.'

Dubreuil has devised. If the apertures were removed, the viewer would have to experience the space peripatetically and move around to uncover the precise angle at which the illusions cohere. The peepholes thus fix the bodies of Dubreuil's ambling figures and signpost each exercise. However, it is not clear which scenario makes for a more engaging experience. On the one hand, the presence of monocular apertures assures instantaneous success; by placing the viewer's eye in a predetermined location, enjoyment is immediate and likely quite compelling. The aperture guards against any frustration. On the other hand, Dubreuil's peepholes arguably reduce the pleasure derived from solving such riddles by providing the observer with the answer before he has had time to ponder the question. By eliminating the guesswork, the theorist has eradicated the satiated feeling that comes from piecing together a puzzle; finding the spot where the illusion aligns would presumably be half the fun.

I qualify Dubreuil's demonstrations as 'catoptric peepshows' that participate in the occluding character of acute perspectival illusions that entail a monocular observer. However, these imagined exercises embellish this principle by rendering it spectacular rather than simply restoring proper form. Central to the effect of a catoptric peepshow is the manifestation of a concealed image. For in addition to situating the observer in the correct spot, Dubreuil's viewing apertures also provide an additional surface on which an artist can paint a hidden picture. In the text, Dubreuil writes that the underside of the viewing apertures in figures 93, 94, and 95 can be painted with a design of the artist's choosing.[18] Like Brunelleschi's peepshow, the painted end of the aperture's panel will only

[18] Dubreuil, *Perspective Pratique* (Paris, 1649), Book III, p. 122. 'De plus on pourroit adjouter icy des images peintes sur un plan, qui seroit opposé au devant d'une Pyramide, ou d'un Cône Speculaire, laquelle image se verroit sur l'un de ces Miroirs, par un petit trou fait au milieu du plan, où l'image seroit peinte, qui

appear when looking through the peephole once it has met the mirror placed opposite. Thus, in addition to situating the viewer in the crucial spot, the aperture also acts as a medium of disguise and revelation. Returning to the mirror-lined cabinets discussed at the outset of this chapter, one interior panel of boxes 3 and 4 (fig. 86) is painted in this way, offering the viewer an instantaneous thrill that exists only when looking through the peephole.

In what way, precisely, were Dubreuil's observers 'thrilled' when peeping towards a mirrored illusion? What did the concealed image 'reveal' once it was seen? While the demonstrations found in *Perspective Pratique* are theoretical in that they exist solely as illustrations, Dubreuil's scholarship developed out of, and speaks to, a wider cultural milieu in which optical illusions served a particular purpose. In the next section, I flesh out this particular environment, and ask in which spaces were these illusions encountered and what did the observer learn upon being deceived so pleasurably.

III. Catoptrics in Spaces of Spiritual Instruction: Jesuits and Natural Magic

Dubreuil was a member of the Order of Jesuits (Society of Jesus) in Paris, a religious sect of the Catholic Church founded by Saint Ignatius of Loyola (1491-1556) in 1540. The Jesuits took particular delight in the science of optics and the artifice of illusion and had a large hand in proliferating the design and production of catoptric anamorphoses in the seventeenth century. In point of fact, *Perspective Pratique* was also

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seroit le reuers de celle-cy, car il faudroit mettre la Pyramide bien obtuse, en la place de la lunette D & le trou pour regarder, en la place de la Pyramide, c'est à dire, au milieu du plan A, où l'image seroit peintre.'

known as the 'Jesuit's Perspective,' clearly demonstrating Dubreuil's notoriety in the Order and the acknowledgment of the Jesuits' role in the practice of perspective.[19]

Optical illusions served two of the Order's vested interests: religious didacticism and scientific inquiry into optics. In Jesuit colleges, teaching was centred on the medieval quadrivium: arithmetic, geometry, astronomy, and music.[20] Perspective, catoptrics, and dioptrics were studied as forms of applied mathematics. The application of mathematical theory in these artful devices and demonstrations was integral to the Jesuits' approach to education.[21] While the Order encompassed different approaches,[22] it was largely focused on Thomist orthodoxy, a philosophical school originated by Saint Thomas Aquinas (1225-1274) that stressed the role of the senses in learning.[23] The Jesuits held that that all knowledge, even the knowledge of God, could be obtained by means of the senses.[24] Jesuit educational reformer Pontanus (Jacob Spanmüller, 1542-1626) elucidated that 'one cannot know God if one does not see the intelligence in the things he created, as the

[19] The title page states that the treatise was written by 'a monk of the company of Jesus', and forgoes Dubreuil's namesake altogether.
[20] P. Dear, 'Jesuit Mathematical Science and the Reconstitution of Experience in the Early Seventeenth Century,' *Studies in History and Philosophy of Science Part A* 18, no. 2 (1987), pp. 133-175, p. 135. Dear notes that while the curriculum varied from college to college, mathematics figured prominently in all. The more mathematically-centred colleges were La Flèche in Normandy (where Descartes and Mersenne studied), Ingolstadt (where Christopher Scheiner read, whom I will discuss in more detail in the proceeding chapter), Würzburg (where Athanasius Kircher and Gaspar Schott studied at one time), and the Collegio Romano.
[21] By the mid seventeenth century, the Jesuit Order controlled higher education practices in Italy, Poland, and Portugal. The Society also produced more colleges and academies than any other religious group in Spain, France, the Spanish Netherlands, or the predominantly Catholic areas of Germany and Hungary. D. Alden, *The Making of an Enterprise: The Society of Jesus in Portugal, Its Empire, and Beyond, 1540-1750* (Stanford, 1996), p. 19. For an overview of the establishment of the Society's colleges, see J. O'Malley, *The First Jesuits* (Cambridge, 1993), especially 'The Schools', pp. 200-242.
[22] See R. Feldhay, 'The Cultural Field of Jesuit Science' in J. O'Malley (ed.), *The Jesuits: Cultures, Sciences, and the Arts 1540-1773* (Toronto, 1999), pp. 107-129.
[23] For more on the origins of Thomism in Jesuit education see A. Simmons, 'Jesuit Aristotelian Education: the *De anima* Commentaries', in J. O'Malley (ed.), *The Jesuits: Cultures, Sciences, and the Arts 1540-1773* (Toronto, 1999), pp. 522-37.
[24] This notion developed at length in Loyola's *Spiritual Exercises* (1522-1524), the founding tract of the Order. S. Dupré, 'The Return of the Species: Jesuit Responses to Kepler's New Theory of Images,' in W. De Boer and C. Göttler, (eds.), *Sensing the Divine: Religion and the Senses* (Leiden, 2012), p. 475.

invisible is cognisable by the mind only by means of what is created.'[25] In turn, Jesuits were committed to demonstrating the role of the senses in gaining spiritual knowledge. Visual art and optical illusions were central to this cause, and catoptric art forms were one of myriad ways in which spiritual and scientific learning could be exercised and acquired.[26] For instance, visual riddles in the form of painted enigmas were commonly used as instructive tools. These painted enigmas came in the form of a religious, mythological, or historical painting that hid references distinct from the painting proper. [27] In addition to these visual games, spoken riddles were also a common form of educational practice in Jesuit colleges.

Through these exercises, Jesuit professors could show that there were rational explanations to seemingly 'supernatural' or strange occurrences. Sven Dupré's recent research on catoptric 'floating spirits'—a common Jesuit exercise—illuminates how supernatural marvels were used to instigate scientific inquiry. In his essay entitled 'The Return of the Species: Jesuit Responses to Kepler's New Theory of Images' Dupré writes that floating spirits were 'summoned' by means of a concave mirror that would project reflected images into the air, seemingly looming in the space just beyond the limits of the glass. The mirror would alter the shape of the reflection just enough to cause a deformity, and hence images of monsters, devils, and demons were common images to materialise 'out of thin air.' These ghostly apparitions were regarded as marvels that could not necessarily be deemed natural, 'but of which the cause was nevertheless not

[25] As translated in K. Vermeir, 'The Magic of the Magic Lantern (1660-1700): On Analogical Demonstration and the Visualization of the Invisible', *The British Society for History of Science* 38, no. 2 (June 2005), p. 131.
[26] Dupré, 'The Return of the Species', p. 475.
[27] Visual enigmas originated at the Jesuit College in Pont- à-Mousson in 1588. J. Montagu, 'The Painted Enigma and French Seventeenth-Century Art', *Journal of the Warburg and Courtauld Institutes* 31 (1968), pp. 307-335.

supernatural.'[28] Furthermore, the very appearance of monstrous, demonic, or devilish figures devised in these exercises exposed the conjured image as a fictional manifestation. Such demonstrations proved that seemingly wicked deceptions have legitimate, scientific explanations; they render the 'preternatural intelligible.'[29] To a Jesuit, optical illusions elucidate that an invisible divine force 'organises the world.'[30] There is no luck, chance, or quandary that cannot be explained by the presence of a higher power. In this way, optical illusions render interpretable what is aberrant or seemingly paranormal.

In the early modern period, optical illusions of this sort—the kinds that produce effects not normally seen in the natural world but are nevertheless concocted by natural forces—were defined as exercises in 'natural magic'.[31] In *Magnes, sive De Arte Magnetica* (*Lodestone, or the magnetic art*, 1641) German Jesuit Athanasius Kircher (1602-1680) defined 'natural' magic as …

> …that kind of magic which, excluding all commerce with the enemy of the human race, whether implicit or explicit, produces prodigious and unseen effects by entirely natural causes, through the combination of various applications.'[32]

In this sense, 'magic' was understood as the forces responsible for modifying the visible world in a manner that exceeded man's abilities. These forces were divided between the

[28] Dupré, 'Images in the Air: Optical Games, Magic and Imagination,' in C. Göttler and W. Neuber (eds.), *Spirits Unseen: The Representation of Subtle Bodies in Early Modern European Culture* (Leiden and London, 2007), p. 83.
[29] Dupré, 'Images in the Air', p. 78.
[30] Vermeir, 'Magic of the Magic Lantern', p. 131.
[31] See J.V. Blanchard, *L'Optique du Discours au XVIIe siècle: de la Rhètorique des Jésuites au Style de la Raison Moderne* (Montréal, 2005), pp. 28-29; and J. Baltrušaitis, *Anamorphic Art*, trans. W. J. Strachan (New York, 1977), p. 153.
[32] D. Stolzenberg, 'The Connoisseur of Magic,' in D. Stolzenberg (ed.), *Great Art of Knowing: The Baroque Encyclopaedia of Athanasius Kircher* (Stanford, 2001), p. 51.

'natural' and the 'demonic'.[33] Whether 'floating spirits' or catoptric curiosities, it was important to Jesuits to stress that natural—as opposed to nefarious—forces were responsible for such convincing illusions. It is precisely the empirical rationalisation behind such exercises that 'provided an appropriate framework in which to develop a demonstrative culture of science' in Jesuit colleges.[34]

Returning to Dubreuil's monocular catoptric demonstrations, we can see that the peepholes and table-top set-ups compel scrutiny from the spectators. They instigate a level of curiosity that is compatible with the empirical didacticism of Jesuit education. Likewise, the distillation of the illusion, as it appears immediately within the confines of the peephole, would likely prompt a line of questioning as to how, precisely, this image was achieved, and thus would push the spectator towards the rationalisation of these miracles as scientifically founded.

Looking closely at the spaces presented within *Perspective Pratique*, one wonders where Dubreuil has situated the catoptric games. The imagined interiors are mostly bare save for the erected table-tops and peephole panels used in the mirrors' service. Where, exactly, could one interact with a catoptric mirror in the seventeenth century? In the following section, I extrapolate on the types of environments in which such optical illusions were housed. While created in Jesuit circles as instructive tools and scholarly recreations, catoptric mirrors were also collected and displayed. The spaces in which they could be found ranged from cabinets of curiosity, to public museums, to the domestic

[33] Stolzenberg, 'Connoisseur of Magic', p. 49.
[34] P. Findlen, *Possessing Nature: Museums, Collecting, and Scientific Culture in Early Modern Italy* (Berkeley, 1994), p. 221. See also W. B. Ashworth, 'Catholicism and Early Modern Science' in D. Lindberg and R. Numbers (eds.), *God and Nature: Historical Essays on the Encounter Between Christianity and Science* (Berkeley, 1986), pp. 136-166.

spaces of wealthy merchant homes. To illustrate this point, I first turn to a museum located in the Jesuit Collegio Romano, which was curated by Jesuit polymath Kircher.

Father Kircher, a prolific natural philosopher, was made Chair of Mathematics at the Roman College of the Jesuit Order upon his move to Rome from the Hapsburg court in Vienna in 1638.[35] He became so well-regarded amongst his peers for his knowledge in many areas of scientific study that he was deemed 'Master of One Hundred Arts.'[36] Nowhere was Kircher's multi-faceted expertise better demonstrated than in the founding of the college's museum in 1651. The museum's establishment was due principally to a donation from Roman patrician Alfonso Donnino, secretary of the *Popolo Romano*, who bequeathed his entire collection of paintings, antiques, and sculptures under the condition that the college erect a public museum to showcase his art.[37] Kircher was appointed as the museum's first curator, and, in addition to Donnino's collection, he filled the space with his inventions and devices, which were previously relegated to his lodgings.[38] Combining both collections, the museum now boasted a wide variety of paintings, instruments, catoptrics, perpetual motion machines, models, and books. The museum quickly became one of the preeminent collections in Europe, and a must-see of any Grand Tour.[39] Indeed, in 1671 Kircher declared that 'No foreign visitor who has not seen the Roman College museum can claim that he has truly been in Rome.'[40] Kircher's role as the museum's

[35] J. Godwin, *Athanasius Kircher's Theatre of the World: The Life and Work of the Last Man to Search for Universal Knowledge* (Rochester, 2009), p. 14.
[36] D. Stolzenberg, 'Introduction: Inside the Baroque Encyclopaedia' in *Great Art of Knowing: The Baroque Encyclopaedia of Athanasius Kircher* (Stanford, 2001), p. 1.
[37] P. Findlen, 'Introduction: The Last Man Who Knew Everything… or Did He? Athanasius Kircher, S.J. (1602-80) and His World,' in P. Findlen (ed.), *Athanasius Kircher: The Last Man Who Knew Everything* (New York, 2004), p. 30.
[38] P. Findlen, 'Last Man Who Knew Everything', p. 30.
[39] E. Lo Sardo, 'Kircher's Rome,' in P. Findlen (ed.), *Athanasius Kircher: The Last Man Who Knew Everything* (New York, 2004), p. 56.
[40] As translated in Findlen, 'Last Man Who Knew Everything', p. 31.

gatekeeper is illustrated on the frontispiece to the museum's catalogue of 1678 (fig. 97). Featured in a black robe, he guides a pair of visitors through his collection. The vastness of the space and the number of curiosities packed within undoubtedly emphasise the breadth and depth of their curator's wisdom. Among the collection were a number of catoptric devices, such as a machine designed to produce an infinite number of reflections of a portrait of Pope Alexander II.[41]

For visitors, the museum became 'a sort of philosophical gymnasium, an exercise space for the mind,' where optical devices could be enjoyed and contemplated.[42] As a public space, the Collegio Romano's collection was evidently accessible to a wider audience than just Kircher's Jesuit brethren. Indeed, inspired by his impressive museum, Roman collectors such as Cardinal Flavio Chigi (1631-1693) amassed catoptric devices (among automata and other optical entertainments) themselves in order to impress guests visiting their residences.[43] In the case of Chigi, such devices were housed in a space separate from his private dwellings. As Patricia Waddy explains, because the rooms used to house Chigi's works of art were kept separate from his work and living space, but nonetheless open to the public as part of his quarters, 'students of art could sense that they were visiting the cardinal and could understand the display as a manifestation of his magnificence, even in his absence.'[44] As to who was permitted access to the Cardinal's collection, anyone 'who could make a presentable appearance' would be granted

[41] P. Findlen, *Possessing Nature: Museums, Collecting, and Scientific Culture in Early Modern Italy* (Berkeley, 1994), p. 46.
[42] Lo Sardo, 'Kircher's Rome', p. 60.
[43] Findlen, *Possessing Nature*, p. 47.
[44] P. Waddy, 'Architecture for Display', in G. Feigenbaum (ed.), *Display of Art in the Roman Palace, 1550-1750* (Los Angeles, 2014), p. 35.

permission to enter the palace in order to enjoy his sculpture garden or proceed up the stairs to the *sala* where other works, such as catoptric portraits, were displayed.[45]

While noble patrons and members of the merchant class in Rome were undoubtedly the most numerous to frequent Kircher's museum and the residence of Cardinal Chigi, it should be stressed that access to catoptric games also reached wider audiences in the seventeenth century. As noted, the translations and reprinting of Dubreuil's publication indicates that his theories circulated outside of France and his Jesuit milieu. Dupré has posed a similar argument for Giambattista della Porta's (1535-1613) treatise on natural magic, *Magia naturalis* (1558) remarking that: 'The wide circulation of this book indicates that participation in these optical games was not the privilege of courtiers with access to princely collections.'[46] Indeed, there are further indications that such optical illusions were enjoyed in circles beyond the Roman public and European Jesuit colleges. In the next section, I return to Dubreuil's peep-boxes to show how catoptric effects were incorporated into furniture designs for cabinets of curiosity in private domestic spaces and royal Kunstkammern in the early seventeenth century.

IV. Catoptric Effects and Collecting Practices: Art Cabinets, Luxury Goods, and Social Status in the Early Modern Period

In addition to functioning as effective learning exercises in Jesuit circles, the designs illustrated in *Perspective pratique* indicate that catoptric games were also popular in cabinets of curiosity and were incorporated into furniture pieces that beseeched participation on behalf of the observer. In this section I argue that Dubreuil's peep-boxes

[45] Waddy, 'Architecture for Display', p. 37.
[46] Dupré, 'Images in the Air', p. 80.

were intended to serve as inspiration for the central compartments of seventeenth-century art cabinets, which cleverly integrated catoptric spectacles behind closed doors. By incorporating peepholes, Dubreuil's drawers render the spectacle of the art cabinet a far more intimate experience.

Each of the four pieces in Dubreuil's illustration of catoptric boxes offers a unique arrangement that is amenable to the whims of the reader. In the first box, a handful of human figurines and dogs run about in pursuit of a royal hunt (fig. 98).[47] These are three-dimensional models that can be arranged in any number of ways. As it is explained, whatever is placed inside the box will be multiplied again and again in a series of proliferating reflections as the top and side panels are lined with mirrors.[48] Dubreuil gives the example of placing flowers, gold vases, pearls, jewellery, or other such valuable objects within the box, so that when met with their mirrored reflections, it will appear as if you have 'a great treasure of riches.'[49] Likewise, he proposes filling the space with a handful of books in order to feign 'a vast library.'[50]

The second box in this group is octagonal in shape and contains a miniature townscape replete with a watchtower, cathedral, and a citadel (fig. 99). As an alternative to

[47] Dubreuil, *Perspective Pratique* (Paris, 1649), Book III, p. 133. '…petits arbres & des chausseurs avec deux ou trois chiens qui paroistrons en grand nombre & fare comme une chasse Royale dans une forest…'
[48] Dubreuil, *Perspective Pratique* (Paris, 1649), Book III, p. 133. 'La premiere marque I, est une piece, en forme de Cabinet, garnie de quantité de Miroirs de tous costez, oposez les uns aux autres pour donner & recevoir reflexion,'
[49] Dubreuil, *Perspective Pratique* (Paris, 1649), Book III, p. 133. '…on peut mettre huict (huite) or dix petites fleurs; qui par les reflexions de ces Miroirs, se multiplient en telle sorte, qu'il en paroist à perte de veuë…qui au lieu de ce jardin, donne un autre fond, où il y a quelques jolies pieces de cabinet, quelques perles, quelques petits vases d'or, & autres petites nipes & gentilesses, de qui les reflexions sont paroistre un grand tresor en richesses, & quantité de belles choses, come perles sams nombre, des vasesd'or des joyaux…'
[50] Dubreuil, *Perspective Pratique* (Paris, 1649), Book III, p. 133. '…à ce tresor succeed une magnifique Bibliothecque, que produit la reflexion de cinq ou six petits livrets (liurets?), mis sur l'un des costez du triangle, c'est à dire sur une des planches qui forment ce triangle, lequel est caché dans le bas au dessous de ce cabinet, & se meuet par une maniuelle que ie fais paroistre à costé (cote?) de la figure. Parmy ces petites pieces on peut encore mettre trois ou quatre petits bouts de bougie allumées, qui outré ce que'elles donneront plus de clairité, leur multiplication sear agreeable.'

the interior display illustrated on the page, Dubreuil proposes placing a few human figurines within the octagon to create the illusion of an army in the throes of battle.[51] This piece offers a more encompassing effect compared to the first due to the fact that every interior panel reflects not only the scene of trees and soldiers before it, but also the opposing mirror placed parallel across the octagon; each surface generates a profuse repetition of reflections, like a funhouse mirror. Similar to the vanishing point in a perspectival schema, mirrors carry the potential of regressing an image into a void through a series of proliferating reflections. Indeed, when two flat mirrors are joined together at a right angle, any object placed between them is replicated, as the object and its mirrored image are reflected concurrently.[52]

The last two pieces illustrated in this section are distinct from the first in both their rectangular shape and inclusion of peepholes at *K* and *N*. As we come to learn, the third box (fig. 100) is lined with mirrors on three of the four panels, while the fourth panel is painted to resemble curtains. When looking through the peephole at *K*, the viewer's line of sight is restricted to the mirror located opposite at *L,* and is now privy to a 'magnificently decorated room,' lush with tapestries and ornate furniture.[53] In addition to the painted panel, Dubreuil also suggests that the artist can arrange canons and barrels within the box to represent an arsenal, paint several books to depict a vast library, add trees and flowers to

[51] Dubreuil, *Perspective Pratique* (Paris, 1649), Book III, p. 133. '…on peu à costé de cette pieces met quelques petits homes rengés en bataille, il en paroistra des armées; on puet encore les faire mouvoir; & pour lors il semble qu'ils se doivent batter, à raison que les verses reflexions, sont paroistre les uns aller a droit & les autres à gauche, & c…'

[52] N. Asakura 'Experiments with Mirror Reflections', *Leonardo* 23, no. 1 (1990), p. 71. When mirrors are placed parallel to each other in a closed shape such as this octagonal box, an object placed inside will reflect infinitely. Parallel mirrors in arrangements such as a pyramidal pillar will also create this effect.

[53] Dubreuil, *Perspective Pratique* (Paris, 1649), Book III, p. 133. 'La marquee 3 est de figure quarée où il n'y a qu'un costé de garny de ce que l'on vue les trois autres l'estant de Miroirs, où celuy-là se reflecthit; tellement que si l'on peint a costé quelques tapisseries, & qu'on y mettre quelques petits meubles; estant regardée un trou, on verra dans le Miroir L, qui luyest opposé, une grande Salle bien tapissée ornée magnifiquement.'

create a garden, or 'anything and everything that you wish to multiply,' upon the mirrored surfaces.[54]

The fourth and final box presented in this section follows a similar structure to the third with slight modifications (fig. 101). First, it is covered, and second, it is illuminated by several architecturally crafted openings on the right and left. As in box 3, the panel opposing the peephole is fitted with a mirror. As Dubreuil instructs, the front panel, which the observer peeps through, is painted with a perspectival vignette. Looking through the peephole *N*, this painted perspective appears as if miraculously, creating an 'admirable recession' of depth as the reflected painting extends the interior display beyond the confines of the box.[55] The addition of the mobile figurines, books, flowers, and jewellery within these peep-boxes renders the spectacle presented therein laden with potential and possibility.

I surmise that the last two pieces were designed as inspiration for the drawers of art cabinets that were prominent in European markets in the first half of the seventeenth century. To date, only sixty cabinets remain.[56] Cabinets of this kind were mainly produced in Antwerp, although they find their origins in the south of Germany, and were

[54] Dubreuil, *Perspective Pratique* (Paris, 1649), Book III, p. 133. 'Si au lieu de tapisseries & de meubles, on met quelques petit canons, barils, boullets, espées & c. on verra dans ce Miroir un Arsenant bigarny. Si au lieu d'armes, en y met quelques livres, ou aura une Bibliotheque; si des arbres & es fleurs, on aura un jardin; & ainsi de tout ce qu'on voudra faire multiplie.'

[55] Dubreuil, *Perspective Pratique* (Paris, 1649), Book III, p. 133. 'La 4. Figure est une piece couverte, qui prend jour de quelques ouvertures qu'on fait à l'un des costez, qui eclaire suffisamment le dedans de la piece, où il y aura deux costex enrichis d'Architecture , ou de ce qu'on voudra; & à l'un des bouts M, un seul Miroir au bout qui reste à l'opposite de ce Miroir, il faut mettre une piece de Perspective (que nous ne pouvons pas voir icy estant supposé en dedans) au poinct de veuë de laquelle on fera un trou, N, pour regarder le Miroir où se reflechissent, premierement les costez qui se termineront avec cette Perspective & donneront un enfoncement admirable.'

[56] M. Baumeister and S. Rabourdin-Auffret, 'A Seventeenth-Century Parisian Ebony Cabinet Restored by Herter Brothers', *Prints of the Wooden Artifacts Group, 33rd Annual Meeting of the American Institute for Conservation* (June 2005), p. 2. For a comprehensive account of these cabinets and their styles, see M. Riccardi-Cubit, *The Art of the Cabinet Including a Chronological Guide to Styles* (London, 1992).

largely exported to the Iberian peninsula.[57] In Europe, art cabinets would have been purchased to adorn the rooms of wealthy merchants, burghers, and aristocrats in their cabinets of curiosity, or Kunstkammern.[58] For example, an inventory of Queen Christina of Sweden's (1633-1654) residences from May, 1656 mentions '*Ung cabinet d'Ebenne et d'Yvoir guarny avec des agats'* (An ivory and ebony cabinet adorned with agates) made in Antwerp.[59] Two examples from the Fitzwilliam Museum and the Rockoxhuis in Antwerp show the intricate carved work of the art cabinet's exterior (fig. 102 & 103). As luxury goods, the materiality of the cabinets reflected the wealth and prestige of their owners. Specialised artists would paint the small scenes on the exterior and interior drawer fronts. Popular vignettes included scenes from the Old Testament, and mythological or allegorical tales. Often, the cabinets were painted with biblical or mythological scenes in the style of Rubens.[60] Inside, jewellery, small statues, *naturalia*, or important documents were housed within the multiple drawers hidden behind the outer doors.[61] In the more elaborate cabinets, ebony veneer, an extremely rare material, was imported from Madagascar in order to adorn the exteriors.[62]

A painting by Flemish artist Frans Francken II (1581-1642) shows one such cabinet in and amongst a collection of paintings, statues, manuscripts and *naturalia*, located on the right (fig. 104). The bottom drawer of the cabinet is open to reveal dangling jewellery. Likewise, in the left portion of Jan Brueghel the Elder's *The Allegory*

[57] S. Dupré, 'Trading Luxury Glass, Picturing Collections and Consuming Objects of Knowledge in Early Seventeenth-Century Antwerp', in S. Dupré and C. Lüthy (eds.), *Silent Messengers: The Circulation of Material Objects of Knowledge in the Early Modern Period* (Berlin, 2011), pp. 284-285.
[58] Riccardi-Cubitt, *Art of the Cabinet*, p. 48.
[59] Riccardi-Cubit, *Art of the Cabinet*, p. 80.
[60] Cabinets decorated with scenes from Ovid's Metamorphoses would be used as a bride's dowry for her bedroom in which she could place her most prized possessions. Riccardi-Cubitt, *Art of the Cabinet*, p. 82.
[61] Dupré, 'Trading Luxury Glass', p. 282; Maumeister, p. 2.
[62] Baumeister and Rabourdin-Auffret, 'Seventeenth-Century Parisian Ebony Cabinet', p. 2.

of Sight (fig. 105), we catch a glimpse of a painted art cabinet, its doors open wide, resting just behind a royal double portrait. Pictures of cabinets of curiosity like Francken's and Brueghel's belonged to a genre of Flemish painting popular in the first half of the seventeenth century.[63] While paintings of collections were not often truthful demonstrations of the contents of specific galleries, they nonetheless reveal the 'cultural ideals' of early modern forms of display.[64] The works functioned as a model against which the arrangement and quality of one's actual collection could be compared. Elizabeth Honig has argued that the ideal enacted by these paintings of collections is that of status; not necessarily the status garnered by relating to the luxuriousness of the objects depicted, but the 'discourse *about* luxury', the knowledge imparted from one connoisseur to another.[65] Indeed, the collection of luxury goods was intended not only to convey one's wealth, but also to serve as the basis for knowledge.[66] The wealthy merchants in Antwerp purchased such goods as mathematical instruments, paintings, and *naturalia* in order to sharpen their discernment of other objects in their collection, or the collections of others. As such, the collection and display of luxury goods in early modern Antwerp 'was a vehicle of friendship and social mobility' for the merchant-collector.[67] The mirrored art cabinet functions as a microcosm of this cultural imperative. Indeed, participating in the arrangement of the art cabinet's interior display was a form of social and intellectual play for the cabinet's owner as well as his houseguests.[68]

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[63] For a detailed overview of the history and provenance of Flemish paintings of collections see A. Marr, 'The Flemish "Pictures of Collections" Genre: An Overview', *Intellectual History Review* 20, no. 1 (2010), pp. 5-25. Marr notes that Francken pioneered this genre.
[64] E. Honig, *Painting and the Market in Early Modern Antwerp* (New Haven, 1998), p. 203.
[65] Honig, *Painting and the Market*, p. 206.
[66] S. Dupré, 'Trading Luxury Glass, Picturing Collections and Consuming Objects of Knowledge in Early Seventeenth-Century Antwerp' *Intellectual History Review* 20, no. 1 (2010), p. 69.
[67] Dupré, 'Picturing Collections and Consuming Objects', p. 70.
[68] Dupré, 'Images in the Air', p. 83.

An example housed in the Metropolitan Museum of Art (fig. 106), produced in France under the reign of Louis XIII,[69] is decorated on the exterior with paintings inspired by woodcut illustrations by Jean Cousin from *Figures Historiques du Vieux Testament* (Paris, 1596): on the left door is a painted scene of *The Judgement of Solomon*, and on the right, *Solomon and the Queen of Sheba.*[70] The cabinet itself consists of two parts: the stand and the cabinet perched above. Once opened, ten drawers flank the left and right ends, while two central arrangements depict Isaac blessing Jacob (right) and Esau selling his birth-right (left) betwixt two arcades flanked by Corinthian columns. Incised flowers decorate the interior of the outer doors, while mouldings and ivory adorn the ten small compartments. The two central arrangements are doors that open up to a hidden architectural perspective, or *caisson* (fig. 107). This interior perspective stands in contrast to the black ebony exterior of the cabinet and is fashioned out of a combination of wood, ivory, bone, and mirrors.[71] The reflective surfaces within the *caisson* feign a limitless interior and reflect any object placed within from every angle. Such hidden parts of the art cabinet were sometimes used to smuggle goods to foreign lands, such as tulips or silver plaques.[72]

The hidden portions of the art cabinet function very similarly to Dubreuil's peep-boxes as they rely upon the effects of parallel mirrors in order to reflect objects placed within their confines over and over again, at times infinitely. In lieu of the expensive materials used to make the cabinets, and the cherished items placed within their drawers,

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[69] P. Remington, 'An Ebony Cabinet of the Seventeenth Century', *The Metropolitan Museum of Art Bulletin* 26, no. 10 (October 1931), p. 232. See also, D. Kisluk-Grosheide, W. Koeppe, and W. Rieder, *European Furniture in the Metropolitan Museum of Art: Highlights of the Collection*, (New York, 2006), pp. 34–37.
[70] Remington, 'An Ebony Cabinet', p. 232-233.
[71] Baumeister and Rabourdin-Auffret, 'Seventeenth-Century Parisian Ebony Cabinet', p. 2.
[72] Riccardi-Cubitt, *Art of the Cabinet*, p. 82.

it is evident that the catoptric effect within the *caisson* would amplify the wealth and prestige of their owner, who could marvel at their worldly possessions from every angle. What is more, the mirrored interior chambers would likely have heightened the appeal of the objects-as-knowledge. Choosing different objects to be placed in the *caisson*, moving them around, and enjoying the spectacle would not only have highlighted the goods owned by the collector, but would have facilitated discussions around them.

While Dubreuil does not explicitly mention that his peep-boxes were intended for art cabinet drawers, the optical basis of their designs is strikingly similar. Other early modern treatises were known to have created designs for such purposes. In *Magia naturalis*, della Porta mentions the design of a 'theatrical mirror' which is placed along the circumference of a circle and which, when moved, would reveal a small statuette.[73] Dupré argues that the very foundations of della Porta's catoptrical exercises also served as the foundation to the art cabinet's interior mirror display.[74] Specifically, della Porta's mentions that his designs were based on Ptolemy's theories on catoptrics, which Dupré clarifies was in fact a book on the science of reflection by Hero of Alexandria (10-70 A.D.) which was first published in Venice in 1518 as Ptolemy's *De speculis*.[75] In light of this, Dupré argues that the catoptrical *caissons* 'embodied Hero's catoptrical knowledge.'[76] Hero insisted that those who understood the mathematical and optical foundations of these visual tricks were superior to those who approached the games with no prior knowledge or understanding. As a result, Dupré surmises that the message conveyed by the art cabinet was that spectators fooled by the multiplication of objects

[73] Dupré, 'Trading Luxury Glass', p. 288.
[74] Dupré, 'Trading Luxury Glass', p. 288.
[75] Dupré, 'Trading Luxury Glass', p. 288.
[76] Dupré, 'Trading Luxury Glass', p. 288.

placed within the *caisson* were only fooled due to ignorance; those familiar with Hero's postulates would not be deceived. Dupré explains that the catoptrical effects of the *caisson* enabled collectors to 'share the knowledge on which their community was built' while simultaneously precluding the 'ignorant' from their elite circles.[77]

Another interesting use of the principle of the mirror box within other domestic showpieces is a collection of sixteenth-century catoptric clocks now housed in the Kunsthistorisches Museum Wien presented in figure 108. Created by Christoph Margraf, one of Prague's preeminent clockmakers, these timepieces previously belonged to Rudolph II's (1552-1612) cabinet of curiosities. Also known as tabernacle clocks,[78] they produced from the sixteenth to the eighteenth century, and often measured astrological information gleaned from astrolabes fitted within their structures.[79] While clock-making became a trade in its own right by 1500, in the sixteenth and seventeenth centuries the practice became more focused on developing luxury goods in high demand in 'courtly, aristocratic, and bourgeois society.' [80] Thus, it is safe to suggest that the audience for such pieces could have been quite similar to those who purchased mirrored art cabinets.

In the clock presented in figure 108, a mirror is attached to the top lid and a small painted panel—here depicting the rescue of Andromeda by Perseus—is placed inside the piece, hidden just out of view. When the clock is opened, the painting appears as if miraculously, as it is reflected on the underside of the lid. Margraf designed a number of

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[77] Dupré, 'Trading Luxury Glass', p. 289.
[78] D. S. Landes, *Revolution in Time: Clocks and the Making of the Modern World* (Cambridge, 1983), pp. 99-100.
[79] For a history of European clock making see C. M. Cipolla, *Clocks and Culture: 1300-1700* (New York, 1967), pp. 37-76; for the history of clock-making practices in Elizabethan England see A. M. Cohen, 'The Clockwork Self and the Horological Revolution', in *Shakespeare and Technology: Dramatizing Early Modern Technological Revolutions* (New York, 2006), pp. 127-149.
[80] A. Turner, '"Not to Hurt of Trade": Guilds and Innovation in Horology and Precision Instrument Making' in S.R. Epstein and M. Prak (eds.), *Guilds, Innovation, and the European Economy*, *1400-1800* (Cambridge, 2008), p. 266.

these pieces for Rudolph's cabinet, some including moveable wax figures that stand out against the painted backdrop of a mythical tale, such as Diana being discovered by Actaeon.[81] In addition to mirrors and wax figures, Margraf also included peepholes in a few of the designs.[82] While Dubreuil's mirrored boxes do not include a timepiece or astrolabe—which would arguably lend a sense of practicality to their making—they nonetheless employ the same visual tricks as Margraf's.

The catoptric clock and the Flemish art cabinet function within a milieu in which the very possessions of the collector are to be emphasised by means of reflective surfaces. As such, the objects multiplied within the confines of such pieces can be compared to the mirroring of goods found repeatedly in seventeenth-century Dutch still-life paintings, such as Pieter Claesz.'s *Still life with Musical Instruments* (fig. 109). In *Looking at the Overlooked,* Norman Bryson theorizes that this trope functions as a metaphor for overproduction in light of the inflation of material goods in Holland following the age of industrialisation. The visual symptom of this cultural shift is located within the frame of Dutch still-life painting, which he defines as…

> …a dialogue between thus newly affluent society and its material possessions. It involves the reflection of wealth back to the society which produced it, a reflection that entails the expression of how the phenomenon of plenty is to be viewed and understood.[83]

Bryson's choice of words is telling. Dutch still-life painting acts as a mirror that reflects abundance back towards the viewer-consumer in a novel way. For when imported and rare goods are depicted within a painting and hung on the walls of a home, they enact a doubling effect of the wealth within the household; the still-life painting creates the

[81] A. Fraser, *A History of Toys* (New York, 1966), p. 78.
[82] R. D. Altick, *The Shows of London* (Cambridge, 1978), p. 56.
[83] N. Bryson, *Looking at the Overlooked: Four Essays on Still Life Painting* (Cambridge, 1990), p. 104.

illusion of panoramic opulence. Another example of still-life's replicative character is seen in a painting by French painter François Desportes (1661-1743), where a tray of ripe peaches is reflected twice over by a pair of silver platters erected vertically behind the fruit (fig. 110). In light of this arrangement, the additional angles simultaneously increase the visible areas of each peach and multiply the amount of peaches present on the table. While the actual number of peaches within the tray does not change, the sum total of peaches to be *painted* is tripled once their image meets the reflective surfaces. Whether actual or feigned, the number of painted peaches within Desportes' still-life grows in concurrence with the number of mirrored platters. What is more, the peaches 'exist primarily as a means to multiply the reflections of the silverware,' as a way of foregrounding the quality of the silver's clarity.[84]

Dubreuil's peep-boxes espouse this approach to painting by reflecting any and all objects placed within their confines in order to multiply their quantity or emphasise their quality. In both the boxes and the still-life, the mirror acts as a means of deceptively multiplying one's possessions by creating an array of angles and surfaces on which the painted object can be viewed. We may go as far here as terming Desportes' painting a 'catoptric still-life' due to the ways in which it toys with reflection and juxtaposes live, painted, and mirrored surfaces in order to trick the eye of the observer. In both Dubreuil's boxes and Desportes' painting, live media and painted surface are, quite literally, held up to a mirror in order to augment their effect.

I would like to suggest that Dubreuil's illustration of peep-boxes operated in the larger context of objects of luxury and collectors items, and that, more specifically they may have served as a kind of elaborate prototype for the various catoptric curiosities that

[84] Bryson, *Looking at the Overlooked*, p. 161.

I have discussed. They may have been used as models for art cabinet *caissons*, or as imaginative means of incorporating mirrored reflections in collector's items like tabernacle clocks. The cabinet-like exterior of box 1 suggests that this is so. The bare architectural interiors of boxes 3 and 4 are also strikingly similar to the empty perspectival vistas hidden within the Metropolitan's art cabinet. Leaving early modern furniture design aside, as a final analysis I think it productive to consider the interconnections between Dubreuil's study of perspective, his Jesuit background, and the theatrical character of boxes 3 and 4.

V. Catoptric Theatres: Jesuit Plays and Perspectival Stage Designs

Unlike Dutch perspective boxes, the conceit of a catoptric peep-box does not lie in the illusionistic presentation of a living scene frozen in time, but is, instead, a three-dimensional *tabula rasa* within which one can fabricate a world of one's own. Truly, these boxes stand as empty stages, as empty *theatres* even, imploring spectators to populate their interiors in order to create their own unique display. In this case, the actual performance is not the illusion of three-dimensionality, but of replication and apparition, as hidden paintings become visible (but only as an apparition) and beloved possessions multiply in space. The curtain tapestry painted on the interior side panel of Dubreuil's third catoptric box further speaks to the theatrical nature of these pieces. These painted panels function as theatrical backdrops in front of which the actors in the scene—the miniature figurines—'perform.' In point of fact, Dubreuil makes reference to theatrical scenery and stage design more generally in his publication.[85] He remarks that his

[85] See T.E. Lawrenson, *The French Stage and Playhouse in the Seventeenth Century: A Study in the Advent of the Italian Order,* 2nd ed. (New York, 1986), pp. 172-182.

perspectival illustrations can be used as backdrops for altars, shrines, gardens, and within buildings, alcoves, theatres, and ballets (fig. 111).[86] What is more, these perspectives can also serve as scenery for oratories of the Holy sacrament.[87]

The attention Dubreuil pays to theatrical backdrops is emblematic of the larger cultural sphere in which he participated. Theatre was an integral component of Jesuit curriculum since the Order's foundation in 1540. In keeping with the Jesuit's predilection for imagery over text as a means of learning, theatricality was an apt means of conveying rhetorical messages. It was assumed that the image was per definition 'performative'. In the same vein, theatre offered an opportunity for didacticism through a visual medium. A Jesuit play was akin to a church sermon, and mostly followed a particular theme with added historical anecdotes for variety.[88] These performances were largely propagandist in nature, and often centred on the lives of saints, martyrs, or the life of Christ.[89] Although few survive today, Jesuit productions took place across the continent in prolificacy, as the integration of physical theatres within Jesuit colleges became more commonplace up until the suppression of the Order in 1773.[90] The

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[86] Dubreuil, *Perspective Pratique* (Paris, 1649), Book III, title page to traité IV. 'Des Pièces detaches qui ne sont autres que Perspectives ordinaires: mais coupées, divisées, et séparées, mouvants, tournantes et coulantes. Qui peuvent serviraux Autels, Oratoires des Eglises; aux Jardins, et Maisons de Plaisance, aux Alcôves, Théâtres, Ballets, etc.'

[87] Dubreuil, *Perspective Pratique* (Paris, 1649), Book III, title page to traité IV. '…cette pièce et les précédents de ce Traité peuvent aussi bein servir, pour les Oratoires, où on met le Saint Sacrement le grand Vendredi, en y ajoutant quelque pièce de dévotion, qu'au bout d'une Alée et d'une Galerie, qu'en une Alcôve et sur un Théâtre.'

[88] G. R. Kernodle, *From Art to Theatre: Form and Convention in the Renaissance* (Chicago and London, 1944), p. 164.

[89] H. Schnitzler, 'The Jesuit Contribution to the Theatre', *Educational Theatre Journal* 4, no. 4 (December 1952), pp. 283-292.

[90] W. H. McCabe, *An Introduction to the Jesuit Theatre: A Posthumous Work,* Louis J. Oldani (ed.) (St. Louis, 1983), p. 47. See also 'The Rise of the Jesuit Theatre', pp. 11-18 of the same volume. McCabe estimates that well over one hundred thousand plays would have been performed by the Jesuits between the years 1550-1773. This estimation is based upon the sum of approximately five hundred schools (which McCabe notes is a very low estimate) multiplied by an average of one or two plays performed a year, and even restricting the calculation to one century.

enthusiasm for theatrics was very strong, so much so that it was not uncommon to see secular plays by the likes of Voltaire and Racine translated and performed by Jesuits for their brethren—despite potentially sacrilegious content—indicating a keenness for dramaturgy of all kinds.[91] In turn, on top of writing and performing theatrical pieces, the Jesuits also paid close attention to stage design, taking particular care to plan sets that accommodated multiple points of view.[92] Italian Jesuit Andrea Pozzo (1642-1709), for instance, was particularly intent on developing methods of transcribing perspectival scenes onto the wings of a stage and designing backdrops that did not appear distorted from oblique angles.[93]

If we place Dubreuil's catoptric peep-boxes in light of the larger interest in Jesuit theatricality and performance we may get a better understanding as to how they were supposed to function. I propose that the cabinets may not only have been inspired by their maker's dedication to theatre, but could very well have acted as leisurely exercises in stage design themselves. This is not merely a speculative stretch, for early modern stage design and linear perspective were often studied in tandem. In point of fact, the word *prospettiva* was used in relation to theatre as early as the sixteenth century.[94] The application of pictorial perspective in the theatre is most evident in the development of the proscenium arch: an architectural window that frames the spectacle and directs the viewer's eye towards the centre of the stage.[95] The proscenium acts as a thoroughfare that guides the eye and occludes peripheral distractions; in so doing, it 'signaled, and

[91] Oldani, 'Jesuit Theatre in Italy', p. 25.
[92] L. J. Oldani, 'Jesuit Theatre in Italy: Its Entrances and Exit', *Italica* 76, no. 1 (Spring 1999), pp. 19-20. Jesuit plays also included detailed costumes and integrated other forms of early modern theatrics, such as ballet, into their performances.
[93] Schnitzler, 'The Jesuit Contribution', p. 290.
[94] S. M. Newton, 'Stage Design for Renaissance Theatre', *Early Music* 5, no. 1 (January 1977), p. 18.
[95] S. Crabtree and P. Beudert, *Scenic Art for the Theatre: History, Tools, and Techniques* (London, 2012), pp. 377-387.

continues to signal, the unity and cohesion—spatial and conception—of the realm beyond the arch', and brings order to the performance.[96] As a result, the proscenium allows the performers to focus their efforts in one direction only, and mitigates the necessity to appease views from different angles, thus ensuring that each vantage point in the audience is relatively the same.

Precisely around the time of Dubreuil's publication, the Italian proscenium arch was integrated in French theatres[97] and by 1650 became the standard in Europe.[98] As Sarah Cohen explains, this changed the way theatrical events were presented and henceforth viewed by reorienting performances within the prescribed space of the proscenium, creating a sense of visual order analogous to a perspectival painting.[99] Indeed, Cohen surmises that 'the challenges that choreographers, costumers, and scenic designers faced in reshaping the dance for the stage must thus have been similar to that of painters attempting to integrate figural scenes in centralised perspective.'[100] In Dubreuil's third and fourth catoptric boxes (fig. 100 & 101), the peephole acts as the thoroughfare, as the proscenium arch, that organises the scene. As such, when peeping into these boxes, the observer is privy to a miniaturised stage setting designed exclusively for a single, monocular spectator.

The peephole is crucial to the effectiveness of the displays presented with boxes 3 and 4. First, in order to see the spectacle of the mirrored and painted panels juxtaposing off of each other, carrying the reflections of the three-dimensional objects with them, we

[96] P. Camp, 'Theatre Optics: Enlightenment Theatre Architecture in France and the Architectonics of Husserl's Phenomenology', *Theatre Journal* 59, no. 4 (December 2007), p. 631.
[97] For details on this development see Lawrenson, *French Stage and Playhouse*, p. 135.
[98] S. V. Longman, 'The Idea of the Playhouse', in P. C. Castagno (ed.)*, Theatrical Spaces and Dramatic Places: The Reemergence of the Theatre Building in the Renaissance* (Tuscaloosa, 1996), p. 14; Kernodle, *From Art to Theatre*, p. 167.
[99] S. Cohen, *Art, Dance, and the Body in French Culture of the Ancien Régime* (Cambridge, 2000), p. 29.
[100] Cohen, *Art, Dance*, p. 30.

must look from the sides of the boxes—and through them. The peephole thus accommodates this point of view. Moreover, because the miniature figurines placed inside the boxes would inevitably be positioned fairly close to the observer's eye monocular vision is paramount to seeing these objects clearly. When an object is placed close to our eyes and our gaze travels elsewhere, the object becomes fuzzy in light of the fact that what we now see is the image from the point of view of the left eye superimposed with that of the right eye. The monocular peephole renders the interior display and all of the three-dimensional objects static, as if painted on a flat surface. The peephole guards against distortion and fixes the interior display as the observer looks about the space in every direction.

In addition to orienting our point of view and guarding against parallax, the monocular peepholes in boxes 3 & 4 are also fundamental to the catoptric peep-box's unique deceits. Like the miniature figurines, jewellery, or coins placed within the box, the viewer's eye looking through would likewise be reflected in the mirrors, caught in the dizzying spectacle and replicated over and over as it stares back towards the observer peeping in. This modifies the voyeuristic appeal of the peep-box, for the observer is figuratively acknowledged through the reflection of his eye; we see ourselves seeing. In turn, it could be said that these peep-boxes act as a play on the concept of 'breaking the fourth wall.' In a proscenium theatre, a fourth wall is imagined as existing between the stage and the audience, enclosing and sealing off the space taken up by the actors. 'Breaking the fourth wall' is a meta-theatrical trope whereby an actor acknowledges the audience, thereby shattering the hermetic world of the play, drawing attention to its fiction and instigating self-awareness. As discussed in chapter 2, Dutch perspective boxes

prompt this self-awareness through the gaze of pets placed within the scenes. In Dubreuil's catoptric peep-boxes, this self-reflexivity is made more acute by mirroring the observer's own eye. While catoptric peep-boxes may not *break* the fourth wall per se, I propose that they pierce it, presenting a glimpse, or a peep, of an otherwise enclosed and self-sufficient spectacle.

Pushing this dynamic to its extreme are the fantastical designs by German scholar Johannes Zahn (1641-1707).[101] In *Oculus Artificialis Teledioptricus Sive Telescopium* (1685), a treatise largely focused on the devices of the magic lantern, Zahn includes illustrations of several unique catoptric projects. In one illustration, a hexagonal box sits atop a rotating platform, with a peephole located in the centre of the front panel (fig. 112). The scenes contained within are similar to Dubreuil's: either imagined architectural interiors or garden views. Looking through the peephole, each surface appears to be multiplied six times over and deceives the viewer into thinking the entire box is filled.[102] In Zahn's second edition of *Oculus Artificialis* (1702), he expands this idea by devising a large-scale catoptric architectural enclave (fig. 113). Presented as a room within a room, Zahn's hexagonal interior is lined with mirrors on every surface, save for the small openings along the ceiling that are fitted with translucent material to allow light to enter from the exterior.[103] Zahn's design recalls Brunelleschi's panel demonstration of the Florentine Baptistery in its incorporation of the sky with a mirrored illusion. However, as opposed to presenting a recognisable and cohesive sense of space, this architectural

[101] Zahn is most well-known for his prolific work on the *camera obscura* and the magic lantern. He was also the first to link projection with motion in his magic lantern demonstrations, thereby contributing to the pre-history of modern cinema. See T. W. Bohn, R.L. Stromgren, and D.H. Johnson, *Light and Shadows: a History of Motion Pictures* (Port Washington, 1975), p. 4.
[102] G. Teyssot, 'Baroque Typographies', *Assemblage*, no. 41 (April 2000), p. 79.
[103] Teyssot, 'Baroque Typographies', p. 79.

design cultivates a dazzling and dizzying spectacle intended to disassociate the observer from his surroundings.

I would like to suggest that Dubreuil's peep-boxes toy with the classical affiliation between mirrored and painted surface. In his theoretical exercises, painting is, quite literally, held up to a mirror, albeit a distinctly *catoptric* mirror. Observers peep through the backside of a painting out towards its mirrored reflection in the same manner as Brunelleschi's panel demonstration. However, Dubreuil's boxes push this visual dynamic to its utmost extreme, for, as mentioned, the likeness of the observer's eye is caught in the proliferating reflections within the scene. In and amongst the replications of figurines and painted backdrops, the eye would likewise fill the box's interior and regress into infinity. In Brunelleschi's demonstration, the mirror and peephole serve to ground the observer's relation to perspectival space by assuring a unification of surfaces in the direct correlation between eye point and vanishing point. Catoptric boxes disrupt this connection and disorient the spectator through a dazzling array of reproductions. While the apertures accompanying *Perspective Pratique*'s mirror anamorphoses fix the eye of the observer, the catoptric peep-boxes complicate the peephole's orienting function. Peeping within, the eye is caught in a complicated web that weaves two-dimensional and three-dimensional media together in dizzying spectacle, casting doubt on the mirror's veracity and the viewer's position before it.

Thus far I have outlined the role of catoptric illusions in the context of the Jesuits' educational program as well as the play of reflections caused by mirrors placed in devices that were often located in the private domestic spaces of wealthy patrons looking to playfully highlight their accumulated wealth, or enjoy a private thrill when peeping into

their treasure chests. In addition to serving a religious or decorative purpose, catoptric mirrors were also used to symbolise political reform, a point I turn to presently.

VI. Invisible Portraits Privy to the Eye: Catoptric and Dioptric Political Allegories

The realigning properties of catoptric illusions offer the artist an opportunity to imbue their design with rhetorical effect. In this section I look deeper into the ways in which the catoptric mirror disseminated clever political allegories in the early modern period. In so doing, I also turn to the unusual devices of the dioptric perspective tube, which amalgamated hidden portraits in the monocular space of a telescopic tube. Both mediums convey meaning in their ability to conceal and reveal two images simultaneously.

In Mario Bettini's (1582-1657) *Apiaria universae philosophiae mathematicae* (1642) we find an illustration of a single eye reflected in a cylindrical mirror; its anamorphically distorted counterpart lies on the ground before it, its eyelid distended and spilling into the margins (fig. 114). The disfigured eye beneath bears a striking resemblance to Leonardo's anamorphosis discussed in chapter one (fig. 12). However, in this case, Bettini's eye is not an anonymous organ, but an ocular portrait of Cardinal Colonna, whose diocese reformed the Catholic Church in Bologna thereby ensuring moral 'alignment' for the Bolognese people.[104] What is more, Bettini's print alludes to the possibility that Colonna's leadership was foretold via 'catoptromancy', the art of divining the future in a mirrored reflection.[105]

[104] H. Grootenboer, *The Rhetoric of Perspective: Realism and Illusioniam in Seventeenth-Century Dutch Still-Life Painting* (Chicago and London, 2005), pp. 110-111.
[105] Blanchard, *L'Optique du Discours*, pp. 170-171.

Another instance of the catoptric mirror's metaphoric potential is found in the design of channel anamorphoses, which involve the display of two disparate images simultaneously (fig. 115). This catoptric technique proves the mirror's capacity to reveal what lies concealed on the underside of any given painting. Channel anamorphoses consist of two paintings, usually portraits, divided into numerous vertical strips and glued on the sides of a series of triangular prisms. Because each image is mounted on either the right or left sides, the disparate images cannot be seen concurrently. When looking at the channel anamorphosis from oblique angles, no clear picture can be made out. With the aid of a mirror placed at a precise position above the series of prisms, two portraits come to life in a rather surprising way.[106] Niceron provides a breakdown of this catoptric method in *La Perspective Curieuse* (fig. 116).[107] Figure *LIII* at the top right corner shows how the corrugated slats of the channel anamorphosis appear from the side, with figure *LV* demonstrating the final effect.

An extant channel anamorphosis by Italian painter Ludovico Buti (1560-1611), now housed in the Museo Galileo, Florence shows how this technique can be used to convey a political message (fig. 115). Created in 1593, this piece contains the portraits of Charles III, Duke of Lorraine (1543-1608), and the hidden portrait of his daughter Christine (1565-1637). Instead of requiring the viewer to move from left to right in order to catch a glimpse of each image, Buti uses a mirror to render this construction a simultaneous viewing experience; Charles' portrait can be seen below, while Christine's portrait is seen above concurrently. If seen from the precise location where the portrait

[106] For a detailed mathematical description of the channel anamorphosis, see: J. Sharp and J. L. Hunt, 'The Mathematics of the Channel Anamorphosis', in *Proceedings of the Bridges 2008 Conference on the Mathematical Connections in Art, Music and Science* (Leeuwarden, 2008), pp. 149-154.
[107] Niceron's channel anamorphosis is adapted from Barozzi da Vignola's in *Le due regole de la prospettiva pratica* (1538).

appears, the mirror's surface will resemble a painting. In this way, the mirror adds an element of enchantment to the viewing experience, for we are not only witness to the 'magical' appearance of a hidden picture, but the surface of the mirror is likewise transformed from glass to canvas. Should the viewer step to the side, father and daughter's portraits vanish in an instant, leaving only a jumble of lines on the table and the observer's reflection above. Charles' likeness can only be summoned when the viewer is properly aligned, and in turn, Christine, joined at the head of her father's portrait, exists only in his reflection. Arguably, this anamorphic exercise demonstrates that Charles' dynasty is reflected in Christine's visage; the royal lineage is mirrored in the body of the King's heir.

In addition to catoptric devices, dioptric perspective tubes were apt mediums for political commentary. This device is fashioned from a long tube fitted with a polyhedral lens that reconfigures whatever is placed before it through manifold refractions of light. The lens is flat on the side nearest the eye, and convex on the side facing out, and can be cut with any number of facets. An extant example of a dioptric telescopic portrait by Niceron is housed in the Museo Galileo, Florence (fig. 117). In this piece we see the portraits of several turbaned figures. A number of flags cross over each other in the middle. The telescopic tube and polyhedral lens have since been lost, however the portrait revealed within the perspective tube is reportedly Ferdinando II de Medici, the grand Duke of Tuscany (1610-1670).[108] In Niceron's treatise, he provides a detailed explanation of the methods used to achieve this telescopic illusion, which was then adapted by Jean Dubreuil in *Perspective Pratique* in 1649, and again by Joseph Moxon in *Practical*

[108] The painting itself has survived and is on display at the History of Science Museum in Florence. However, the viewing tube was destroyed during a flood in 1966. The Museum does not have any photographic replications of what appears when looking through the telescope.

Perspective in 1670. In what follows, I will outline the aforementioned authors' exploration of this technique, moving towards a discussion of the perspective telescope's proclivity towards the body politic as a central motif.

Next to optics (study of light and vision) and catoptrics (the study of reflected light), the science of dioptrics developed as a response to the newly invented telescope. Dioptrics is defined as the study of the refraction of light as it passes through a lens. Prior to Descartes' *Dioptrics*, the employment of lenses as optical tools was championed by several writers who advocated their role in perfecting vision, projecting images, or setting things ablaze from a distance, as noted in the writings of Roger Bacon, William Bourne, Alhazen, and Ptolemy.[109] Perspective's clever and artful response to the developing field of dioptrics came in the form of a telescope built for alternative purposes (fig. 118). The so-called perspective telescope amalgamates sections of an existing image, painted flat on a wood panel or canvas, into an entirely new configuration seen only when peering through the telescope itself. The earliest extant exploration of a dioptric telescope is found in *La Perspective Curieuse*, however, Niceron clarifies that he was not the first to have developed this effect, noting that he witnessed a successful dioptric demonstration by Father du Lieu, a Jesuit from Lyon, France.[110] Like a mirror anamorphosis, the telescope is used to reconfigure a carefully planned schema and present the viewer with the unexpected. In this case, the image proper—the one painted on the panel—is not

[109] For an extended discussion on the history of dioptric lenses, see A.Van Helden, 'The Invention of the Telescope', *Transactions of the American Philosophical Society* 67, no. 4 (1977), pp. 1-67. For a history on dioptrics focused on the contributions of Descartes, Huygens, and Hartsoeker, see F. J. Dijksterhuis, 'Constructive Thinking: A Case for Dioptrics', in L. Roberts, S. Schaffer, and P. Dear (eds.), *The Mindful Hand: Inquiry and Invention from the Late Renaissance to Early Industrialization* (Amsterdam, 2007), pp. 59-85.

[110] Niceron, *La Perspective Curieuse*, Book IV, p. 101. Niceron writes that Father du Lieu was the 'first person to have succeeded' at the dioptric effect. '…qui y a le premier bien reüssi que je sçache.'

distorted or skewed; the perspective telescope takes pieces of a painting's makeup here and there and combines them to make an entirely new representation.

Niceron's treatise provides several interesting examples of how this illusory trick can function as propaganda for religious and political purposes. In figure 119, a group of twelve portraits of Ottoman Turks encompass the portrait proper, or the portrait seen without the aid of the dioptric telescope.[111] He writes that when looking through the telescope towards the Turks, we see nothing but the portrait of the king, who is made up of many pieces of other portraits.[112] This conglomeration of disparate pieces of the Ottomans' bodies that form the visage of the king (who one can guess is King Louis XIII) is symbolic of the monarchy's rule over the Turkish Empire. Niceron writes that each Ottoman depicted in his portrait 'pays homage' to the king through the contribution of their body parts to form his own. As Barbara Stafford has argued, the French king's portrait is obviously 'tinged with irony' as it implies that it would take at least twelve Turks to match Louis XIII's might and power. [113]

In the accompanying text, Niceron further accentuates the direct correlation between the body of the ruler and those of the ruled. If you were to touch the right eye of the Ottoman positioned at trapezoid A, he writes, whether with your finger or the indicator, it will seem to the person looking through the telescope that you are touching

[111] Niceron, *La Perspective Curieuse*, Book IV, p. 101. Niceron writes that these portraits were derived from the book *Icones Sultanorum*, or, *vitae et Icones Sultanorums turcicorum* (Frankfurt am main, 1596) by Jean Jacques Boissand: 'Ce tableau dressée en la façon, que nous avons dit en ce livre, estant veu directement, represente une quinaine d'Ottomans vestus à la Turque, la plus part au naturel tirez d'un livre intitulé *Icones Sultanorum*…'

[112] Niceron, *La Perspective Curieuse*, Book IV, p. 101. '..& quand on vient à regarder lar la lunette, au lieu des ces Ottomans, on ne veoit plus, que le portrait de sa Majesté Tres-Chrestienne tres-bien fait, resemblant & vestu à la Francoise, encore qu'il se compose de plusieurs pieces des autres portraits, qui se ramassent & s'unissent ensemble, pour le former tel qu'il se veoit.'

[113] B. M. Stafford, *Devices of Wonder: From the World in a Box to Images on a Screen* (Los Angeles, 2001), p. 187.

'the right eye of the King.' Or, if you were to touch the nose of the Ottoman depicted at trapezoid B, it will appear as if you are in fact touching 'the King's nose,' and so on and so forth (figs. 120 & 121).[114] The central figure at trapezoid E is a portrait of Sultan Amurath IV (1612-1640), the Ottoman Emperor at the time of *La Perspective Curieuse's* publication. Cunningly, Niceron stresses that while he is positioned as the central figure in this array of historic Ottoman leaders, the portrait of Louis usurps his precise position. It would appear to the observer peering through the telescope that Amurath is choosing to abdicate his throne to the French.[115]

In addition to symbolising French rule over the Ottomans,[116] the portrait is coupled with an accompanying poem that serves as an instruction on how to look at it. This verse, Niceron explains, allows the 'mute' portrait 'to speak':[117]

> What is this flat painting?
> You see it as curious, and do not know;
> You see Ottomans & beneath their portraits
> A face is hidden that does not show itself:
> If you would like to see it, put your eye at the opening
> Of the little tube, and you will recognise
> The French Monarch in the painting,

[114] Niceron, *La Perspective Curieuse*, Book IV, p. 115. 'Ce dessein est fait à propos de la Prophetie, au moins tenuë telle, par ceux, à qui elle a esté donnee, que Mahomet laissa autresfois à ses successeurs. Leur recommandant de ne jamais offencer la Monarchie Françoise; parce que leur empire ne seroit jamais ruiné que par la puissance de quelqu'un de ses Roys. Sur ce voulant montret que l'honneur de cette conqueste n'appartient point à d'autre qu'à Louys le Juste, nous faisons que la plus part de ces Empereurs, en ce tableau luy rendent hommage, en sorte qu'ils contribueut chacun quelque partie de soy pour former son image, comme s'ils se despoüilloeint eux-mesmes pour honorer son triomphe: d'où vient qui si avec le doit ou quelque petite baguette où touche l'oeil droict de celuy qui est au trapeze A, il semblera à ceux qui regarderont par la lunette, qu'on touche l'oeil droict du Roy; ainsi mettant la baguette sur le bout du nez de l'autre qui est au trapeze B, il semblera encore que ce foit le nez du Roy, duquel le portrait entier tel qu'il est descrit en la septante-uniesme figure se veoit par la lunette au milieu du tableau, au mesme endroit où est figuré celuy d'Amurath quartiesme, à present Empereur, comme s'il le deboutoit de son Thrône, & prenoit desia possession de son Empire.'

[115] Niceron, *La Perspective Curieuse*, Book IV, p. 115.

[116] Niceron, *La Perspective Curieuse*, Book IV, p. 116. 'A ce propos, un mien amy, à qui j'avois fair veoir le tableau & declaré mon dessein, entrant en ma pensee sit parler cette peinture muëte par une douzaine de vers...'

[117] Niceron, *La Perspective Curieuse*, Book IV, p. 116. 'A ce propos, un mien amy, à qui j'avois fair veoir le tableau & declaré mon dessein, entrant en ma pensee sit parler cette peinture muëte par une douzaine de vers...'

Who brought down the Ottoman Empire;
Who made believers out of an infidel race
Out of these Mohammedans, arise the fleurs de lis
Of our very Christian King, our faithful France
Always recognised as favourite in the sky. [118]

The poem illustrates how the bodies of the Ottoman rulers are subsumed under the head of the King; how he appears, ever so curiously, from the likenesses of his subordinates. In another example, the bust portraits of various historic popes surround the portrait of Jesus in the centre (fig. 122). Peering through the telescope, the viewer is privy to the portrait of Pope Urban VIII (1568-1644), who replaces the position previously taken by Christ.[119]

The reconstituting quality of the dioptric telescope can also bring together disparate aspects of a whole. Niceron explains how a human body, broken into several pieces and arranged on a canvas, can be reconstituted in the space of the telescope.[120] In addition to reconstitution, this instrument is capable of magnifying or uncovering hidden pictures for the delight of the viewer. Niceron illustrates this by instructing the viewer to paint an image as tiny as they can on a finished painting; he recommends hiding this 'secret' painting on a medallion or ring on the painting proper (such as on a lady's finger, or a button on a coat). Reversing the picture can further conceal it as well. In order to do

[118] Niceron, *La Perspective Curieuse*, Book IV, p. 116. 'Que va representant cette plate peinture?/ Tu le veois curieux, & ne le cognois pas;/ Tu veois des Ottomans, & souz leur portraiture/ Un visage est caché, qui ne se montre pas:/ Si tu le veux cognoistre, mets l'oeil à l'ouverture/ De ce petit canal, & tu recognoistras/ Du Monarque François la naifue peinture,/ Qui doit des Ottomans l'Empire mettre à bas;/ Qui fera des Croissans de la race infidelle/ De ces Mahometans, surgir les Fleurs de Lis/ De nos Roys Tres-Chrestiens, que la France fidelle/ A toujours recogneu du ciel les favoris.'
[119] Niceron, *La Perspective Curieuse*, Book IV, p. 118-119. 'Ce tableau dressé de la sorte que nous avons dit en ce livre, represente d'abord Jesus-Christ au milieu de plusieurs Papes, dont la plus part contribuent à former le portrait de N.S.P. le Pape Urbain VIII qui se veoit, en regardant par la lunette, au milieu du tableau, en la mesme place où est figuree l'image du Christ.'
[120] Niceron, *La Perspective Curieuse*, Book IV, p. 119. 'On pourroit faire de mesme en un dessein où les parties de la figure d'un corps humain estant divisees &reduites aux espaces du plan artificiel... .'

so, one should situate the telescope near the hidden area, so that the secret miniscule painting will appear in its fully magnified form.[121]

Looking through a perspective telescope, we realise that what our naked eye understood to be real was actually fiction. We come to see that we cannot put too much stake into the new portrait hovering within the space of the telescope for it will disappear with the slightest shift in position. Apparently, creating a perspective telescope is no easy task. While the main points of the disparate portraits can be mapped onto a canvas or piece of paper with a fair bit of ease, in order to assure that the image appears within the telescope as it should, drawing and adjustments must also be performed while looking through the telescope. Because the conglomerated portrait exists solely within the space of the tube, it is imperative that aspects of the design are performed within this monocular space.

In *La Perspective Pratique,* Jean Dubreuil adapts Niceron's dioptric setup, and offers an explanation for how to construct this demonstration vis-à-vis the telescope.[122] In order to sketch the whereabouts of each fragment of the portrait seen in the telescope, it is required that the draughtsman uses the telescope itself as a tool to outline the facets of the

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[121] Niceron, *La Perspective Curieuse*, Book IV, p. 119. 'Car on pourroir peindre en quelque tableau que se fut, ce qu'on voudroit faire veoir par la lunette, extremement petit, & renversé s'il estoit necessaire; en sorte qu'en regardent la peinture directement, en ne s'en apperceut pas; & mesme, pour en cacher davantage l'artifice, on pourroit peindre sa figure sur quelque medaille ou anneau, qui d'ailleurs ne parut pas inutile en la peinture; & mettant l'oeil à la lunette opposeedirectement à ce petit objet, elle en grossiroit tellement l'apparence qu'on verroit les moindres parties sort distinctement.'

[122] J. Dubreuil, *La Perspective Pratique: necessaire à tous peintres, graveurs, sculpteurs, architectes, orfeures, brodeurs, tapissiers, & autres se servans du dessein.* (Paris, 1642), Book VII, p. 158. Looking through the telescope, Dubreuil suggests that the draughtsman mark the outlines of each facet of the crystal on the plane *FGHI* (fig. 123). If light is projected into the tube, it will be broken up into pieces due to the multiple facets, and will project shapes at different areas on a flat surface in front of it. These shapes can then be traced with a pencil. Looking through the lens, the draughtsman can carefully draw an image on these fragmented pieces. The telescope should be placed along the board *KL* no longer than one or two feet from the draughtsman as it must accommodate the length of an arm in order to reach the canvas. '…l'on doit marquer sur le plan FGHI les projectons que chaque facette du verre y donne, en regardent par le petit trou , ainsi qu'on verra au feüille suivant.'

polyhedral lens (fig. 123). While both Niceron and Dubreuil suggest to plan out the design of the portrait beforehand, it would nonetheless be necessary to verify how the image comes together in the telescope, and to make adjustments as needed. It is only within the monocular space of the telescope itself that the portrait as a whole 'exists' to the extent that it becomes visible, thus it is crucial that the telescope is treated not solely as a vehicle through which the amalgamated portrait comes together, but it should also be regarded as the primary tool with which to craft the image; the telescope is both means and method. Curiously, while Dubreuil and Niceron urge the draughtsman to consider the distance between the board and the telescope in lieu of the length of the draughtsman's own arm, Dubreuil appears not to have taken this into consideration when sketching his illustration. In figure 29 the draughtsman's right arm is stretched a considerable amount. If he were to place his arm at his side, it would no doubt fall close to his feet.

This dioptric portrait functions as a clever piece of propaganda, for the piece is held together at all four corners by the presence of Jesuit decree. In figure 124, we see four separate and discrete portraits, comprised entirely of key Jesuit figures. Starting in the top left and moving clock-wise are: Saint Ignatius (1491-1556), Saint Xavier (1506-1552), the patron saints of the Jesuit Order, and Louis Gonzague (1591-?) and B. Stanislas (Stanislaus Kostka) (1550-1568), who were prominent French and Polish Jesuits, respectively. Each respective portrait at *A,B,C,* and *D* are hidden amongst the heads of angels and cherubim in the spaces of (top, clock-wise), *L, M, K, N*.[123] The observer would have to move his telescope around to meet the four corners of the

[123] Dubreuil, *La Perspective Pratique*, Book VII, p. 165. '…estant tres certain que si on desseigne & rapporte fidellement ce qui est aux Prototype A.B,C,D, sur les projections de K,L,M,N, que regardent par les trous qui sont au bout du tuyau; Ces images paroistront à la perfection. Par example, par le trou B, celuy de S. Xavier; Par le trou C, celuy du B. Louis de Gonzaque; Et par le trou D, celuy du B. Stanislas. Le premier est sur le plan en K, le second en L, le troisiéme en M, & le quatriésme en N.'

illustration, where all of the saints are stationed, awaiting revelation. The choice of such figures for the portraits is compatible with Dubreuil's membership in the Jesuit Order in Paris.

Several decades after Dubreuil's treatise, the English perspectivist Joseph Moxon adopts this curious mode of picturing in his treatise *Practical Perspective* (1670).[124] At first sight, Moxon's method for creating a hidden dioptric portrait is the same as that of Niceron and Dubreuil. However, Moxon's plan remains incomplete. While he suggests that the spaces between the traced faces of the crystal can be filled so as to hide the dioptric portrait, he only does so in one instance, shape number *1*, with the bust portrait of a woman (fig. 125).[125]

As we have seen, Moxon, Niceron, and Dubreuil all advocate a method of picture making and picture viewing that in one way or another relies upon the monocular vision brought about by means of the tube. Their hidden portraits are largely executed not only from the vantage point of the perspective tube, but notably *within* and *through* a portrait that exists solely as an appearance generated by monocular vision. The telescope has a double role as the prime means of creating the image, and the essential tool used to reveal the illusion. Behind the fascination with the hidden images uncovered and reconstituted in the dioptric telescope is the belief that our vision, unaided, is unable to solve such

[124] J. Moxon, *Practical Perspective or Perspective Made Easie: Useful for all Painters, Engravers, Architects, &c. and all others that are any waies inclined to Speculatory Ingenuity* (London, 1670), p. 66.
[125] Moxon, *Practical Perspective*, p. 66. 'If you have a mind to further amuse Spectators, you may to every one of the Faces on the plain draw another Picture: as in the Face marked 10 on the Plain you find an Ey, to this Ey make up an whole figure; To the Face marked 12 you find the Mouth, to this make up another whole Figure & c.'

visual riddles, to get to the root or truth of the image. What is afar cannot be fully understood nor is it intelligible until it is brought within close range for proper study.[126]

This study of perspective telescopes would be remiss without an explanation of the repeated use of portraits as the prime motif to demonstrate the dioptric effect. As discussed in chapter one, the use of portraits in anamorphic exercises such as Scrots' Edward VI (figs. 14-15) functioned as a fitting allegory for the period. In the exercises discussed in the body of this chapter, I have suggested that dioptric portraits present a great opportunity to convey the notion of the body politic, where the idea of a country is represented as a corporeal entity, and where portions of a whole, the populous, are amalgamated into one.[127] This is especially true in light of Niceron's portrait of Louis XIII formed out of the bodies of the Ottoman Turks. Whether a figure of political or religious rule, the visage that appears within the confines of the telescope expresses, both literally and metaphorically, the 'correct' vision for the people it represents. Moreover, as discussed in this dioptric setup, the spectator is encouraged to engage with these unreachable figures by 'touching' the nose of the King or Christ through the bodies of his followers and subordinates. Another link between anamorphic devices and the body politic I will work out in the next section is the manner in which perspective telescopes such as Niceron and Dubreuil's informed what is perhaps the most famous visualisation

[126] B. M. Stafford, '"Brilliant Ideas" to "Fitful Thoughts": Conjecturing the Unseen in Late Eighteenth-Century Art', *Zeitschrift für Kunstgeschichte* 48, no. 3 (1985), p. 352. Barbara Stafford contrasts the phenomena of the phantasmagoria of the eighteenth century, wherein two levels of reality (the fantastical and the everyday) are present within the same space, with the impetus and desire in the seventeenth century to bring what appears 'far away' (i.e., astronomical objects) close at hand for direct study. Making the unseen visible is a terrain of imagination that the artist is well-equipped to handle.

[127] A.D. Harvey's recent study has shown that by the sixteenth century, the use of the body as a metaphor for the state was an established trope and had become somewhat of a cliché. A.D. Harvey, *Body Politic: Political Metaphor and Political Violence* (Newcastle, 2007), p. 23. See also E.H. Kantorowicz, *The King's Two Bodies: A Study in Mediaeval Political Theology* (Princeton, 1957).

of the idea of the 'body politic,' namely as it has been reified in the frontispiece to Hobbes' *Leviathan.*

VII. The Perspective Tube's Effect on Poetic and Philosophical Thought

While rare, dioptric telescopes aroused much interest from philosophers and poets alike as we find many references to their unique design in several early modern pieces of writing. Indeed, the way in which one image of a monarch is constructed from his various subjects carries a straightforward political connotation as well. Noel Malcolm has argued that Thomas Hobbes' well-known engraving for the frontispiece of his treatise *Leviathan* (fig. 126 & 127), published in 1651, was influenced by Hobbes' interest in dioptric telescopes.[128] This frontispiece presents a very similar idea to Niceron's dioptric portrait of Louis XIII, and while it may not have directly inspired Hobbes' design, its rhetorical structure is similar. Engraved by Abraham Bosse—who was, by the way, a perspectivist—the frontispiece depicts several compartments illustrating various branches of political power: ecclesiastical power (on the right) and civil or earthly power (on the left). Above, an enormous figure towers over a landscape with a sword in one hand and a crosier in the other. This figure stands beneath a quote from the book of Job: '*Non est potestas Super Terram quae Comparetur ei. Iob. 41 . 24*,' ('There is no power on earth to be compared to him. Job 41 . 24'). This excerpt links the body of the gargantuan figure to the Behemoth, a large beastly figure mentioned in Job 40: 15-24, who has come to represent powerful entities.

The body of this behemoth is made up of over three hundred individual figures. Bosse's engraving is likely a copy of a similar illustration by Wenceslaus Hollar, which

[128] N. Malcolm, *Aspects of Hobbes* (Oxford, 2004), p. 201.

was placed in the copy of *Leviathan* given to Charles II by Hobbes (fig. 128).[129] Both designs carry the same intended meaning: that the body of the Leviathan (the sovereign) is made up of the members of the public who abide by the social contract. In Hollar's illustration the figures populating the body of the sovereign look out toward the viewer. Conversely, Bosse's engraving depicts the figures facing in, looking up towards the sovereign. Keith Brown has argued that Hollar's illustration in fact represents a closer reading of Hobbes' political theory. In duplicating the body language of the sovereign, the figures in Hollar's work uniformly affirm that 'what Leviathan wills is what we will.'[130] Thus, the turning of the heads in Bosse's engraving is peculiar. I suggest that there are two possible reasons for this modification. First, the grouping of heads in Hollar's drawing makes for an awkward mosaic given that the level of detail of each portrait lends the Leviathan's body a certain unappealing lumpiness.[131] Second, the turning of the figures in Bosse's engraving may be due to the fear that the figures looking out toward the viewer reflect too closely the biblical demon, Legion, who was composed of many monstrous creatures.[132] While Bosse modified Hollar's drawing, his rendition nonetheless points to the original intention of Hobbes' design, inspired by the very dioptric telescopes discussed above.

In addition to the well-known image of Leviathan, more evidence of the popular appeal of perspective telescopes can be found in two English texts from the seventeenth century. The first was written by Richard Fanshawe, and is found in the dedication to

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[129] For details on this attribution see K. Brown, 'The Artist of the *Leviathan* title-page', *British Library Journal* 4 (1978), pp. 24-36.
[130] Brown, 'The Artist of the *Leviathan*', p. 32.
[131] Malcolm, *Aspects of Hobbes*, p. 201.
[132] 'And Jesus asked him, saying, 'What is thy name?' And he said, 'Legion': because many devils were entered into him.' Luke 8:30 (Authorized (King James) Version).

Prince Charles in Fanshawe's translation (1647) of Giovanni Battista Guarini's *Il pastor fido* (1590):

> You Highnesse may have seen at Paris a Picture (it is in the Cabinet of the great Chancellor there) so admirably design'd, that, presenting to the common beholders a multitude of little faces (the famous Ancestors of that Noble man); at the same time, to him that looks through a *Perspective* (kept there for that purpose) there appears onely a single portrait in great of the *Chancellor* himself; the Painter thereby intimating, that in him alone are contracted the Vertues of all his Progenitors; or perchance by a more subtile Philosophy demonstrating, how the *Body Politick* is composed of many *natural ones*; and how each of these, intire in it self, and consisting of head, eyes, hands, and the like, is a head, an eye, or a hand in the other: as also, that means *Privates* cannot be preserved, if the *Publick* be destroyed, no more then those little Pictures could remain in being, if the great one were defaced: which great one likewise was the first and chiefest in the Painters designe, and *that* for which all the rest were made. [sic][133]

The dioptric portrait that Fanshawe discusses has not survived, but following its description in this passage, it is highly plausible that it looked very similar to Niceron's design.

Three years after Fanshawe's mentioning of a dioptric telescope, in response to his preface to *Gondibert* (1650), Hobbes himself described the device in a letter to Sir William Davenant, dated January 1650:

> I believe (sir) you have seene a curious kind of perspective, where, he that looks through a short hollow pipe, upon a picture conteyning diverse figures, sees none of those that are there paynted, but some one person made up of their partes, conveighed to the eye by the artificiall cutting of a glasse. The vertues you distribute there amongst so many noble Persons, represent (jn the reading) the image but of one mans vertue to my fancy, which is your owne; and that so deeply imprinted, as to stay for ever there, and governe all the rest of my thoughts, and affections… [sic][134]

[133] W.F. Staton and W.E. Simeone (eds.), *A Critical Edition of Sir Richard Fanshawe's 1647 Translation of Giovanni Battista Guarini's Il pastor fido* (Oxford, 1964), pp. 3-4. As quoted in Malcom, *Aspect of Hobbes,* p. 202.
[134] W. Davenant, *Gondibert* (Oxford, 1971), p. 55.

Hobbes' description of the 'short hollow pipe, upon a picture conteyning diverse figures' is undeniably a description of a dioptric device.[135]

References to the awe-inspiring effects of dioptric perspective tubes also spring up in several seventeenth-century poems, pointing not only to the general knowledge of such ludic instruments but also to their imaginative properties. These references often occur in conjunction with discussions on the astronomical telescope. In a poem entitled 'The Telescope and Imagination,' later published in Galileo's *Il Saggiatore* (1623), Johann Faber (1574-1629) blesses Galileo's newly invented telescope as possessing extraordinary abilities. Just as eyeglasses allow the old and frail to see, writes Faber, so too has Galileo provided the earth with spectacles to see the stars anew:

> O bold deed, to have penetrated the adamantine ramparts of
> heaven with such frail aid of crystal.
> Happy souls, to whom it is given to survey the citadels of
> the gods through your tube, Galileo.[136]

Here, Faber not only equates the celestial with the tough, 'adamantine' surface of a diamond, he also describes how it could be punctured by means of an object that holds similar properties. Piercing the heavens with the 'frail aid of a crystal' eloquently demonstrates the perspective tube's material properties.

Faber's dedication to Galileo was later mocked by Jesuit rhetorician Emanuele Tesauro (1592-1675) in his treatise on poetics, *The Aristotelian Telescope (Il cannocchiale aristotelico*, 1654). Tesauro was dubious about Galileo's role in telescopic innovation, and instead chose to credit the invention of this device to the Dutch:

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[135] Malcolm, *Aspect of Hobbes*, p. 202. Malcolm is the first to explicitly connect Bosse's engraving for *Leviathan* with Niceron's dioptric device.
[136] As translated in M. Nicolson, 'The Telescope and Imagination', *Modern Philology* 32, no. 3 (February 1935), pp. 250-251.

> I do not know if it was human or divine genius when, not so long ago, that Dutchman, using two lenses, or rather two wings of glass, brought human sight by means of a hollow tube further than a bird can fly. With them the sea can be crossed without sails, and one can clearly see the ships, forests, and cities that normally escape the eye. Flying like lightning up to the heavens one may observe the spots of the sun, see the horns of Vulcan in front of Venus, measure the mountains and the seas on the globe of the moon, count the children of Jupiter. That which God has hidden from us, a tiny bit of glass reveals. Thus you may judge how old the world has grown, since she needs glasses of such long vision. What is it indeed that can now remain hidden from human artfulness? [137]

Tesauro's use of the wings of glass as metaphor for the astronomer's ability to fly towards the heavens beautifully illustrates the manner in which the astronomical telescope equips the body with the appendages necessary to see objects at a great distance. Moreover, his use of the phrase, 'That which God has hidden from us, a tiny bit of glass reveals' movingly speaks to the perspective tube's ability to reveal the otherwise covert.

The likelihood of Tesauro having come in contact with dioptric telescopes is illustrated in the frontispiece to his treatise (fig. 129). *Il cannocchiale* is devoted to the literary devices of metaphor, which Tesauro defines as 'the most eloquent and fertile childbirth of human intellect,'[138] and the ultimate expression of wit.[139] On the left, the personification of Poetry gazes through a telescope toward the sun, as Aristotle lends his support, holding the end of the instrument. The title of the treatise, *Il cannocchiale aristotelico*, refers to Aristotle's *Rhetoric* (4th century BC), which Tesauro qualifies as a

[137] As translated in E. Reeves, 'The Rhetoric of Optics: Perspectives on Galileo and Tesauro', *Stanford Italian Review* 7 (1987), p. 132.
[138] As translated in A. Maggi, 'The World's Self-Portrait in Blood: The Shroud of Turin as Ecstatic Mirror in Emanuele Tesauro's *Sacred Panegyric*', *The Journal of Religion* 85, no. 4 (October 2005), p. 583. See also R. E. Proctor, 'Emanuele Tesauro: A Theory of the Conceit', *MLN,* 88, no. 1 (January 1973), pp. 70-71. Proctor notes that Tesauro ranks 'wit', as devised through metaphor, as the ultimate achievement in language.
[139] P. Schwenger, 'Crashaw's Perspectivist Metaphor', *Comparative Literature* 28, no. 1 (Winter, 1976), pp. 66-67.

'most clear telescope to be used to examine all the perfections and imperfections of eloquence.'[140] To Poetry's right, the personification of Painting sits at an easel where a conical mirror has been painted, while in the upper right corner the blazing sun is marked with several faint shadows. Focusing in on the palette held in Painting's left hand, Eileen Reeves has put forward the argument that the five conspicuous paint globs represent the sunspots that Galileo captured on a white sheet of paper through the projection of his telescope, as shared in his *Letters on Sunspots* (1613).[141] For Galileo, the sunspots functioned as metaphors that helped to infer pertinent information about the sun through indirect observation. As Reeves' argument goes, Painting transforms such indirect projections, 'that representation of metaphor,' into material form and uses them as paint for her canvas.[142]

Further evidence to support the relationship between Galileo's spotted sun and Tesauro's exploration of metaphor is found in the two Latin inscriptions on the frontispiece. A banner above the scene reads 'egregio in corpore' ('excellent in body'), while the phrase 'egregio inspersos reprehendit corpore naevos. Horativs' ('no more than birthmarks mar a handsome man [or body]. Horace') stretches along the bottom of the page.[143] The second quote derives from the Roman poet Horace's (65 BC-8 BC) collection of semi-autobiographical poems, *Satires* (35-33 BC). The line quoted by Tesauro is taken from Book I, and when read in context beseeches the reader to admire the author's strength of character in spite of small imperfections:

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[140] As translated in L.B. Lambert, *Imagining the Unimaginable: The Poetics of Early Modern Astronomy* (Amsterdam, 2002), p. 12.
[141] Reeves, 'Rhetoric of Optics', p. 140.
[142] Reeves, 'Rhetoric of Optics', p. 140.
[143] Horace, *Satires* 1.6, 89. As translated in Horace, *Horace: Satires,* trans. J. Svarlien (Indianapolis, 2012), p. 26.

> Now if my faults are few and rather middling
> And compromise my otherwise good nature
> No more than birthmarks mar a handsome man;
> If no one can in fairness charge that I'm
> In love with wealth, or vile, or lecherous;
> If I may take some pride in living a clean
> And honest life and say my friends are fond
> Of me—all this I owe my father.[144]

When read within the confines of Tesauro's frontispiece, 'egregio inspersos reprehendit corpore naevos' speaks to the small faults, or spots, that deface an otherwise immaculate surface, here represented by the sun. These spots are detectable only through close inspection with the telescope, or, in light of the main concerns of *Il cannocchiale*, true wit. Ladina Bezzola Lambert explains that 'wit works like a telescope in that it may be used to scrutinize one's surroundings in the attempt to establish as many different qualities in each object as possible.'[145] After differentiating the distinct qualities of objects, the rhetorician can then devise new connections in the pursuit of clever metaphors. Wit, like the telescope, is a discerning tool that allows one to probe. Thus, uncovering minor imperfections can be said to indicate that one is looking very closely and is ultimately able to uncover minute yet critical details. Finally, 'egregio inspersos reprehendit corpore naevos' may also refer to the pursuit of perfection in the practice of poetry and rhetoric. Tesauro may be commenting that while flawlessness is a noble and worthwhile objective in the creation of art, it is far from attainable in practice.[146]

The mirror within Painting's canvas realigns a stretch of blurred text at its base, which is ripe with symbolic meaning. The text reads 'omnis in unum', or 'all in one.' On

[144] Horace, *Satires* 1.6, 87-94, p. 26.
[145] Lambert, *Imagining the Unimaginable*, p. 12.
[146] L. Bolzoni, 'L'image comme interprète du texte. Exemples de livres illustrés au XVIIe siècle', *Comptes rendus de séances de l'Académie des Inscriptions et Belles-Lettres* 152, no. 3 (2008), p. 1165.

a superficial level, 'omnis in unum' signifies the unity provided by the mirror, or perspective, as a means of seeing an illusion 'all in one', from one specific location. Tesauro's inscription is likewise seen best from our point of view before the frontispiece. The catoptric mirror also bears significance in light of *Il cannocchiale*'s central thesis. In the text metaphor is presented as a medium for 'bringing together different concepts within a single term, showing these things in a miraculous way, such that one appears by means of the other.'[147] Writing metaphorically, Tesauro qualifies human intellect as a mirror, which expresses 'the images of the objects that present themselves before it [the intellect].'[148] The mirror, like the mind, reflects the external world, and is subject to change depending on what is placed, or seen, before it. The ultimate goal of a metaphor is to evoke a 'marvel' which Tesauro defines as 'the mind's attentive contemplation of some new and remarkable object. Ignoring its origin, the soul is suspended and wishes to know it [the object's origin].'[149] A marvel originates in the intellect as a curiosity, a question, a query, and then 'overflows into the body' and renders its speechless.[150]

As Armando Maggi explains, 'a successful visual or verbal metaphor produces an "ecstatic" moment of inner suspension. In this internal silence man yearns to understand, to dive into the mystery summoned by marvel.'[151] For Tesauro, metaphor works like an anamorphic mirror that 'magnifies the light such that it is more astonishing and enjoyable to view objects through a perspectival distortion than when you see the original things with your own eyes.'[152] Pleasure derives from the midpoint between illusion and

[147] As translated in T. Weststeijn, *The Visible World: Samuel Van Hoogstraten's Art Theory and the Legitimation of Painting in the Dutch Golden Age* (Amsterdam, 2008), pp. 306-307.
[148] As translated in Maggi, 'The World's Self-Portrait', p. 583.
[149] As translated in Maggi, 'The World's Self-Portrait', p. 584.
[150] As translated in Maggi, 'The World's Self-Portrait', p. 584.
[151] Maggi, 'The World's Self-Portrait', p. 584.
[152] As translated in Weststeijn, *The Visible World*, p. 307.

disillusion; the moment at which you happen to know you are being fooled, but cannot quite ascertain the 'origin' of the deception, despite how eager you are to uncover it. Thus it follows that true wit, for Tesauro, is found in conceit. As he explains,

> …it is a secret and an innate delight of the human intellect to find that it has been sportively deceived; because the transition from illusion to disillusion is a kind of learning by an unexpected way; and therefore most pleasing.[153]

The emphasis Tesauro places on learning 'by an unexpected way' speaks to the Jesuit decree that illusionistic art can teach us that an invisible force (God) organises the world around us. When you are deceived, you ask questions, and this curiosity can lead to spiritual growth.

The depiction of catoptric devices on Tesauro's frontispiece evokes the use of anamorphic illusions as instructive tools for intellectual play. By placing a catoptric mirror on the frontispiece of a text devoted to metaphor, Tesauro infers that optical illusions stand at the apex of visual wit. What is more, the phrase 'all in one' reflected on the mirror's surface reminds the reader that wit often requires seeing things from a certain point of view. Indeed, the pleasure derived from visual deceptions is contingent on a specific location before an image. Dubreuil's monocular catoptric set-ups are distilled versions of such witty deceptions. The illusion is seen 'all in one' by means of the peephole, and it is here where the spectator comes to understand that he is deceived.

VIII. Conclusion

What is particularly potent about a catoptric peep-box and perspective tube is that they render the observer incapable of shifting his position in order to question the

[153] As translated in Schwenger, 'Crashaw's Perspectivist Metaphor', p. 67.

spectacle. We cannot 'look around [their] corners' as Gombrich would suggest.[154] A catoptric peepshow, much like the peephole exercises prominently featured in Dubreuil's treatise, occlude disparate points of view that would otherwise break the illusion. Thus, Dubreuil's peep-boxes reify the irony of monocular illusions: they optimise effect by diminishing our perception. Here we are subsumed in a deceptive funhouse, rendered delightfully incapacitated. Although, as illustrated in the ambling figure occupying the spaces of *Perspective Pratique*'s fictive world, we must first conform ourselves by crouching, leaning, or making a hole of our fist before we can immerse ourselves in within. By arguing that Dubreuil's catoptric peep-boxes were in fact designed as drawers for art cabinets, I have traced a thread connecting the theory of perspective, as presented in treatises, with the culture of collecting and display in the early modern period. The spectactular effects of the catoptric peep-box render it an apt addition to any cabinet of curiosity. By reflecting one's beloved possessions in the hidden *caissons* of the art cabinet, one offers their house guest an opportunity to participate in a visual game and test their knowledge of optics.

In the next chapter, I turn to a drawing instrument that was housed in an art cabinet similar those outlined in the preceding pages, which was presented as a collectible object in the home of a prominent French courtier. Moving forward, I aim to further stress the interrelationship between the practice of perspective, perspective's marvellous accoutrements, and the collecting practices of the European elite.

[154] E. Gombrich, *Art and Illusion: A Study in the Psychology of Pictorial Representation* (New York, 1960), p. 211.

Chapter 4

PERSPECTIVE'S COMPASS: LUDOVICO CIGOLI'S 'PERSPECTOGRAPH' AND KINETIC NAVIGATION

> 'The eye is an instrument… deeply moved by the impact of the outside world, an emotion which is given back to the visible by tracing with the hand.'
>
> —Maurice Merleau-Ponty, *L'oeil et l'esprit*

I. Introduction

On the frontispiece of *La Prospettiva Pratica* (*The Practice of Perspective*) (1610-1613), a manuscript written by seventeenth-century Florentine artist Ludovico Cigoli (1559-1613), one finds an illustration of a rather peculiar looking, multi-angled instrument (figs. 130-131).[1] Gazing through an eyepiece, the draughtsman detailed in this illustration traces the outlines of a cube on a piece of paper beneath his right hand. A complex display of rods, wires, and knobs have been erected in the space before him. In *La Prospettiva Pratica,* Cigoli explains that this is a machine of his own invention, capable of tracing any object onto a picture plane mechanically (fig. 132 & 133). This 'perspectograph' (a term that has been coined by Martin Kemp) is the first machine to lay claims as a genuine automated drawing system, and is the basis for subsequent technological adaptations in the eighteenth and nineteenth centuries.[2]

Cigoli's treatise detailing the form and function of the perspectograph was never published and currently exists only in manuscript form in the Gabinetto Disegni e Stampe

[1] While the physical instrument is no longer extant, the Museo Galileo, Florence owns a contemporary reproduction, which is here pictured.
[2] M. Kemp, *The Science of Art: Optical Themes in Western Art from Brunelleschi to Seurat* (New Haven, 1990), p. 182.

degli Uffizi in Florence.[3] Cigoli had been working on it during the final years of his life, and it was only after his passing that his nephew, Giovanni Battista Cardi (1592- ?), who was a notary by profession, sought the privilege to publish the manuscript in Florence. However, this plan never came to fruition. The treatise was later acquired for Cardinal Leopoldo de' Medici's library where it was perused and held in high regard by artists, theorists, and mathematicians alike.[4] *La Prospettiva Prattica* reveals Cigoli's vast knowledge of current and past art theory in his attempt to provide the most up-to-date, technologically advanced means of drawing in perspective. The truly innovative feature of the treatise is Cigoli's so-called 'third rule' of perspective in which he strongly advocates the use of particular instruments to aid the draughtsman in rendering an object in three dimensions, or for the purposes of creating illusionistic tricks such as anamorphic frescoes. Above all else, Cigoli champions his innovative instrument as the optimum means of circumventing the laborious and lengthy process of drawing in perspective.

Cigoli's perspectograph belongs to a rich history of early modern instruments devised to assist the artist in the rendering of scenes or objects in linear perspective. While the geometrical rules of perspective had been codified by Alberti in the early

[3] The first published version of Cigoli's manuscript dates to 1992, R. Profumo (ed.) *Trattato Practico de Prospettiva de Ludovico Cardi detto il Cigoli: Manoscritto Ms 2660 A del Gabinetto dei Disegni e delle Stampe degli Uffizi*, (Rome, 1992), and subsequently it has been published by F. Camerota in *Linear Perspective in the Age of Galileo: Ludovico Cigoli's* Prospettiva pratica, trans. C. Frost (Florence, 2010), pp. 93-339. It has been generally agreed upon that the manuscript is in Cigoli's hand, however, Eileen Reeves has argued that it is in fact a copy containing a number of Cigoli's handwritten notes. Rodolfo Profumo holds that the manuscript is indeed a copy with large quantity of additions made by Cigoli's nephew Battista Cardi. Miles Chappell explains that the manuscript should be understood as consisting of two parts: Cigoli's treatise, and later additions made by another hand. See F. Camerota, *Linear Perspective in the Age of Galileo: Ludovico Cigoli's* Prospettiva pratica, trans. C. Frost (Florence, 2010), chapter 2, 'The Manuscript', pp. 19-48; M. Chappell, 'Cigoli's *Prospettiva Pratica*: Unpublished But Not Unknown', in L. Massey (ed.) *The Treatise on Perspective: Published and Unpublished* (New Haven, 2003), p. 113; Profumo, *Trattato Practico*, pp. 13-14; E. Reeves, *Painting the Heavens: Art and Science in the Age of Galileo* (Princeton, 1999), p. 120; and Kemp, *Science of Art,* pp. 177-180.

[4] M. Chappell, 'The *Prospettiva Pratica* and Cigoli's Reputation', in Filippo Camerota, *Linear Perspective in the Age of Galileo: Ludovico Cigoli's* Prospettiva pratica, trans. Catherine Frost (Florence, 2010), p. xviii.

fifteenth century, and further studied and developed by artists and theorists throughout the sixteenth century and beyond, the development of perspective instruments thrived in tandem with such abstract, written principles that followed the publication of *On Painting*.[5] The design, function, and malleability of these devices differ to a great degree, yet they all point to a marked interest in the early modern period for precision in drawing. In lieu of mathematical principles, here technology lends a helping hand.[6]

The focus of this chapter can be roughly divided into three main areas of concern. The first section aims to contextualise the perspectograph within Cigoli's enterprise as well as the history of perspectival instrumentation. To begin, I will detail how the perspectograph works and highlight its innovative features. Following, I will examine the provenance of Cigoli's manuscript, moving towards a discussion of Cigoli's theories on vision. In order to ascertain the social profiles of those who would have used an instrument such as the perspectograph, I explore the role of instrumentation in the mathematical sciences in the early modern period. Subsequently, in order to highlight the ingenuity of the perspectograph, I will discuss various drawing instruments that served as the basis for Cigoli's design, such as those by Jacopo Barozzi da Vignola (1507-1573), Albrecht Dürer (1471-1528), Jacob De Keyser (1613-?), and Wenzel Jamnitzer (1508-1585). Through these examples I will trace the monocular basis of drawing in

[5] F. Camerota, 'Looking for an Artificial Eye: On the Borderline between Painting and Topography', *Early Science and Medicine* 10, no. 2 (2005), p. 267.

[6] While I use the term 'technology' to describe Cigoli's device in this chapter, I am using it in the most contemporary of senses, for the word 'technology' did not apply to such devices until after the mid seventeenth century. While there exist many illustrations of technological devices in this period, Jessica Wolfe argues that there is little distinction made between these advents of technology and other 'intellectual disciplines.' Moreover, Adam Max Cohen explains that when early modern theorists discussed devices that we may define as 'technological' in our present day understanding, they, on the other hand, 'used a variety of terms such as *instrumenta nova* [new instruments], *nova reperta* [new discoveries], and *novitates* [novelties], and they referred to the processes used to manufacture these objects as the *artes novae* [new arts] and the *artes mechanicae* [mechanical arts].' See J. Wolfe, *Humanism, Machinery, and Renaissance Literature* (Cambridge, 2004), p. 6; and A. M., Cohen, *Technology and the Early Modern Self* (New York, 2009), p. 13.

perspective, with special focus on several strange, ghostly figures that annotate the draughtsman's presence.

The second section of this chapter explores the legacy of the perspectograh as a marvel collected and exhibited in a seventeenth-century French court. While the manuscript in which the perspectograph originates was never published, knowledge of the instrument circulated beyond the confines of early modern Italy, ultimately manifesting in a reconstruction of the device housed in an art cabinet of a French courtier, Louis Hesselin. Presented as a collectible object, the perspectograph was later happened upon by the perspectivisit Jean-François Niceron during a visit to Hesselin's home. The perspectograph's presence within an art cabinet similar to those discussed in the preceding chapter is demonstrative of the cult of instrumentation in early modern collections. Through a case study of the Dresden Kunstkammer, which housed the largest collection of instruments in the early modern period, I argue that the perspectograph functioned as both a practical tool and an object of marvel.

In the final section, I turn to Niceron's adaptation of the perspectograph in *La Perspective Curieuse* (1652), and will be show that there is a marked difference between his and Cigoli's intended projects. I will question the perspectograph's practical applicability by underscoring the schism that exists between the theoretical and practical uses of this device. Ultimately, I argue that the perspectograph functions as a choreographed performance that allows the draughtsman to perfect his embodied understanding of perspectival space. In the final analysis of this chapter, I will demonstrate how the perspectograph functions metaphorically as a representational

compass that has been used to traverse the boundaries between lived three-dimensional space and the space of representation.

II. The Perspectograph's Mechanics

Consisting of pulleys, strings, a bead, a monocular eyepiece, and manual indicators, the perspectograph requires a fair amount of hand-eye coordination, bodily engagement, and plenty of practice. In order to draw with it, a synchronized rhythm must be achieved between the intricate movements of the right and left hand and the alignment of the eye with the bead, which materially pinpoints the line of sight. To begin, the draughtsman positions the manual indicator on a piece of paper before him, which is fitted beneath with a small lead pen. The manual indicator (lying at the midsection of the white piece of paper in fig. 132) is attached to a string that runs along the table and joins up with a series of poles erected before the draughtsman. The string continues along the vertical pole and is fitted with a tiny bead. When the manual indicator is pulled down toward the draughtsman, the string, and henceforth the bead, moves up along the axis of the vertical rod. Following, when the manual indicator is pushed away from the draughtsman, the bead slides down in tandem. Under the left hand of the draughtsman is a knob that can be turned left or right (bottom left of figs. 132 & 133). A string is wrapped around the knob that then runs horizontally along the lower pole. When the knob is turned to the left, the string pulls taut, and move the vertical pole toward the left. When the knob is turned to the right, the string is released, allowing the pole to glide back toward the right.

Looking through the monocular eyepiece (attached to the rod bent askew on the right-hand side of fig. 132), the draughtsman attempts to align the bead with a starting point on any given object. In Cigoli's manuscript, it is the corner of a cube. By pulling the manual indicator, turning the knob at the left, and moving the eye-piece in the manner he so chooses, the draughtsman aligns his point of view with that of the bead, and then with that of a point on the object in question. A mark is then made on the piece of paper beneath him, after which the bead is moved downward ever so slightly along the edges of the cube, and again a mark is made. The draughtsman continues in this manner until a point-by-point outline of the object is rendered on the paper.

The perspectograph can also be employed to project any image from a sheet of paper onto any given surface at a distance (fig. 134). This is a novel achievement. No other perspective device developed prior to Cigoli's was capable of projecting an image so quickly and with relative ease. In the sixteenth century, a popular method for transferring the outlines of a drawing onto a second surface was the 'pricking' technique, where an artist would lay their cartoon flat against a second surface, such as a wall or canvas, and use a sharp needle to puncture the outline point by point.[7] Cigoli's technique does away with marking the surface with holes, allowing for a far less invasive technique. The draughtsman would begin with the drawing placed on the table before him, and the indicator (with the pen removed) would be placed on top of it. A second person would be required to stand in a predetermined location in order to mark the points on the wall. The

[7] C. C. Bambach, *Drawing and Painting in the Italian Renaissance Workshop: Theory and Practice, 1300-1600* (Cambridge, 1999), pp. 58-60. Carmen Bambach has shown that these pricking instruments were often household tools such as nails, hard wires, or the point-ends of compasses, or if less concerned about the precision of the prick, artists often used the backs of their paintbrushes. This pricking technique is noted by early modern artists such as Giorgio Vasari (1511-1574), Filippo Baldinucci (1624-1697), and Raffaele Borghini (1537-1588).

indicator simply runs over the main points of the drawing in question, and the person maneuvering the perspectograph tells the second draughtsman where to mark the points.

Another innovative feature of the perspectograph is its malleability. The central rod, which works parallel to the picture plane, can be moved at an angle both towards the viewer or tilted away (Fig. 135 & 136). Compared to other early modern drawing devices such as by Pietro Accolti (1455-1532) (fig. 137)[8] which remains fixed in a static, ninety-degree angle, this is an ingenious feature, for it means that not only can objects be traced or projected in perspective proper, but their anamorphic rendition can also be automatically achieved. We have to imagine that when the front rod is tilted away from the viewer, and the artist is in the process of mapping an image onto a wall, the perspective will then be skewed in an anamorphic manner. Inclining the intersection of the perspectograph, one could create an anamorphic image, which is achieved by either depicting the object with the vertical rod on an incline (away from the draughtsman), or by positioning the perspectograph at an oblique angle away from the wall. In light of the perspectograph's ingenuity, it is curious that Cigoli's manuscript was never published. A number of theories circulate explaining this mystery, to these I now turn.

III. Cigoli's Manuscript and Perspective Theory

Despite the unpublished status of Cigoli's treatise, the artist was hardly an enigmatic figure in seventeenth century Florence; in addition to his success as a painter,[9]

[8] Accolti's perspective instrument is functionally similar to an earlier device devised by Albrecht Dürer, which will be outlined in more detail further in this chapter.

[9] For more on Cigoli's paintings see M. Chappell, 'Some Works by Cigoli for the Capella de' Principi', *The Burlington Magazine* 113, no. 823 (October 1971), pp. 577 + 580-583; J. Bean, 'Two Celestial Virtues by Cigoli', *Master Drawings* 6, no. 3 (Autumn 1968), pp. 259-322; S. F. Ostrow, 'Cigoli's Immacolata and Galileo's Moon: Astronomy and the Virgin in Early Seicento Rome', *The Art Bulletin* 78, no. 2 (June 1996); For more on Cigoli's sculpture work such as his *Notomia*, the wax and bronze versions of which are

he was also well regarded for his prose and poetry.[10] Cigoli conducted research for *Prospettiva Pratica* for approximately four years while working for Grand Duke Ferdinando I de' Medici, the Grand (1549-1609) on the decoration of the capella de' Principi at the Church of San Lorenzo in Florence.[11] Drawing was central to Cigoli's practice as an artist, and he devoted much time to it in preparation for his paintings.[12]

The question arises as to why Cigoli's manuscript was not published in his lifetime. One of the most intriguing possibilities lies in his close relationship with Galileo Galilei, whom he met while studying in Pisa,[13] both men having studied perspective under the tutelage of mathematician Ostilio Ricci (1540-1603).[14] In relation to Cigoli's twenty-nine letters to Galileo, there are only two replies, in draft form, from Galileo.[15] These responses were not found among Cigoli's belongings, but among Galileo's papers, which indicates that all physical evidence of correspondence with Galileo might have been intentionally destroyed, either to preserve Cigoli's name, or for the Cigoli family to avoid persecution from the Church. Moreover, the contents of *Prospettiva Pratica* could have been seen as too scientific in nature, which may have led to suspicion from Catholic theologians and Dominican friars who were critical of texts that went against Holy

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now housed in the Museo Nazionale del Bargello Firenze, see L. P. Amerson Jr., *The Problem of the Écorché: Catalogue Raisonné of Models and Statuettes from the Sixteenth Century and Later Periods* (Ann Arbor, 1977), pp. 153-165.

[10] Chappell, 'Cigoli's Reputation', p. xvii.

[11] Chappell, 'Cigoli's *Prospettiva Pratica*', pp. 109-113. Chappell has argued that Cigoli's treatise was in fact written in several sections spanning the years 1606 and 1613, the year he died. Cardi inherited the manuscript in 1613 and planned to publish it during the 1620s.

[12] A. H. Sievers, L. D. Muehlig, and N. Rich, *Master Drawings from the Smith College Museum of Art* (New York, 2000), p. 52.

[13] M. Chappell, 'Cigoli, Galileo, and *Invidia*', *The Art Bulletin* 57, no.1 (March 1975), pp. 92-93. Chappell notes the close friendship between Galileo and Cigoli may have borne out the overwhelming similarities between each man. Both were from noble families in Tuscany, were very well-educated, and shared many diverse and overlapping interests aside from their primary careers.

[14] P. Molaro, 'Possible Portrait of Galileo Galilei as a Young Scientist', *Astronomische Nachrichten* 333, no. 2 (February 2012), p. 190. Molaro expands that there is some evidence that Cigoli may have painted a now lost portrait of Galileo, as noted in a letter from Luca Valerio (1552-1618) to Galileo on April 4, 1609.

[15] Chappell, 'Cigoli's *Prospettiva Pratica*', p. 118, note 38.

Scripture.[16] Eileen Reeves notes that a number of cropped pages in Cigoli's treatise are in fact sections that have been removed to avoid suspicion.[17]

The most plausible reason for the manuscript's unpublished status is the state in which Cigoli left it before he passed away. The inconsistent pagination of the treatise, paired with several incomplete ideas, meant that it was not sufficiently polished enough for publication.[18] Despite the manuscript's draft status, evidence points to the circulation of Cigoli's ideas in Florence during the 1620s and 30s. Specifically, Cigoli's perspective instrument must have been widely discussed if we are to believe Florentine artist Filippo Baldinucci (1624-1697), who in his treatise *Notizie dei professori del disegno da Cimabue in qua* (1702) refers to a device that is clearly very similar, if not identical, to the perspectograph:

> Quite well known is the operation of that instrument, but notwithstanding that, we shall say for those not familiar with it that this machine is intended to draw every object and to take the profile in such a way that, inevitably, that which from a given point appears in perspective will come to be expressed in depth.[19]

Evidently, the perspectograph was noted for its ability to translate—literally—three-dimensional objects into two dimensions, representing a feat in engineering that made a significant impact on the early modern art world.

Cardi's motivation behind publishing his uncle's text may have been more than mere familial affection; he was likely motivated to lend Cigoli's name the respect it was due, and assure that his original theories were properly attributed. In turn, he set out to

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[16] See J. J. Langford, *Galileo, Science, and the Church,* 3rd ed. (Ann Arbor, 1992); and E. McMullin, *The Church and Galileo* (Notre Dame, 2005).
[17] Reeves, *Painting the Heavens,* pp. 121-125.
[18] Chappell, 'Cigoli's *Prospettiva Pratica*', p. 118.
[19] F. Balduccini, *Notizie dei professori del disegno da Cimabue in qua,* Ferdinando Ranalli (ed.), (7 vols., Florence, 1974-1975), vol. 3, p. 656. As translated in Chappell, 'Cigoli's *Prospettiva Pratica*', p. 124.

shape the manuscript, finalising a body of work that the author was unable to complete himself. Cardi included a biography, the *Vita dell' Autore*,[20] of Cigoli at the beginning of the treatise, wherein he writes that his uncle was fervently dedicated to the writing and researching of his treatise whilst conducting other artistic business, which proved fortuitous:

> Recognizing the great dedication with which he was being served, the Grand Duke many times offered Cigoli a stipend and rooms up in the Galleria. Cigoli always thanked him for this offer but never wanted to accept it. This was perhaps because, loving independence even while never being remiss in the service of his prince, he wanted to be able to work as he pleased on certain of his own research projects and in particular on those studies relating to perspective. Having begun to write on this, he developed some instruments that appear at the end of this treatise… This was very productive, for it led to the perfection of his principal instrument, which has such fame and is known everywhere by masters, who are bold to say that it is impossible to be able to make it easier or facilitate it more. It works from every given distance and for everyone, even for the most inexpert in drawing and in perspective, so perfectly, that neither rules nor human intellect can succeed in any way without this tool.[21]

If Cardi's claims are to be believed, then knowledge of Cigoli's perspectograph was widespread in Florence's artistic milieu. Moreover, these exuberant words lend credence to the device's capability of surpassing even the most comprehensive perspectival theory.

Cigoli was astutely aware of the position his manuscript occupied within the larger canon of historic and contemporary perspective treatises. He makes references to several key books on perspective preceding his own such as Leonardo da Vinci's writings, Dürer's *Unterweysung der Messung mit dem Zirckel und Richtscheyt* (*Instructions on Measurement with Compass and Ruler*) (1525), Sebastiano Serlio's *Primo libro* and *Secondo libro* of the *Trattato dell'architettura* (*The First and Second*

[20] Cardi's *Vita* has been published in A. Matteoli, *Ludovico Cardi-Cigoli Pittore e Architetto* (Pisa, 1980), pp. 19-37.
[21] As translated in Chappell, 'Cigoli's *Prospettiva Pratica*', p. 109.

Books of the Treatise on Architecture) (1551), Daniele Barbaro's *La pratica della prospettiva* (*The Practice of Perspective*) (1568), Jacopo Barozzi da Vignola's *Le due regole della Prospettiva Pratica* (*The Practice of Perspective in Two Rules*), as published and edited by Egnatio Danti (1583), Lorenzo Sirigatti's *La pratica della prospettiva* (*The Practice of Perspective*) (1596), and Guidobaldo del Monte's *Perspectivae libri sex* (*Perspective in Six Books*) (1600). Clearly intending to follow in this tradition, Cigoli's manuscript would have been ideally intended for fellow perspectivists and working artists.

The *Prospettiva Pratica* is organised into two books. Book I focuses on Cigoli's theories on vision and the eye in addition to discussions on the relations between the point, line, and plane. Book II concerns the topic of perspective and focuses more on practice than theory. The perspectograph undoubtedly stood as the most innovative and attractive feature of the manuscript, and is probably the reason why Cardi made the decision to make folio 88v (fig. 131) the title image for the frontispiece of the treatise. If the title page is meant to convey the overarching achievement of the treatise as a whole, the perspectograph no doubt functions as the most inspired piece of the text's intellectual pie.

In Book II of his treatise, dedicated to 'Young Painters who delight in perspective,'[22] Cigoli explains that while well-versed in the rules and mathematical principles behind the perspectival method, abstract principles alone are not enough to 'fulfill our needs as painters.'[23] After listing several shortcomings of the perspectival method, such as the difficulty in assessing the plan and elevation of a complex street

[22] I owe the following translations of Cigoli's manuscript to Martin Kemp in 'Ludovico Cigoli and Ragione of Painting', *Mitteilungen des Kunsthistorischen Institutes in Florenze* 35, no. 1 (1991), pp. 133-152.
[23] L. Cigoli, *La Prospettiva Pratica,* Book II, Part VI. Kemp, 'Ludovico Cigoli and Ragione', p. 147.

view, Cigoli laments the frustrations in depicting the human form: 'it is the most difficult of all,' states Cigoli, 'and yet it is more necessary than anything else.'[24] He discusses how certain concessions are made along the way, how, more often than not, the artist is 'forced to abandon' the rules, and required to work 'by eye' in order to render a scene in perspective.[25] He regards perspective's rules as often too rigid, too cumbersome, which inevitably leaves the artist with no choice but to trust his own judgment by eye and hand. However, this instinctual practice alone 'does not befit the dignity of the noble art of painting,'[26] thus the perspectograph presents an alternative, as a means of ensuring that neither the precision of the picture is lost, nor the physical instincts of the artist abandoned. For Cigoli, the perspectograph offers an ideal median point between the extremes of abstract, purely geometrical principles on the one hand, and the imprecision of the artist's kinetic abilities on the other. By melding the two, the artist can both fulfill his desires as a painter and rest assured that his drawing is perspectivally correct.

The physical immediacy of Cigoli's perspectograph can also be understood in light of his theories concerning the import of vision in relation to the other senses. In his treatise, sight is characterised as the most dignified and expressive sense.[27] In the proem to his treatise, he describes sight as rarified and delicate, something that requires preservation and care:

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[24] Cigoli, *La Prospettiva Pratica,* Book II, Part VI. As translated in Kemp, 'Ludovico Cigoli and Ragione', p. 147.
[25] Cigoli, *La Prospettiva Pratica,* Book II, Part VI. As translated in Kemp, 'Ludovico Cigoli and Ragione', p. 147.
[26] Cigoli, *La Prospettiva Pratica,* Book II, Part VI. As translated in Kemp, 'Ludovico Cigoli and Ragione', p. 147.
[27] This was a common view for artists and art theorists to hold in this period. Kemp explains that in this way, Cigoli's theories are aligned in the Aristotelian tradition, and specifically, are akin to Leonardo's theories on vision. For Cigoli and Leonardo: 'The eye is what allows us to pursue all the visual arts, the sciences of nature and advanced technologies.' Kemp, 'Cigoli and the Art of "Divine" Sight', in F. Camerota, *Linear Perspective in the Age of Galileo: Ludovico Cigoli's* Prospettiva pratica, trans. C. Frost (Florence, 2010), p. xii.

> Our Soul, closed within our body, can know nothing of the world outside except what our sense relay to it; for this reason, through a certain natural instinct, we take great care of our sensory instruments, and are particularly inclined to the conservation of our eyes, more than of the others, as befits the nobility of their function.[28]

Furthermore, without sight, 'a man is so imperfect and wanting, and so incapable of performing any task, that one could almost say that he lives as a dead man.'[29] Vision enlivens the subject and serves as the cornerstone for *being* in a very real, immediate, and corporeal sense. In this way, vision is what animates the subject; the eye serves as a link between the soul, brain, and heart, and through the images it receives, allows us to communicate the very activities and proclivities of the Soul. Our eyes express 'the greatest and most certain indications' of our passions, 'rather than from any other part of the body. For in them Anger, Clemency, Mercy, Hatred, Love, Sorrow and in short every other affection of our mind can be clearly recognized.'[30] Cigoli goes so far as to articulate how our eyes physically convey that which is felt within, and in so doing, paints the eye as an acutely animated entity:

> Our eyes burn, shine, tremble, smile, and become sad, from them issue tears of compassion, and of pity, and sometimes clear signs of happiness; therefore some people believed that the mind was contained within them, thinking that every time we enjoy or possess something, our eyes enjoy and possess them.[31]

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[28] Cigoli, *La Prospettiva Pratica,* Book I, Part I. As translated in Kemp, 'Ludovico Cigoli and Ragione', p. 144.
[29] Cigoli, *La Prospettiva Pratica,* Book I, Part I. As translated in Kemp, 'Ludovico Cigoli and Ragione', p. 144.
[30] Cigoli, *La Prospettiva Pratica,* Book I, Part I. As translated in Kemp, 'Ludovico Cigoli and Ragione', p. 144.
[31] Cigoli, *La Prospettiva Pratica,* Book I, Part I. As translated in Kemp, 'Ludovico Cigoli and Ragione', p. 144.

Trembling, shining, burning, and smiling, Cigoli so characterises the eye as an emotive and active body, physically conveying what is within and reacting to external stimuli.[32] As the primary site of emotion and sensory reception, the eye acts as *the* physical medium through which we understand and communicate with the world.

IV. Perspective, Instrumentation, and Early Modern Mathematics

When thinking of perspective, we tend not to associate this method with specific kinds of machinery or technological innovation, for since Alberti's publication, it has largely been characteried as a set of geometrical principles through which feigned three-dimensionality on a flat picture plane could be achieved. In this chapter I aim to rethink perspective in the vein that Jonathan Sawday has presented in *Engines of the Imagination* (2007), as an innovation akin to the machine that, likewise, developed out of 'precisely calibrated mathematical procedures.'[33] Due to the exacting quality of the perspectival method, it is not surprising that early modern artists and craftsmen would have used forms of technology to heighten the realism of their works.

Sawday's recent research has shown how this early modern 'techno-artistic fantasy', predominately popular in the West, was often interpreted metaphorically in terms relating to the visual arts.[34] In a poem devoted to the Royal Society, the English poet Abraham Cowley (1618-1667) characterised the influx of new technologies in

[32] Kemp, 'Art of "Divine" Sight', p. xiii. According to Kemp, Cigoli's poetic discussions of the eye's emotive properties is one of the most formidable aspects of the treatise, for it demonstrates the strength of Cigoli's capabilities as 'an accomplished writer in his own right.'
[33] J. Sawday, *Engines of the Imagination: Renaissance Culture and the Rise of the Machine* (London and New York, 2007), p. 217.
[34] Sawday, *Engines of the Imagination*, p. 217. The mechanisation of the visual arts as a particularly Western phenomenon is also corroborated by Kemp, *Science of Art*, p. 167.

Europe and the impact they had on knowledge and creativity as directly related to the task of the artist:

> 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'Idaeas and the Images which Iy
> 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 judgement of his Eye, and Motion of his hand. [sic][35]

Cowley's poem is indicative of the hand and eye becoming subsumed under the wave of mechanisation as 'organic instruments.'[36] Working from nature, or the 'Natural and living face', the artist must trust his eye and hand to translate the image before him. As the eye judges, the hand is set in motion, which is precisely the choreography that Cigoli's perspectograph aimed to mechanise. As such, the perspectograph is in keeping with the cultural imperatives of the seventeenth century, where leading innovators such as Newton, Robert Hooke, and Christian Huygens, began to see:

> …living creatures mechanistically, as ingenious contraptions made up of skilfully articulated components…functioning as levers, pulleys, pipes, and wheels, in line with the laws of mechanics, kinetics, hydrostatics, and so forth. The body became a *machina carnis*, a machine of the flesh.[37]

The level of automation that Cigoli's perspectograph achieves means that the draughtsman's body is wholly fused with the mechanical instrument. The amalgamation of such a device with the artist's hands and watchful gaze renders the perspectograph a novel achievement in perspectival instrumentation.

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[35] Sawday, *Engines of the Imagination,* p. 218.
[36] Sawday, *Engines of the Imagination,* p. 218.
[37] R. Porter, *Flesh in the Age of Reason: The Modern Foundations of Body and Soul* (London, 2005), p. 51.

The mechanisation of perspective is in keeping with the changing approach to mathematics in the sixteenth and seventeenth centuries. Indeed, the fields of astronomy, surveying, and fortification design, united under their relation to the foundations of Euclidean geometry, shared further similarities in their use of geometric instruments. According to James Bennett, the seventeenth century marks an era of the mechanisation of learning and knowledge, where the 'natural world came to be regarded as a machine—based on mathematical principles, effected, usually at the microscopical level, by mechanical means.'[38] Instruments became fully integrated in the practice of mathematics and natural philosophy, blurring the distinction between the disciplines and instigating a legacy of 'conceptual change.'[39]

The pragmatic, problem-solving capabilities of such mathematical devices as spheres, astrolabes, quadrants, and sectors generated much interest from practicing mathematicians and amateurs alike.[40] The appeal of instrumentation in the mathematical sciences can also be explained by their status as effective learning tools. Indeed, instruments were used as a means of education for elite gentlemen, as mathematical knowledge was an essential component to 'engage in the activities traditional to [their] class,' such as surveying or mapping.[41] For such men, using mechanical devices was an easier method of learning and calculating than taking pen to paper.[42]

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[38] J.A. Bennett, *The Divided Circle: A History of Instruments for Astronomy, Navigation, and Surveying* (Oxford, 1987), p. 51.
[39] Bennett, *The Divided Circle,* p. 72.
[40] J.A. Bennett, 'The Mechanics' Philosophy and the Mechanical Philosophy', *History of Science* 24 (1986), p. 2.
[41] A. Turner, 'Mathematical Instruments and the Education of Gentlemen,' *Annals of Science* 30, no. 1 (1973), p. 51-52. Turner's study is largely centred on English noblemen in the seventeenth century, although the claim concerning upper class mathematical literacy can be applied also to France and Italy.
[42] Turner, 'Mathematical Instruments', p. 58. For more on the tension inherent in this approach in the English context in the seventeenth century, see K. Hill, '"Jugglers or Schollers?": Negotiating the Role of a Mathematical Practitioner', *The British Journal for the History of Science* 31, no. 3 (1998), pp. 253-74.

In his book on Italian mathematician Mutio Oddi (1569-1639), *Between Raphael and Galileo: Mutio Oddi and the Mathematical Culture of Late Renaissance Italy* (2011), Alexander Marr explains that the didactic character of mathematical instruments can be attributed to the ways in which they generate an atmosphere of communal learning, as tools that can be 'both contemplated and operated.'[43] Marr centres his argument on a double portrait by Daniele Crespi of Oddi engaged in a mathematical lesson with a merchant, Peter Linder (fig. 138). Both Crespi and Linder studied under Oddi's mathematical tutelage, rendering the portrait particularly emblematic of the social atmosphere in which mathematical learning took place. The illustration in front of Oddi and Linder is a diagram of reflection and was likely created through the use of a beam compass, which lies across the table in the portrait.[44] As Marr argues, the beam compass' presence in the portrait shows that Oddi used instrumentation in his lessons on optics.[45] What is more, the foreshortened character of the diagram reifies the lessons in perspective that the artist, Crespi, would have received from his tutor, 'making the picture itself part of the material culture of mathematics that it represents.'[46] Turning to the instrument itself, it is evident that the men are engaged in contemplating both the instrument involved in the study as well as the mathematical properties behind the results it obtains. Thus it can be said that mathematical instruments were contemplated in their own right, and also used in the service of certain effects that could then be studied abstractly. Speaking of the double portrait of Oddi and Linder, Marr explains:

[43] A. Marr, *Between Raphael and Galileo: Mutio Oddi and the Mathematical Culture of Late Renaissance Italy* (Chicago, 2011), p. 135.
[44] Marr, *Between Raphael and Galileo*, p. 86.
[45] Marr, *Between Raphael and Galileo*, p. 86.
[46] Marr, *Between Raphael and Galileo*, p. 90.

> By experimenting with the optical properties of a given instrument, then using mathematics either to demonstrate the results obtained or to explain how the instrument used could be drawn and made, the two friends echoed the activities of scores of other figures involved in mathematization.[47]

Crespi's double portrait epitomises not only the communal culture of mathematical learning in the early modern period, but also the didactic qualities of instruments involved in these lessons. In relation to Cigoli's perspectograph, one could imagine a lesson in perspective between an artist and pupil similar to the set-up arranged by Crespi. This point will be stressed later in the course of this chapter.

Returning to Cigoli's manuscript, it is important to emphasise that had it been published, Cigoli's work would have belonged to a genre of treatises known as the practical mathematical or instrumental treatise.[48] Throughout the sixteenth century there was a rapid increase in publications on practical mathematics, aimed not necessarily at practitioners, but also probably printed to meet the evolving upper class' interest in mathematical subjects. Because such publications catered to those interested in both the practice of mathematics through instrumentation as well as the study of mathematics as theorems and principles, the audience for such publications was often quite diverse. This is especially true of books written in the vernacular, which were read by practitioners interested in the geometry governing their works, as well as by more theoretically-minded mathematicians who were interested in how various instruments were fabricated or implemented.[49] Thus, those who would have been interested in a publication like Cigoli's *Prospettiva Pratica* would have included members of the court, learned and amateur

[47] Marr, *Between Raphael and Galileo*, p. 103.
[48] A. Marr, 'The Production and Distribution of Mutio Oddi's *Dello squadro* (1625)' in S. Kusukawa and I. Maclean (eds.), *Transmitting Knowledge: Words, Images, and Instruments in Early Modern Europe* (Oxford, 2006), p. 165.
[49] Marr, 'Mutio Oddi's *Dello squadro*', p. 166. See also Marr, *Between Raphael and Galileo*, pp. 110-115.

mathematicians, surveyors, architects, engineers, and instrument makers. What is more, the relationship between instrument making and printed instrument books runs deeper than mere subject matter. As printers were developing new technology in the early sixteenth century, they would share their expertise in metalwork with the 'heterogeneous community' of instrument makers.[50] This relationship was further strengthened when inexpensive paper instruments designed from engravings began to hit the market.[51]

Cigoli was knowledgeable of the instrumental treatises and drawing technologies that serviced those interested in perspectival study. In the next section I turn to the several key texts that shaped his design and offer insight into how the perspectograph ameliorates the various difficulties he encountered with these methods.

V. Perspective's Instruments: The Drawing Technologies of Vignola, Dürer, and Jamnitzer

To highlight the distinctive features of the perspectograph, this section details several instruments devised prior to Cigoli's that aim to facilitate drawing in perspective. First, I would like to turn to Vignola's perspective instrument as detailed in his treatise *Le due regole della Prospettiva Pratica* (1583), which was published posthumously by Dominican Friar Egnazio Danti (1536-1586), who also edited and amended much of the text.[52] *La Due Regole* became popular in its day, and was reprinted and reissued as late as

[50] S. De Renzi, *Instruments in Print: Books from the Whipple Collection* (Cambridge, 2000), p. 1
[51] The association between these two sectors was especially prominent in seventeenth-century London where instrument makers often published books on the subject as well. In these instances, their workshops acted as small printing presses. See A. Turner, *Early Scientific Instruments: Europe 1400-1800* (London, 1987). On instrument books in general, see also S. De Renzi, J. Bennett, and D. Bertoloni, *Sphaera Mundi: Astronomy Books in the Whipple Museum 1478-1600* (Cambridge, 1994).
[52] In addition to editing the material, Danti also added bits of his own work to Vignola's theories. It is not easy to distinguish the work of the author, Vignola, over the work of his editor. Examining the type setting, it would appear that Vignola's text only comprises one sixth of the entire treatise.

1743.[53] The 'due regole' (two rules) that Vignola covers in the treatise are the *constructione legittima* and the distance point method.[54]

Like Cigoli, Vignola details an instrument of his own making intended to graph and plot the contours of an object at a distance (fig. 139). The procedure begins with the draughtsman looking through the viewpoint fixed at *N*. Following, the mechanisms *AB* and *CD* first allow the draughtsman to move the grid forward or back, and secondly, they help him to determine specific coordinates of a particular point on the object that is to be drawn in perspective. These points are then transferred to paper, which as evidenced in this figure, is divided into grids.

With Vignola's instrument, the process of translating live object onto paper is split in two, each draughtsman acting as an eye and hand, respectively. While the first draughtsman is responsible for locating the various points on the large grid, the second is responsible for plotting the points on paper. Systematising the act of drawing in perspective seemingly obstructs a seamless relationship between the body of the artist, the object before him, and the paper beneath. Vignola's instrument illustrates that one cannot keep an eye on the object in question, move the various parts of the instrument to follow the line of sight, and plot each point on paper simultaneously. There are not enough hands or eyes to go around. In the search for accuracy, the draughtsman must relinquish control and summon a second body.

In *Memoirs of the Blind* (1991), Derrida eloquently discerns that the act of drawing incites a form of blindness caused by the momentary break that occurs between

[53] K. Andersen, *The Geometry of An Art: The History of the Mathematical Theory of Perspective from Alberti to Monge* (New York, 2007), p. 125.
[54] T. K. Kitao, 'Prejudice in Perspective: A Study of Vignola's Perspective Treatise', *The Art Bulletin* 44, no. 3 (September 1962), pp. 173-194. Kitao notes that little was novel in Vignola's treatise, as it is mainly a summary of theories on perspective and vision that had come before.

regarding the object to be drawn with our eyes, and turning towards the paper to observe our hand as it traces on the paper:

> In its originary, pathbreaking moment, in the *tracing* potency of the *trait,* at the instant when the point at the point of the hand (of the body proper in general) moves forward upon making contact with the surface, the inscription of the inscribable is not seen.[55]

No matter how concentrated the draughtsman is on his chosen object of study, the act of drawing, of 'tracing' a 'trait', eclipses direct observation. This is true even if the object in question is directly in front of the artist, for no matter how briefly we shift our eyes from model to paper, the very act of tracing necessitates visual attention, and hence the trait 'must proceed in the night', as it 'escapes the field of vision.'[56] In this way, Derrida qualifies the act of drawing as an activity that is accomplished 'in the dark', by memory.[57]

It is precisely this split between hand and eye that Cigoli's perspectograph remedies. By merging the process of looking with the act of drawing, Cigoli circumvents the need to glance down at the drawing beneath his hand. Because the draughtsman's line of sight and lead pointer correspond to the position of the bead, this synchronicity eliminates the need for comparison between the two planes. However, when the process is reversed, when the draughtsman seeks to plot an image from paper onto a wall or ceiling, a single body simply will not do. However, the presence of this second body does not necessarily ensure for the production of an accurate-looking image. Looking at the illustration of Vignola's instrument, we suddenly see a perplexing element: Vignola in fact positions the draughtsman in a location where he cannot observe the sculpture that is

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[55] J. Derrida, *Memoirs of the Blind: The Self-Portrait and Other Ruins*, trans. P.A. Brault and M. Naas (Chicago and London, 1993), p. 45.
[56] Derrida, *Memoirs of the Blind*, p. 45.
[57] This blindness is not regarded as a negative feature, for it gives drawing a 'quasitranscendental' character. Derrida, *Memoirs of the Blind*, p. 44.

modeled. Furthermore, it would appear that the drawing on the draughtsman's paper does not correspond to the appearance of the sculpture from the eye point. We should be privy to an image looking up toward the sculpture. I would like to suggest that this discrepancy points to the *theoretical* rather than *practical* application of these devices, an essential point in my argument to which I will return later in this chapter.

Another key text that Cigoli lauded as influential in his pursuit of a mechanised perspective device was Dürer's *Unterweysung der Messung* (1525). The discussion of perspective, including illustrations and descriptions of several novel instruments, comes in the fourth and final chapter of his treatise on geometry.[58] These perspective instruments can be divided into two groups with disparate means of achieving a drawing that is 'true to life.' The first group corresponds to instruments that use a glass pane and a monocular sighting device to steady the gaze of the draughtsman (figs. 140, 141 & 142). Figure 140 demonstrates one of these instruments specifically designed for portrait painters. Looking through the monocular eyepiece, the draughtsman outlines the sitter's visage on the pane of glass. Similar to the instrument just described is a method that employs a transparent vertical plane marked by horizontal and vertical lines that allow the draughtsman to plot the scene before him on the corresponding grid-marked sheet under his right hand (fig. 142).[59]

The second group of perspective instruments is presented as techniques to solve a very specific problem that arises when following the methods previously outlined. The

[58] G. Bartrum, *Albrecht Dürer and his Legacy: The Graphic Work of a Renaissance Artist* (London, 2002), pp. 218-219.

[59] This woodcut has been the source of feminist criticism and has served as a cornerstone for arguments concerning the problematic effects of the male gaze in Western art. Mieke Bal has argued that the instrument's dominion over the female body cannot be ignored, and while the device is 'supposedly helping him to measure distances,' the 'phallic status is hard to overlook.' M. Bal, *Reading 'Rembrandt': Beyond the Word-Image Opposition* (Cambridge, 1991), p. 173.

difficulty with the perspective devices just discussed is the limited distance between the eye point, the picture plane, and the object to be depicted. Because the draughtsman's arm can only extend so far, the object's position relative to the picture plane will appear quite short. Dürer explains this conundrum as such:

> Flat [two-dimensional] things are suitable for tracing on a glass pane from the near point of sight. But other solids become distorted if the eye is too close to them during the process of drawing them. For the same reason, objects which are too close to the eye appear too large compared to objects at a greater distance. If an object is far away from me, when I trace it on the glass pane it becomes small on the pane because I cannot place the glass pane farther away from me than I can reach with my hand. But if I place the glass very close to the object to be traced, but retain the distance of the eye, I cannot reach the pane with my hand. For that reason one has to resort to another method which will save much trouble and work and loss of time, and one can use it to render large and small objects. Anyone who wishes to draw a large object in its original size has to position the glass pane on which it is to be traced very close to the object. And the eye must be at a reasonable distance to avoid distortion. But for the hand to be close to the glass and the eye to be far away is impossible. For that reason Jacob Keser's invention has to be used in this case.[60]

When tracing objects on a glass pane, it is important that the pane remain quite close to the object, while the point of view be positioned at a greater distance. In many scenarios the draughtsman's body encumbers this dynamic and renders it impossible. In order to produce a drawing free from distortion, the hand and eye must be stretched in a way that human bodies simply cannot. In these scenarios, the body impedes any flexibility, and in its prescribed measurements, cannot accommodate a distanced arrangement. To circumvent these shortcomings, the draughtsman's point of view must be extended by mechanical appendages, as devised by Jacob De Keyser.

[60] A. Dürer, *The Painter's Manual: A Manual of Measurement of Lines, Areas, and Solids by Means of Compass and Ruler Assembled by Albrecht Dürer for the use of all Lovers of Art with Appropriate Illustrations Arranged to be Printed in the Year MDXXV*, trans. W. L. Strauss (New York, 1977), p. 431.

De Keyser's device, here illustrated by Dürer (fig. 143), extends the position of the 'eye' which is now represented by a point on the wall. According to Dürer, this artificial eye 'is nothing less than the position of a real eye,' as it extends toward the monocular gunnery-style sight intercepting the sight line.[61] Further elucidating the monocular means of navigating this drawing process, Dürer instructs his reader to 'look through the scanning hole with your right eye as you would sight a shotgun, using the pointer to look through the glass at the object.'[62]

While the universal practicality of this device is dubious,[63] it was nonetheless further refined and re-worked by Wenzel Jamnitzer, a Nuremburg goldsmith (fig. 144). In addition to his ambition as a highly-skilled instrument maker, Jamnitzer was also a perspectivist. His pupil, the Swiss-born Jost Amman (1539-1591), aided Jamnitzer in the publication of a perspective treatise *Perspectiva corporum regularum* (1568), and is responsible for the engraving depicting Jamnitzer in the act of drawing in perspective through the guises of a machine.[64] In his treatise, he wrote that the art of perspective enables the artist to depict things with such precision that 'to portray so similarly and exactly by hand almost appears impossible.'[65]

As with De Keyser's instrument, the viewpoint in Jamnitzer's device is also located behind the draughtsman, but here atop a vertical stand. A string extends from this

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[61] Dürer, *The Painter's Manual*, p. 431.
[62] Dürer, *The Painter's Manual*, p. 433.
[63] Dürer's perspective geometry was often deemed too theoretical for general practitioners, and many of his ideas were later adapted into abridged versions such as craft manuals and pamphlets in sixteenth-century Germany. See J. Peiffer, 'Constructing perspective in sixteenth-century Nuremburg', in *Perspective, Projections, and Design: Technologies of Architectural Representation,* M. Carpo and F. Lemerle (eds.) (London and New York, 2008), pp. 65-76.
[64] Sven Hauschke remarks that all existing portraits of Jamnitzer do not present him as a typical goldsmith, but as a scientist involved in the studies of art, mathematics, and astronomy. S. Hauschke, 'The Mathematical Instruments of Wenel Jamnitzer', in G. Strano, S. Johnston, M. Miniati (eds.), *European Collections of Scientific Instruments 1550-1750* (Leiden, 2009), p. 5.
[65] W. Jamnitzer, *Perspectiva Corporum Regularium* (1568)*,* as translated in P. H. Smith, *The Body of the Artisan: Art and Experience in the Scientific Revolution* (Chicago and London, 2004), p. 79.

stand to the object to be depicted, and represents the visual ray that extends from viewpoint to viewed. The end of the thread is tied to a cursor that lies along another rod. A third stand is erected before the draughtsman and can be moved horizontally along a trough built into the table. This rod is equipped with a vertically-adjustable pointer. In this way, the draughtsman can lay out the perspectival points of an object on the sheet below him.[66]

In *Unterweysung der Messung*, Dürer also details a perspectival method that pushes such developments further by piercing the picture plane (fig. 145). In this illustration, two draughtsman are engaged in sketching the outline of a lute,[67] whose handle points towards the picture plane, likely positioned in an angle that is difficult to foreshorten when drawing by hand. This technique is based upon the principle that strings, or wire, can be made to stand in for the intangible visual rays that extend from the vanishing point through the picture plane toward the object in question. In this image, the string is tied and gathered tautly at a given point behind the draughtsman. The principal at work here is that the draughtsman should be able to intercept and mark point by point where the visual ray (the string) intersects with the picture plane. Key to this method is the fact that the paper, on which the points are plotted, is attached to a swinging frame. Within the empty frame are two moveable axes: a string extending vertically and another extending horizontally. The draughtsman locates where the visual ray of the first chosen point will intersect with the frame of the picture plane and then moves the two strings on

[66] S. A. Bedini, 'The Perspective Machine of Wentzel Jamnitzer', *Technology and Culture* 9, no. 2 (April 1968), p. 201. Bedini explains that Jamnitzer's treatise does not contain a comprehensive discussion of the perspectival method, and it is likely he intended to publish a second volume for this very purpose. Bedini surmises that Amman's engraving of this perspective device was made for this second volume.

[67] Lutes figure prominently in illustrations of perspective instruments. Judith Dundas has suggested that the repeated use of musical instruments to demonstrate the art of perspective emphasises the mathematical basis of these measured practices, as she poetically discerns, 'All is harmony.' J. Dundas, *Pencil's Rhetoric: Renaissance Poets and the Art of Painting* (Newark, 1993), p. 78.

the frame itself to form an X or a cross point. Once the point is determined, the string extending from the lute is momentarily removed, the paper is swung back into place, and the point is marked. This process continues, point by point, as with Cigoli's instrument.

What is unique about Dürer, De Keyser, and Jamnitzer's devices is that the eye-point is located *outside* the draughtsman's body, looming in the space behind, effectively demonstrating that 'eyeballs need not inhabit the foci of perspective projectors.'[68] In both instances, the focal point is monocular, and though seemingly disembodied, the integration of the draughtsman's body is far from removed from the choreography of the scene. The eye merely serves as the point of origin, while the draughtsman serves as the physical conduit transposing points on a sheet of paper. The viewpoint, or point of origin, may be divorced from the draughtsman, but the process of drawing could not be more dependent on physical engagement.

According to Cigoli, Dürer's operations, while commendable, result in a potentially inadequate looking picture, and he provides a particularly intriguing reason for this shortcoming. The strings, which materially replicate the visual rays, are prone to sag. A true visible ray, states Cigoli, has no mass, whereas the wire or string, being 'material and therefore heavy, and by nature flexible, and being fixed only at each end, even when pulled taut, will curve in the middle.'[69] In addition to the shortcomings of the string and frame method, Cigoli notes the varying distances and angles that the string is incapable of reaching which hence renders this method subpar. In regards to Dürer's

[68] P. Maynard, *Drawing Distinctions: The Varieties of Graphic Expression* (Ithaca and London, 2005), p. 35.
[69] Cigoli, *La Prospettiva Pratica,* Book II, Part VI. As translated in Kemp, 'Ludovico Cigoli and Ragione', p. 147.

device, it is the very materials of the machinery that interrupt the flow of movement and perspectival choreography that Cigoli so fervently champions and defends.

Cigoli argues that a material substitute for an ineffable, yet inextricably phenomenological experience (i.e. the visual rays extending from the vanishing point toward the picture plane) will always fall short. Advocating the ingenuity of his device once more, he notes how the perspectograph allows the draughtsman's very eye to serve as this point of contact, how the incorporation of the body itself in the perspectival dynamic in fact provides far more accuracy and less risk of material malfunction. Here the visual rays can

> …reach any given object in an instant, regardless of who is using the instruments, and touch every part of the object which can be seen, and which we wish to portray, and the section and segment of every visible ray can be done directly with the instrument.[70]

Cigoli extols the perspectograph as a means of uniting the draughtsman's body with the precision of a mechanical device.

In lieu of abstract principles that do not leave room for the instinctual, kinetic dexterity of the artist, and in avoidance of pure guesswork and possibly erroneous results, the perspectograph capitalises upon the eye of the draughtsman and the precision of automation. In this way, the body functions as a perspectival automaton, a fusion between embodied movement and mechanical engineering. The perspectograph, in fact, ushers the body back into the process of perspectival image-making, and proves that it was far from seen as a problem or hurdle to overcome in the rendering of illusory space.

Thus far I have outlined the ingenuity of the perspectograph as an embodied form of mechanical drawing that developed out of a historical period in which instrumentation

[70] Cigoli, *La Prospettiva Pratica,* Book II, Part VI. As translated in Kemp, 'Ludovico Cigoli and Ragione', pp. 147-148.

was integral to the study of mathematics. While useful as a drawing tool in and of itself, the perspectograph was also appreciated as a collector's item in the early modern period. In the next section of this chapter, I investigate the perspectograph's legacy as an object of marvel in the French court. As I will show, the re-surfacing of Cigoli's perspectograph in this milieu speaks to the fascination of instrumentation within courtly collections.

VI. The Resurfacing of Cigoli's Perspectograph in the French Court of Louis Hesselin

Despite the unpublished status of Cigoli's manuscript, the perspectograph emerged as a collector's item in France in the first half of the seventeenth century. Evidence of the instrument's circulation is found in Niceron's second perspectival treatise, *La Perspective Curieuse* (1652), where one finds a detailed drawing of a so-called '*instrument universel*' (figs. 146 & 147).[71] This instrument, with its pulley system, bead, and monocular peephole, is remarkably similar to Cigoli's device.[72] In point of fact, Niceron concludes his introduction by attributing Ludovico Cigoli, 'the excellent Florentine artist,' as the inventor of the instrument he will henceforth discuss, explaining that the 'LC' markings on his illustrations denote this attribution.[73]

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[71] J.F. Niceron's *La Perspective Curieuse* has yet to be translated into English. All of the following translations are my own. Niceron's *instrument universel* is functionally identical to Cigoli's perspectograph, however for clarity's sake, I will refer to it as the *instrument universel* when discussing Niceron's version to distinguish it from Cigoli's.

[72] While there is no explicit mention of Cigoli's manuscript in Niceron's writing, several aspects of the treatise point to a general awareness of the manuscript. Like his Italian colleague, Niceron chose to illustrate the basic functionality of the universal instrument by means of a cube. Furthermore, he renders and orients the universal instrument in the same manner as Cigoli, positioning the draughtsman on the right and the cube on the left. The manual indicators both rest over the cube drawn on the paper, and the artists, whether represented in full or hinted at by means of a looming eye, both peer through the eyepiece towards the cube, aligning their point of view with it.

[73] J.F. Niceron, *La Perspective Curieuse du Reverend P. Niceron Minime. Divisée en quatre livres avec l'optique et La catoptrique du R.P.. Mersenne du mesme Ordre, mise en lumiere après la mort de l'Autheur* (Paris, 1652), Book II, p. 30. '…aprez avoir averti qu'Albert Durer est le premier qui s'est serui de treillis, ou de la fenestre, au lieu du tableau, qu'il explique dans ses oeuvres: don't Barbarus parle, & Danti sur le 3. chap. De la premiere regle de Barocius, ou (ac) il aporte plusieurs instruments derivez de ladite fenestre,

In Book II, Niceron jotted down a chance meeting with a perspective instrument found in the home of renowned collector Louis Hesselin (1602-1662), Counsellor to Louis XIII (1601-1643), and subsequently Louis XIV (1638-1715).[74] Niceron describes how Hesselin's entire house was fashioned like a cabinet of curiosity where objects of great rarity could be found in every corner. Among Hesselin's collection was a novel instrument that Niceron claims to have 'never seen used anywhere.'[75] The perspectivist would have encountered a model of the perspectograph upon his visit to Hesselin's home in 1638.[76] Perusing Hesselin's quarters, Niceron marvelled that his household was filled with so many rare objects, dazzling mirrors, paintings, and books relating to multiple branches of science.[77] The contents of his collection undoubtedly proved that he was a man of 'universal cognisance.'[78]

The model of Cigoli's perspectograph belonged to a collection bequeathed to Hesselin by his uncle, under the condition that he acquired his namesake.[79] As evidenced in an inventory produced after his death in 1662, Hesselin's collection was split between his two residences: his home in Paris and his country estate, 'de Chantemesle', located in

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aussi bien que celuy que je decries, don't on tient que Louys Cigolus excellent peintre de Florence est l'inventeur: c'est pourquoy j'y ay marquee (ac) L&C pour signifier son nom.'

[74] Niceron refers to Hesselin as the *Maître de la Chambre aux Deniers*. In 1655, Hesselin's title became *Intendant des menus plaisirs du roi*, which was a fitting appointment and made him an esteemed figure in the French court. J.H. Leopold and C. Vincent, 'A Watch for Monsiuer Hesselin', *Metropolitan Museum Journal* 28 (1993), p. 111.

[75] Niceron, *Perspective Curieuse,* Book II, p. 130. '…Monsieur Hesselin, Conseiller du Roy, & Maitre de la chamber aux deniers, l'un des plus rares homes du monde, & don't toute la maison est un cabinet perpetual, où l'on void tout ce que l'on peut trouver ailleurs de plus rare, & de plus excellent, m's communiqué un instrument particulier sans en avoir veu l'usage en aucun lieu.'

[76] A. Schnapper, *Curieux du Grand Siècle: Collections et collectionneurs dans la France du XVIIe siècle* (Paris, 1994), p. 184.

[77] As quoted in Schnapper, *Curieux du Grand Siècle*, p. 184. '…toute sa maison: car véritablement elle est ornée & remplie de tant de raretez; on y veoit tant de belles glaces, d'excellens miroirs, tant de rares peintures & de pièces à ravir pour les rondes bosses & les reliefs, tant de beaux & bons livres en toutes sortes de sciences, qu'on la peut dires l'abbrégé des cabinets de Paris, & que les rares diversitez, qui sont ça & là en tous les autres, se retrouvent en cestuy-cy soigneusement assembles…'

[78] As quoted in Schnapper, *Curieux du Grand Siècle*, p. 184. '…qui monstrent assez que l'esprit du maistre est tout à fait universel en ses cognoissances.'

[79] Louis Hesselin was formerly known as Louis Cauchon. See Schnapper, *Curieux du Grand Siècle*, p. 182.

Essones, France, between Paris and Fontainebleau. Both properties boasted a large collection of paintings, books, and art cabinets filled with *naturalia* and *mirabilia*; vases, urns, goblets, and fine china spilled from his 'chambre l'italienne' to his library and 'golden cabinets' in the terrace and antechamber.[80]

In France, the tradition of court collections dates back to the reign of Francis I (1494-1597), and while a steady decline in the appreciation for painting can be seen in the late sixteenth and early seventeenth centuries,[81] attention to royal collecting began to pick up under Louis XIV's reign. The king's personal inclination towards collecting occurred only after his move to Versailles in 1682. Here, Louis arranged for a semi-private small museum to be built within his apartment.[82] Between 1682 and 1685, a royal cabinet of curiosity was erected next to the 'Salon de l'Abondance', containing twenty-four paintings, vases, and engraved medals and stones, all shipped from Paris. Other rooms were later added to the royal cabinet to house crystals, filigrees, and agates. By 1687, most of the king's collection had been moved from Paris to Versailles to the private spaces of his residences.[83]

As the *Intendant des menus plaisirs du roi* in the court of Louis XIII, Hesselin was in charge of organising royal festivities within his residences. Over several decades, his abodes were visited by a number of writers, royal dignitaries, and perspectivists such as Niceron. In 1644, the English Diarist John Evelyn graced Hesselin's premises and

[80] Schnapper, *Curieux du Grand Siècle*, p. 184.
[81] Antoine Schnapper has noted that a decline in the appreciation of painting and decorative arts began under the rule of Henry IV (1553-1610). Furthermore, despite Louis XIII's fondness for painting, many notable artists such as Simon Vouet, Claude Vignon, and Nicolas Tournier, left France for Italy as they could not find satisfying work in France under Louis XIV's reign. A. Schnapper, 'The King of France as Collector in the Seventeenth-Century', *The Journal of Interdisciplinary History* 17, no. 1 (Summer 1986), pp. 189-191.
[82] Schnapper, 'King of France as Collector', pp. 194-196.
[83] Schnapper, 'King of France as Collector', pp. 197-198.

marvelled at the 'many good payntings' adorning the walls at de Chantemesle.[84] Evelyn was also greatly impressed by the vast garden and 'fountaine of Serpents twisting about a Globe.'[85] Two years after Evelyn's visit, Henrietta Marie of France (1609-1669), wife of King Charles I (1600-1649), was invited to the country residence while in exile from England. Her stay in de Chantemesle demonstrated the French government's support for the Catholic Queen, and also served to bolster the reputation of the French crown as a regime whose officers happily expended their own fortunes to please foreign royalty.[86]

A decade after Henrietta Marie's visit, Queen Christina Alexandra of Sweden (1626-1689) sojourned at Hesselin's residences, and was especially taken with an illusionistic 'fête' organised in her honour. At this celebration, Hesselin arranged an elaborate scheme to mystify his guests. Painted murals that included pairs of Swiss guards within their scenery surrounded a series of doors flanking the room where the party was held. Upon closer inspection, the guests were delighted to see that the guards were in fact live men who would detach from the walls and dance around the room.[87] In this extraordinary illusion, Hesselin cleverly incorporated his spectators within a theatre of scenic transformations.[88] This elaborate fête for the Swedish queen demonstrated Hesselin's exceptional talent in the conjuring of natural magic, while the knowledge of the technical means of achieving such illusions enhanced 'the aura of the prince.'[89]

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[84] K. Britland, 'Exile or Homecoming? Henrietta Maria in France 1644-69', in P. Mansel and T. Riotte (eds.), *Monarchy and Exile: The Politics of Legitimacy from Marie de Médicis to Wilhelm II* (New York, 2011), p. 127.
[85] Britland, 'Exile or Homecoming?', pp. 127-128.
[86] Britland, 'Exile or Homecoming?', pp. 127-128.
[87] See J. Baltrušaitis, *Anamorphic Art*, trans. W.J. Strachan (New York, 1977), p. 59; M. Hobson, *The Object of Art: The Theory of Illusion in Eighteenth-Century France* (Cambridge, 1982), pp. 22-23.
[88] Hobson, *The Object of Art*, p. 24. See also T.E. Lawrenson, *The French Stage and Playhouse in the Seventeenth Century: A Study in the Advent of the Italian Order,* 2nd ed. (New York, 1986), especially chapter 6, 'Hypertrophy', pp. 172-226.
[89] Hobson, *The Object of Art*, p 23.

The spectacle of Hesselin's illusionistic fête was in keeping with late Renaissance French court culture. Under Louis XIV's rule, every act of etiquette was fetishized to a theatrical extent, and visual displays of power, manner, and comportment became an economy in which each person was enmeshed and expected to exchange.[90] Such standardised rituals of courtly performance can be traced back to a handbook on courtly decorum, *The Book of the Courtier* (1528) by Baldassare Castiglione (1478-1529). Castiglione stated that the courtier should show himself 'remembering the place where he is, and in the presence of whom, with proper devices, apt poses, and witty inventions that may draw on him the eyes of the lookers on as the magnet attracts iron.'[91] These books of court behaviour, popularised in the sixteenth century, functioned as manuals for aspiring courtiers keen to learn the rules of 'self-fashioning' in order to garner attention from the ruling elite.[92] Stephen Greenblatt has qualified this self-fashioning as a highly theatrical form of self-presentation, and has noted that it can be found in all Renaissance court environments where groups of people, cut off from the workaday world, compete for adulation and security through a currency of standardised manners, dress, and verbal exchange.[93] While such gestures were standardised in courts, they were intended to appear spontaneous and natural. This explains the appeal of puzzles, jokes, and visual games in early modern court culture, where 'the norms of play are closely regulated while

[90] N. Elias, *The Court Society*, trans. E. Jephcott (Oxford, 1983), pp. 85-86. Elias notes that once the rules of etiquette were firmly established the courtiers, without force, kept up this form of exchange, as those eager to obtain prominence and privilege in the court stuck to the rules in order to gain a competitive edge.
[91] As translated in R. Starn and L. Partridge, *Arts of Power: Three Halls of State in Italy, 1300-1600* (Berkeley, 1992), p. 120.
[92] S. Greenblatt, *Renaissance Self-Fashioning: From More to Shakespeare* (Chicago, 1980), p. 162.
[93] Greenblatt, *Renaissance Self-Fashioning*, p. 162.

the moves are up to the player and are in that sense freely performed.'[94] While choice is left up to the players, the game itself is familiar and known.

It is within this context of theatrical display and royal opulence that the model of Cigoli's perspectograph was happened upon by Niceron. Specifically, the device would have been housed in one of Hesselin's art cabinets. These cabinets were likely very similar to the Flemish cabinets discussed in the preceding chapter (figs. 102, 103, and 106). In terms of design, this cabinet would have been either large enough to stand as furniture alone, or small enough to be placed on top of tables or dressers. In the sixteenth century, the market for these pieces was quite different in France than in Antwerp or Germany, as design and production largely revolved around princely courts. After 1596, foreign craftsmen were admitted into the country in order to save the courts the expenditure of pricey imports, which lead to a rapid boom in the cabinet trade.[95]

Within the home of collectors such as Hesselin, art cabinets served an ambiguous purpose as both functional pieces of furniture used to house collectable objects, and as collectible objects themselves.[96] They were both practical and artistically revered. Likewise, the perspectograph served a similarly ambiguous purpose in Hesselin's home. Placed within an art cabinet in and amongst a collection of *artificialia*, the perspectograph was considered a collectible item in and of itself, in addition to the reverence it received as a novel form of technology. Indeed, in seventeenth-century European court culture, mathematical instruments like the perspectograph were commonly collected and displayed, a point to which I now turn.

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[94] Starn and Partridge, *Arts of Power*, p. 120.
[95] M. Riccardi-Cubitt, *The Art of the Cabinet Including a Chronological Guide to Styles* (London: Thames and Hudson, 1992), p. 84.
[96] Schnapper, *Curieux du Grand Siècle*, p. 45.

VII. The Collection and Display of Mathematical Instruments in Early Modern Court Culture

The perspectograph's presence within a courtly collection is representative of a wider interest in mathematical instrumentation as stand-alone objects of marvel in the early modern period. Indeed, for in addition to *artificiala* and *naturalia*, *scientifica* (scientific instruments) became collectible items as early as the sixteenth century in European courts and the homes of the well-to-do.[97] In order to grasp the role that instruments played in early modern collections, I turn to the royal collection in Dresden as an excellent comparative case study for the cult of instrumentation in early modern court culture. This will allow for further contextualisation concerning the technical knowledge and expertise of the ruling elite.

Located within the palace, the Dresden Kunstkammer was founded in 1560 by Elector August of Saxony (ruled 1533-1586), and contained an incomparable amount of instruments relating to the practice of astrology, surveying, map-making, and the techniques of perspective drawing. Indeed, the instruments amassed within the Dresden Kunstkammer exceeded all other early modern European collections.[98] The first inventory of the Kunstkammer, dating to 1585, divides the collection into eighty-five categories of disparate *naturalia*, *mirabilia*, and *artificialia,* two dozen of which were instruments.[99] Eyeglasses, telescopes, mirrors, and surveying tools were positioned within the collection relative to their area of inquiry. Many devices housed in the Kunstkammer

[97] G. Strano, 'Introduction', in G. Strano, S. Johnston, M. Miniati, and A. Morrison-Low (eds.), *European Collections of Scientific Instruments 1550-1750* (Leiden, 2009), p. xxi.
[98] M. Korey, *The Geometry of Power: Mathematical Instruments and Princely Mechanical Devices from around 1600* (Dresden, 2007), p. 3.
[99] Korey, *The Geometry of Power*, pp. 3-4.

were directly related to the political and economic climate of Dresden. For instance, surveying instruments were integral to the measuring and plotting of the Saxon territory, while mining instruments helped to support a growing industry south of Dresden. Thus, a large proportion of the mathematical instruments collected in the Dresden Kunstkammer were part and parcel with the Elector's 'princely strategy' for establishing dominion over his land.[100]

The emphasis on mathematical instruments in the Dresden Kunstkammer was thanks in large part to its curator, German mathematician Lucas Brunn (1572-1628), who undertook a re-organisation of the collection upon his appointment in 1619.[101] Brunn's mathematical expertise can be seen in his treatise on optics *Praxis perspectivae das ist von Verzeichnungen ein aussführlicher Bericht* (1615), in which he included an illustration of a perspective machine that was later presented within the Kunstkammer, as well as instructions on how to position anamorphically distorted images so that one can observe the illusion in an optimal manner, an exercise that may have been applied in his curating practices.[102]

Brunn was well aware of the effect his mathematical expertise had in the shaping of his curatorial abilities within the Saxon court. In *Euclids Elementa practica* (1625), Brunn's translation of the German edition of Euclid's *Elements*, Brunn declared that…

> …geometry and the study of proportion form a lofty and necessary art, one which can rescue a land and its inhabitants from great danger. Neglect of this field leads

[100] S. Dupré and M. Korey, 'Optical Objects in the Dresden *Kunstkammer:* Lucas Brunn and the Courtly Display of Knowledge' in G. Strano, S. Johnston, M. Miniati, and A. Morrison-Low (eds.), *European Collections of Scientific Instruments 1550-1750* (Leiden, 2009), p. 65.
[101] Dupré and Korey, 'Optical Objects', p. 78. Prior to his appointment, Brunn served as a court mathematician in the Dresden palace.
[102] Dupré and Korey caution that it is not clear whether or not this method was actually used in the display of pictures in the Kunstkammer. Dupré and Korey, 'Optical Objects', pp. 83-84.

> to all manner of disorder and arrogance among the people, as is unfortunately now too much the case.[103]

For Brunn, training in geometry and mathematics was an important practice for the ruling elite as much as it was for scholars. Such study would provide princes with a 'well-proportioned' ability to govern the Saxon court amidst war, while also acting as a source of entertainment and marvel.[104]

Indeed, early modern courts and the aristocracy within had a significant influence on the development of new mathematical technologies. In the preface to a work on sundial and astrolabe designs, Nürnberg mathematician Andreas Schöner (1528-90) paid great respect to German princes who showed an interest in the design and study of mathematical instruments:

> There are now many princes who even excel in the knowledge of the mathematical arts. Through their own effort they betake themselves to these studies as well as to a certain widening of the intellect. They design instruments and indeed I have seen many of this sort designed by princes. They observe the motion of the heavens and perform duties similar to those of their mathematicians. Undoubtedly among these are the illustrious prince August, the Elector, Duke of Saxony; Wilhelm, Landgraf of Hesse; Johann Friedrick and his brothers, dukes of Saxony' and Johann, the Elector of Brandenburg… [105]

In developing their skills in mathematics, such princes were aiming to cultivate an intellectualism that originated in the courts of the Holy Roman Empire.[106] As mentioned in regard to Brunn and the Dresden *Kunstkammer*, these 'prince-practitioners' were often politically motivated to develop new map-making, surveying, and exploratory technologies.

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[103] Korey, *The Geometry of Power*, p. 44.
[104] Korey, *The Geometry of Power*, p. 45.
[105] As translated in B. Moran, 'German Prince-Practitioners: Aspects in the Development of Courtly Science, Technology, and Procedure in the Renaissance', *Technology and Culture* 22 (1981), p. 254.
[106] Moran, 'German Prince-Practitioners', p. 254.

While court mathematicians often served in the interest of the ruling elite, this relationship was reciprocal, for mathematicians benefitted greatly from the political and patronly protection of the court.[107] As Mario Biagioli has shown in the case of Galileo Galilei, the Medici court played a significant role in the development and dissemination of his astronomical theories.[108] In his study, Biagioli maintains that the history of the burgeoning of the scientific revolution can be traced within 'a trajectory that leads from the university, to the court, and, eventually, to the scientific academy.'[109] Indeed, Galileo leveraged his scientific discoveries to gain patronage in the court of Cosimo de' Medici (1590-1621) by dedicating the satellites of Jupiter (seen through the newly invented telescope in January 1610) to the Medici name. In turn, the discovery became 'scientific proof of their dynastic horoscope.'[110] The moons of Jupiter were leveraged as 'dynastic emblems' that ensured Galileo's continuing prosperity as a funded and socially supported scientist in the Medici court.[111]

Prior to Galileo, the Danish astronomer Tycho Brache (1546-1601) was also generously supported by court patronage under King Frederick II in Denmark as well as Rudolph II in Prague.[112] Whereas Galileo leveraged the dedication of the moons of Jupiter to attain patronage, Tycho dedicated his findings to his courtly benefactors in his publications. Adam Mosley explains how this benefited Tycho's scholarly practices:

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[107] See L. Daston and K. Park, *Wonders and the Order of Nature 1150-1750* (New York, 2001), pp. 165-172.
[108] M. Biagioli, *Galileo, Courtier: The Practice of Science in the Culture of Absolutism* (Chicago, 1993), p. 2.
[109] This is demonstrated in Galileo's own biography, as he began as a university mathematician, then a philosopher in the Medici court, and then ultimately a member of the Accademia dei Lincei, which is considered to be one of the earliest scientific academies. Biagioli, *Galileo, Courtier*, p. 6.
[110] Biagioli, *Galileo, Courtier*, p. 128.
[111] Biagioli, *Galileo, Courtier*, p. 128.
[112] A. Mosley, *Bearing the Heavens: Tycho Brahe and the Astronomical Community of the Late Sixteenth Century* (Cambridge, 2007), p. 113.
p. 113.

'Within the culture of display, the printed dedication allowed an author or editor to exhibit his civility and erudition; and yet do so without letting fall a much-cherished but frequently threadbare garment, the cloak of authorial modesty.'[113] Through these dedications, Tycho participated in the economy of patronage and gift exchange central to courtly comportment, and ensured that his works would be issued and discussed amongst prince-practitioners and other learned men.[114]

Thus, it can be said that court society had a profound impact on the development of scientific and mathematical practice in the early modern period. Furthermore, in seeking protection under the court, astronomers like Galileo and Tycho could elevate their status to that of a natural philosopher, thereby further legitimising their pursuits. As Biagioli elucidates, while the court was not primarily seen as a learned academy, 'it was an institution that could offer social legitimation which, in turn, could help establish the credibility of mathematicians-turned-philosophers.'[115] It offered scholars financial and social support, in addition to a space where their ideas could circulate.

While the case studies of the Dresden, Prague, and Medici courts are varied in their geographical milieus, they illustrate nonetheless a cultural climate in which mathematical and scientific study are not only appreciated by the ruling elite, but practiced as well. As pointed out in regard to the status of 'prince-practitioners', it was not unheard of for a prince or courtier to come into contact with a mathematical instrument, or to be interested in exercising one. In point of fact, demonstrating one's knowledge and skill in this realm would have only bolstered one's status at court. Thus, we can surmise that Hesselin and his fellow courtiers may have not only admired the

[113] Mosley, *Bearing the Heavens*, p. 128.
[114] Mosley, *Bearing the Heavens*, p. 124.
[115] Biagioli, *Galileo, Courtier*, p. 156.

perspectograph for its abilities, but may have also partaken in the practice of drawing themselves. Indeed, this would have reinforced the perception of Hesselin as a man of 'universal cognisance,' as Niceron so eloquently noted.[116] Leaving behind Hesselin's court, I now turn to the ways in which Niceron adapted the capabilities of the perspectograph in order to augment his studies on perspective and anamorphosis.

VIII. Niceron's Adaptation of the Perspectograph

Impressed by the perspectograph's multi-faceted technology, Niceron set about weaving the device into his studies on 'the curious perspective'. He approached the *instrument universel* as a challenge not just applicable to art practice but also for the materialisation of a theoretical exercise to achieve high-level anamorphic effects on odd, angular surfaces. It is worth pointing out that Baldassare Lanci's surveying instrument and drawing machine discussed in chapter two (fig. 55) was also referred to as a 'universal instrument' by its maker, which underscores the range of capabilities inherent in these drawing devices.[117] In *La Perspective Curieuse*, the procedure for using the *instrument universel* is explained point by point.[118] In essence, Niceron's instructions are very much in line with Cigoli's, yet provide more vivid detail as to the materials used. As such, *Perspective Curieuse* can be defined as 'practical geometry', as it is written in dialogue with the reader, who is addressed directly. Pascal Briost elucidates that practical geometries imitate a classroom in which a teacher goes about instructing his pupil, and

[116] As quoted in Schnapper, *Curieux du Grand Siècle*, p. 184. '…qui monstrent assez que l'esprit du maistre est tout à fait universel en ses cognoissances.'
[117] Kemp, *Science of Art*, p. 175.
[118] Niceron, *Perspective Curieuse,* Book II, p. 130. First, one begins with a strong piece of white paper, 'fort blanc,' which is to be placed parallel to the horizon line of the object in question. The paper is then secured at the corners with wax. The draughtsman then looks toward the cube *tus* through the hole *R*, and places his right hand over the mobile marking device.

are defined in this period through their 'systematic instructions about the manipulation of mathematical instruments.'[119]

In addition to an extended discussion of the instrument's functionality, Niceron provides illustrations of the device that far surpass Cigoli's drawings in terms of the level of detail provided. Figure 146 illustrates the basic functionality of the instrument, used here in the service of drawing of a cube. While it appears initially as an illustration of the device alone, a closer look at the eyepiece and manual indicator shows a small, floating eye and a hand cut off at the wrist by the instrument's back rod. These ghostly body parts are repeated again in a subsequent illustration (fig. 147) however this time, the eye is foregone altogether and the right hand appears to have become sentient as it glides along the surface of the paper beneath, severed from an arm yet moving on its own. Such disembodied figures footnote the draughtsman's presence. Considering the embodied character of the *instrument universel*'s very application, the absence of a draughtsman here is puzzling.

One may assume that Niceron has quite deliberately removed any excess or unnecessary aspects from the illustration and has included only the vital components. Notably, he chose to omit the left hand of the draughtsman in the schema. As discussed in regard to the perspectograph, the left hand is used to turn the knob on the left (seen here at 'x'), which is responsible for moving the vertical pole to the left or the right. It would seem, then, that he regards the draughtsman as an obstacle to override in the process of perspective, characterising it as superfluous and its representation redundant.

[119] P. Brioist, 'Oronce Fine's Practical Geometry', in A. Marr (ed.), *The Worlds of Oronce Fine: Instruments and Print in Renaissance France* (Donington, 2009), p. 59.

These disembodied eyes and hands recall a particularly enigmatic figure on the frontispiece of German Jesuit Christoph Scheiner's (1575-1650) treatise *Pantographice* (1631) (fig. 148). *Pantographice* was the first manual on the pantograph: an instrument used to trace three-dimensional objects in various proportions.[120] While the pantograph is intended mainly to produce an outline of an image, 'its precision and efficiency presented a major breakthrough for the reproduction of images.'[121] In manipulating the distance between each of the rulers that form the parallelogram, the artist can choose how large or how small they wish to modify the object they are copying.

On the frontispiece, a bizarre spectre floats in mid-air centred in a rotunda and surrounded by life-size statues of popes and saintly figure. Upon closer inspection, this ghostly apparition is comprised solely of an arm, hand, and eye, all couched in a cloud-like form hovering in space (fig. 149). The eye peers through a monocular sight erected on a stand and directs its gaze toward a bust in the distance. The outstretched arm grasps a pen that is attached to a device lying flat against the canvas, while an outline of the likeness of the statue begins to take shape.

Volker Remmert has shown that the frontispiece to *Pantographice* is arranged as an homage to Scheiner's patron Paolo Savelli (?- 1632). Savelli, a member of an elite noble family in Rome and Imperial ambassador to the Holy See, financially supported

[120] For more on Scheiner's optical theory see O. Gal and R. Chen-Morris, 'Baroque Optics and the Disappearance of the Observer: From Kepler's Optics to Descartes' Doubt', *Journal of the History of Ideas* 71, no. 2 (2010), pp. 191-217; and A. E. Shapiro, 'Images: Real and Virtual, Projected and Perceived, from Kepler to Dechales', *Early Science and Medicine* 13, no. 3 (2008), pp. 270-312.

[121] B. M. Stafford, *Devices of Wonder: From the World in a Box, to Images on a Screen* (Los Angeles, 2001), pp. 276-277. Stafford notes that Scheiner first learned about the pantograph in 1603 from an artist in southern Germany, who, in turn, refused to teach Scheiner how to construct one of his own. Scheiner learned the method himself.

Scheiner's journey from Rome to Vienna in 1633. [122] In return, Scheiner fashioned his frontispiece as a gift to his patron through several carefully placed symbols. First, the Christogram IHS lights the rotunda under which the bust statues lie, which pays homage to Savelli's position in the ecclesiastical jurisdiction.[123] The Savelli family coat of arms—a double-headed eagle—is imprinted on the shield carried by putti in the dome. On the floor, stretched just underneath the easel, a plaque reads, 'Inspice et fac secundum exemplar,' or 'look that thou make them after their pattern.'[124] As Remmert argues, this marks the pantograph as a divinely inspired enterprise. Indeed, he equates the looming hand extending out of the spectre in the centre of the illustration as further indicative of the device's inspired origins. As he explains, the frontispiece functioned as a gift to Scheiner's patron that appealed not only to his artistic interests but also flattered Savelli by referencing his family's coat of arms. In this way the frontispiece acted as 'a gift that was highly *à la mode* among the status conscious elite in seventeenth-century Rome'; a gift that honoured the very patron who supported Scheiner's scholarly pursuits.[125]

The parallels between Niceron's illustrations of the *instrument universel* and Scheiner's pantograph are marked by the level of flexibility with which they provide the draughtsman in copying objects from life. Furthermore, the eye and hand in both scenarios function in unison, as fused with the instrument, defined as organic instruments themselves. Scheiner and Niceron's treatment of lone, ethereal eyes and hands further evinces the monocular foundations on which drawing in perspective rests. In order to

[122] V. Remmert, *Picturing the Scientific Revolution: Title Engravings in Early Modern Scientific Publications* (Philadelphia, 2011), p. 209-210.
[123] The IHS Christogram is an abbreviation of the Greek word for Jesus, as well as an acronym denoting 'Iesus Hominum Salvator', or Jesus Savior of Mankind.
[124] Remmert, *Picturing the Scientific Revolution*, p. 210.
[125] Remmert, *Picturing the Scientific Revolution*, pp. 213-214.

guide the *instrument universel*'s bead across contours of an object, the eye must be steadied and binocular parallax must be negated. Close scrutiny of this kind is best achieved when our vision is halved.

Niceron's and Scheiner's illustrations of such eerie apparitions say something quite poignant about the very achievement of the *instrument universel* as a feat of engineering that rendered the act of drawing nearly automatic. If we return to Niceron's illustration, we can now better understand the omission of a draughtsman in light of his own fascination with the device from a technical standpoint. As if meditating on all of the intricate parts that comprise the instrument as a whole (fig. 150), [126] Niceron asks the reader to marvel at the fact that the various applications of the device are so vast that there is 'nothing in all of perspective that cannot be executed with this instrument.'[127] The moniker *instrument universel* is evidently not hyperbolic; Niceron is fully convinced that in the history of perspective no device surpasses the level of accuracy and ubiquity Cigoli's instrument is able to achieve.

The most apparent difference between Cigoli and Niceron's treatment of the universal instrument lies in their respective treatment of skewed perspective, or anamorphosis. Like Cigoli, Niceron was also interested in the instrument's ability to manipulate perspective, whether on a flat or irregular surface. As Niceron remarks, with a simple operation, one can achieve every sort of oblique or deformed perspective

[126] Niceron's and Cigoli's detailed, technical illustrations of the perspectograph can be said to participate in the vogue for machine drawings in the early modern period. For an overview of the history of machine illustration, see E. Rovida, *Machines and Signs: a History of the Drawing of Machines* (Dordrecht and New York, 2013), especially pp. 31-69; and F. Camerota, 'Renaissance Descriptive Geometry: The Codification of Drawing Methods', in W. Lefèvre (ed.), *Picturing Machines: 1400-1700* (Cambridge, 2004), pp. 173-208.

[127] Niceron, *Perspective Curieuse,* Book II, p. 133. '…voyons en les usages qui sont so nombreux qu'il n'y a rien dans toute la Perspective qui ne se puisse executer avec cet instrument.'

discussed in the second book of this treatise, which he coyly adds had not yet been explored by Cigoli.[128]

Niceron begins by discussing how the image to be transposed onto a wall must be placed on the sheet before you, on the space delineated by *EBCF* (fig. 147). *TVXl* delineates the space on which the design in question is to be drawn, with T marking the highest point on the right, and *l* marking the highest point on the left. This space will be viewed obliquely through '*z*', the eye-piece. The draughtsman must first move the pole so that it encloses the illustration you wish to transpose onto the wall, in this case, *LMNO*. Once the pole is moved to such an extent that the cursor is able to touch the outer edges of the illustration, the procedure can begin.[129] The cursor is moved over a point on the illustration in question and the eyepiece is aligned with the bead at *f.* Attached to the eyepiece is a string, *Zopq*. Once the eyepiece and the bead have been aligned, the string is pulled up to meet with the bead, forming an angle that is extended to the wall, *TVXl*. Wherever the string touches the wall, a point is made. This procedure is carried out, point by point, until an outline of the illustration is made. In addition to oblique angles, this procedure can be repeated to transpose the same illustration onto a catoptric plan.

Comparing Niceron's treatment of the universal instrument with Cigoli's, there is an evident divide in intent in relation to the goal of their respective projects. Whereas Cigoli lauds the perspectograph as the optimum means of circumnavigating the laborious process of drawing in perspective, Niceron introduces the universal instrument as one of

[128] Niceron, *Perspective Curieuse,* Book II, p. 134. 'L'on fait par une simple operation de cet instrument tout ce que nous avons dit en ce 2 livre des Perspectives obliques & difformes, a quoy l'inventeur n'avoit peut ester point pense.'

[129] Niceron, *Perspective Curieuse,* Book II, p. 134. 'Il faut aprez, du point z conduire le filet ZKopq par le mesme lieu du noeud sur le plan lTVX, sur lequel vous marquerez l'endriot ou cette partie de l'image doit ester representee:& faisant ainsi de tous ses autres points l'oeil 2 verra la Perspective sembable à lobjet LMNO, d'où elle a esté prise.'

a number of tools in the draughtsman's toolkit for experimenting with illusory imagery. The universal instrument is not the be-all and end-all of perspectival innovation, and his treatment of the device has a far more experimental tone than that of Cigoli's. As stated, Cigoli categorises perspective instruments as one of three rules of perspective. The perspectograph is a necessary means of exploring and understanding feigned three-dimensional space. The instrument allows the artist to study, train, and execute perspectival accuracy; like pen and paper, Cigoli characterises the perspectograph as an important piece of equipment in the study of linear perspective. For Niceron, the universal instrument is one of a bevy of illusory methods used in the service of deception—illusion for illusion's sake.

IX. Perspective Instruments as Kinetic Learning Tools

Despite the precision of the perspectograph, it is unclear how often it was in fact employed throughout Cigoli's and Niceron's career. Considering the lengths Cigoli and Niceron must have gone to engineer the instrument, one would assume that it would have been incorporated into their everyday practice as artists. This does not appear to be the case. In Niceron's case, one of the most well-known anamorphoses he had a hand in creating, in collaboration with his Minim colleague, Emmanuel Maignan (1601-1676), was a portrait of *St. Francis of Paola* (1642) (figs. 151-152) located in San Trinità dei Monti in Rome. This large-scale anamorphic fresco was achieved by exercising an adaptation of Dürer's string method (fig. 153).[130].

[130] For more on this fresco, see L. Massey, *Picturing Space, Displacing Bodies: Anamorphosis in Early Modern Theories of Perspective* (Philadelphia, 2007), pp. 96-97; K. Harries, *Infinity and Perspective* (Cambridge, 2001), pp. 95-96; Baltrušaitis, *Anamorphic Art,* pp. 50-57.

When standing in front of the fresco, one sees a landscape of a bay replete with a series of winding mountains in the background, and an olive branch swept by the wind in the upper-most register (fig. 151). Looking closer, an urban townscape appears to the left. Sailboats drift within the bay as St. Francis glides along the surface of the water. As you exit the cloister, a portrait of the saint kneeling in prayer appears miraculously from the grisaille landscape. What were previously the sinuous lines of the mountainous regions is now the outline of St. Francis' cloak, with the body of water now transubstantiated as his left thigh (fig. 152).

Niceron painted two more such frescoes in the cloister of San Trinità that have since been lost: one depicting St. John the Evangelist, and the other of Mary Magdalen. The technique used to achieve these large-scale frescoes relies on the same principles as Dürer's string method, only in lieu of the string touching a point on an object, here it touches a point on a small painted panel that can be swung perpendicularly to the wall (fig. 153). The viewpoint is a monocular peephole located at the far end of the cloister. By stretching the string from the peephole through the drawing and onto the perpendicular wall of the cloister, the draughtsman can mark the anamorphic rendition point by point. From the peephole, the image will appear as perspectivally proportioned, identical to the small panel painting used in the process of construction.

Why did Niceron choose not to implement the universal instrument for such an important project? Would this not present a perfect opportunity to demonstrate the wondrous effects of the device? One explanation for this disparity lies in the disharmony between theory and practice. In theory, the perspectograph can be employed, with fantastic results in any locale; it is portable, malleable, and applicable in an infinite

number of circumstances. However, it is quite possible that the benefit of the perspectograph for artists lies more in the study of perspective, not in its execution. Transcribing an object at a distance onto a sheet of paper via the perspectograph is a lengthy and arduous procedure that requires a fair amount of practice. While the exercise is 'mechanic,' it is by no means fluid or seamless. As evidenced in both Cigoli's and Niceron's treatise, translating a three-dimensional cube onto a two-dimensional surface is done point by point. After every point is made, a series of physical actions must take place: nobs must be turned, the bead, manual indicator, and eyepiece aligned. Even in the hands of a well-practiced draughtsman, there is, nonetheless, a divisive break in the momentum of drawing. This is mechanic pointillism, where import lies in the position of the point placed on the paper, and not in the continuous and fluid execution of the line. Moreover, the length of time it would take to trace a complicated or intricate pattern is undoubtedly exorbitant. One must surmise that a simple outline of the object would suffice, and that the artist would then employ his talents to 'fill in the blanks,' so to speak, in order to finalise the image proper.

This is corroborated by Kemp who writes that De Keyser's device 'is undeniably cumbersome and long-winded,' leading him to conclude that 'it was conceived less as a practical aid in making works of art than for the purposes of demonstration.'[131] De Keyser's innovation would have not have been designed for universal application, but instead for pedagogical training.[132] The impractical yet edifying quality of perspective instruments can historically be traced back to Alberti's veil technique. By placing a thin veil between the eye of the artist and the object to be depicted, points can be plotted

[131] Kemp, *Science of Art*, p. 172.
[132] Kemp, *Science of Art*, p. 173.

precisely as outlined above. Alberti refers to the didactic quality of this method when discussing how the artist should approach a painting after practising this technique:

> …when a painter wishes to try his skill without the veil, he should note first the limits of objects within the parallels of the veil. Or he may study them in another manner by imagining a line intersected by its perpendicular wherever these limits are located. But since the outlines of the planes are frequently unknown to the inexpert painter—doubtful and uncertain as in the faces of man where he does not discern the distance between the forehead and the temples—it would be well to teach him how he can come to understand them.[133]

In this way, perspective devices *instruct* and guide the budding artist in circumnavigating the perspectival technique. Instruments devised by the likes of Cigoli, Dürer, De Keyser, and Jamnitzer were evidently training tools in the art of perspective, as they physically manifest an otherwise invisible process. But what, precisely, do these instruments 'train'? I propose that through physical engagement with the strings, rods, and sighting devices, the artist is able to ascertain how our hand and eye transcribe perspectival space. Such devices render a previously invisible process both perceivable and malleable. Moreover, in relation to the perspectograph, the 'making visible' of the process of perspective can be seen as the level of automation the draughtsman's body follows again and again. While the perspectograph dictates the choreography, the artist's body carries out the dance.

Like any other form of physical training, the practice of repeated movements soon becomes second nature; the only way to perfect a talent is *to do*, in this case *physically*, over and over again.[134] While the act of drawing with the perspectograph is not a

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[133] L. B. Alberti, *On Painting,* trans. John R. Spencer (New Haven, 1956), pp. 69-70.

[134] C. Korsmeyer, 'Instruments of the Eye: Shortcuts to Perspective', *The Journal of Aesthetics and Art Criticism* 47, no. 2 (Spring 1989), p. 142. Korsmeyer suggests that the use of mechanical drawing aids primarily allows the draughtsman to exercise a progression from drawing from a picture to drawing from nature; copying pictures mechanically first may have allowed the draughtsman to practice before tracing an object by hand. She suggests that an easy progression would be to trace simple shapes such as lines or squares first, then move on to copy pictures from books, larger compositions, and then finally drawing from nature.

continuous movement, the body is no less at play during the process. Conversely, when the draughtsman goes about projecting an image from the paper before him onto a wall or vaulted ceiling, the body is equally incorporated. As discussed, when projecting the image at a distance, a second person is required in order to mark the corresponding points on the surface in question. While it could be argued that with the introduction of a second person the connection between object, draughtsman, and paper is made less direct, one must instead think of the second person as the now-removed lead pen beneath the cursor. The second person acts as the marker, and hence, the relation between the draughtsman's body, the image in question, and the space at a distance, remains intact. When projecting an image on a wall or ceiling, the draughtsman is still exercising, playing with, and physically working through, how his body relates to perspectival space.

X. Perspective's Compass: Navigating the Void

In the preamble to his first rule of perspective, Cigoli uses a striking metaphor in order to defend the necessity of perspective. He writes, after Leonardo, that a painter without perspective is 'like a Sailor at Sea with neither rudder nor compass, never knowing where he is or where he is going.'[135] Elucidating, Cigoli writes that when painting an object on a surface, the artist inevitably runs into a conundrum: 'the surface consists of only two dimensions, whereas the object has three.'[136] It is 'Art,' or perspective's role to 'counterfeit' the missing dimension.[137] Taken in this way,

[135] Cigoli, *La Prospettiva Pratica,* Book I, Part I. As translated in Kemp, 'Ludovico Cigoli and Ragione', p. 146.
[136] Cigoli, *La Prospettiva Pratica,* Book I, Part I. As translated in Kemp, 'Ludovico Cigoli and Ragione', p. 146.
[137] Cigoli, *La Prospettiva Pratica,* Book I, Part I. As translated in Kemp, 'Ludovico Cigoli and Ragione', p. 146.

perspective is defined as an instrument that the artist uses to traverse space, to navigate the void that exists between the second and third dimensions. The language Cigoli chooses to employ is deliberate and speaks to the larger impetus of his treatise as a whole. By equating perspective with navigational instruments like the rudder and compass, he implicitly characterises perspective as a physical tool. Instead of classifying perspective as a map, or set of abstract geometrical principles, it is analogous to a device that is manipulated physically, not intellectually, as a feat of engineering that the artist can use to traverse representational space.

Taken in this way, I propose that Cigoli's metaphor of perspective as a navigational instrument alludes to an intriguing vignette painted at the rearmost point of an enigmatic panel now located in the Gemäldegalerie in Berlin (fig. 154). This perspective, attributed to Francesco di Giorgio Martini, was likely made for the ducal palace in Urbino,[138] and belongs to a group of three architectural perspectives, or 'ideal cities,'[139] originating from the Duchy of Urbino. The second, *Ideal City* by Fra Carnevale, is now located in the Walters' Museum of Art in Baltimore (fig. 155),[140] while the third, *Città Ideale,* is housed in the Galleria Nazionale delle Marche in Urbino (fig. 156).[141] While these three paintings differ in size and preparation, they have, nonetheless,

[138] The inventories of the ducal collections speak of several oblong 'perspectives' painted on wooden panels, however definitive evidence of the origins of these paintings still remains unclear. See H. Damisch, *The Origin of Perspective* (Cambridge, 1994), p. 190.
[139] The trope of the 'ideal city' as a repeated motif in Renaissance paintings can be attributed to the influx of surveying instruments at this time, which turned the geography of the city into an objective space ripe for study and scrutiny. See R. Eaton, *Ideal Cities: Utopianism and the (Un)Built Environment* (London, 2001), p. 41.
[140] J. Spicer, 'The Ideal City, attr. to Fra Carnavale, in the Walters Art Museum', in M.S. Hansen and J. Spicer (eds.), *Masterpieces of Italian Painting in the Walters Art Museum* (Baltimore, 2005), pp. 62-63. This painting has been attributed to Fra Carnavale after an inventory from the ducal palace in Urbino in 1599.
[141] It is inconclusive whether or not the same artist constructed all three panels. Spicer holds that they have not been made from the same hand, but nonetheless confirms that they originate from the same cultural and physical milieu. Spicer, 'The Ideal City', p. 62.

repeatedly been thought of as a group.[142] Richard Krautheimer goes so far as to say that in light of their subject matter and style 'they are intimately related to one another', and in their acute perspectival rendering of cityscapes 'altogether stand apart in fifteenth-century Italian painting.'[143] Pointing to their theoretical character, these three paintings pay homage to Alberti's theories in his treatise *On Building* (1483),[144] which was dedicated to Frederico da Montefeltro, the Duke of Urbino (1422-82). Frederico not only hosted the theorist at his palace on many occasions, but the two shared a close friendship.[145] If these panels indeed originate from the Urbino court, they present an interesting correlation to Frederico's affinity for extravagant perspectival illusions, as demonstrated in the *intarsa* designs for his private *studiolo* (fig. 157).[146] While the Urbino palace was open to the public from dawn until dusk, the *studiolo* was designed as a private sanctuary near Frederico's apartment, in which he could study and greet select guests.[147] This private space was designed with close attention to perspectival geometry in addition to what Kemp describes as: 'ingeniously knowing pragmatism in the devising of something that will work best in the given circumstances of the room.'[148] Like a

[142] R. Krautheimer, 'The Panels in Urbino, Baltimore and Berlin Reconsidered', in H. A. Millon and V. M. Lampugnani (eds.), *The Renaissance from Brunelleschi to Michelangelo: The Representation of Architecture* (New York, 1997), p. 235.
[143] Kratheimer, 'The Panels in Urbino', p. 235.
[144] See Kemp, 'The Mean and Measure of All Things', in Jay. A. Levenson (ed.), *Circa 1492: Art in the Age of Exploration*, exh. cat. (New Haven and London: Yale University Press, 1991), p. 99.
[145] In light of their kinship, Krautheimer weighs the theory that Alberti may have designed and painted the three ideal cityscapes, but ultimately pulls back from this speculation as the evidence is scant. Krautheimer, 'The Panels in Urbino', p. 256
[146] For more on Frederico da Montefeltro and his taste for decorative arts, see C. H. Clough 'Art as Power in the Decoration of the Study of an Italian Renaissance Prince: The Case of Frederico da Montefeltro', *Artibus et Historiae* 16, no. 31 (1995), pp. 19-50.
[147] O. Raggio, *The Gubbio Studiolo and Its Conservation: Fredrico da Montefeltro's Palace at Gubbio and its Studiolo* (New York: The Metropolitan Museum of Art, 1999) vol. I, p. 79.
[148] For a detailed analysis of the *studiolo*'s use of perspective, see M. Kemp, 'Making It Work: The Perspective Design of the Studiolo', in O. Raggio, *The Gubbio Studiolo and Its Conservation: Fredrico da Montefeltro's Palace at Gubbio and its Studiolo* (New York, 1999) vol. I, p. 176.

perspective box brought to life, the *studiolo* is a private sanctuary designed to inspire and impress through perspectival feats.

Marr has shown the weighted importance mathematics carried in the Duchy of Urbino, as Frederico was especially keen on geometry, having studied under the tutelage of Vittorino da Feltre (1378-1446).[149] As an anecdotal aside, after suffering from a severe blow during a jousting match at the Urbino court in 1451, Frederico lost his right eye, and thus spent the remainder of his life observing the world monocularly.[150] I speculate that he would have likely perceived his trompe l'oeil *studiolo* and the perspectival cityscapes incorporated throughout his palace in a different manner than binocular observers. While this is purely speculative, it is nonetheless constructive to entertain the idea that, in addition to satiating his fervent interest in geometry, Frederico had a penchant for perspectival art as it enlivened his perception of three-dimensional depth that would have then been so hindered after his accident.

Because the three ideal cityscapes have been removed from their original setting it is difficult to surmise how, precisely, they were incorporated into the interior décor at Urbino. However, the original wood panelling in the Berlin painting provides more insight into its intended display as a backing to a piece of ornate furniture (*spalliera*) (fig. 154).[151] In this panel, six strong lines mark the vertical axis of the perspective's pavement that pulls the viewer's eye forward, like road markings extending along a long stretch of highway. Our gaze comes to rest at a seascape that drapes the rear of the painting like a theatrical backdrop. Three ships encircle the harbor as the North wind fills their sails.

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[149] Marr, *Between Raphael and Galileo*, pp. 29-33.
[150] O. Raggio, 'The Liberal Arts Studiolo from the Ducal Palace at Gubbio', *The Metropolitan Museum of Art Bulletin* 53 no. 4 (Spring 1996), p. 6.
[151] Spicer, 'The Ideal City', pp. 64-65.

In *The Origins of Perspective* (1994), Hubert Damisch theorises that this painting, along with the other two 'Urbino perspectives', embody the enigmatic character of perspective as a representational method and mode of thought. Damisch regards these three works as a 'transformational group,'[152] where the paintings play off one another, representing a 'purely visual kind of thinking in which the relation of artwork to artwork is paramount.'[153] In lieu of a connected iconography or even speculative provenance, these paintings fraternise in pictorial terms as 'a strictly formal level of articulation.'[154]

Central to the formal relations between each piece are their perspectival arrangements. Specifically, the repeated motifs of various openings or *vedute* (triumphal arches, porticos, doors, and windows) that direct the eye to see *through* the painting, acting as 'a kind of escape hatch giving onto the painting's background,' akin to a 'window or hole in the perspective configuration,' that pierces the two-dimensionality of the painted surface.[155] When looking at these perspectives, the viewer is enticed to gaze through each and every *vedute,* utterly compelled by the recessions of depth within each scene.[156] Moreover, in referring to the Urbino panel (fig. 156), Damisch writes that when engaged with this piece, the observer soon discovers that 'he is implicated in a perfectly calculated apparatus.'[157] The order of the painting beckons the viewer…

> …to its center, to the point henceforth marked, in the painted surface, by a small conical hole, but without furnishing him, as to all appearances would be necessary under the perspective rule, with a stable, secure point, in relation to which he

[152] Damisch, *Origin of Perspective*, pp. 287-289. In his detailed analysis, Damisch notes the parallels in geometrical symmetry between each piece.
[153] M. Iversen, 'The Discourse of Perspective in the Twentieth-Century: Panofsky, Damisch, Lacan', *Oxford Art Journal* 28, no. 2 (2005), p. 198.
[154] Damisch, *The Origin of Perspective*, p. 297.
[155] Damisch, *The Origin of Perspective*, p. 298.
[156] John White elaborates that in regard to perspective paintings like the Berlin panel, no matter where the observer's gaze looks within the composition, 'it is forced back towards the centre lying deep in pictorial space.' J. White, *The Birth and Rebirth of Pictorial Space* (Cambridge, 1987), p. 190.
[157] Damisch, *The Origin of Perspective*, p. 172.

> could easily get his bearings in the game in which he must take a stand, however much he's inclined to resist.[158]

Indeed, the Berlin and Baltimore panels are marked at their centre with a tiny hole piercing the wood of the panel (fig. 154b).[159] These holes correspond to the vanishing points in each configuration. In the Urbino panel, the vanishing point lies within the temple door; in the Baltimore panel it is located within the opening of the central gate of the triumphal arch; and in the Berlin panel, a hole is punctured on the horizon of the seascape.

For Damisch, the hole at the centre of these paintings denotes the larger lack seated within the very origins of perspective. The site where the depth of the painting is achieved is a continuously regressing void. We may seek it, and orient our bodies according to it, but it is ever eluding our grasp as it recedes into infinity. Analogous to the figurative lack that qualifies the regression of two-dimensional space, the very material origins of this method, Brunelleschi's panel demonstration, is lost to history. As Hanneke Grootenboer explains: 'Perspective's multiple histories circle around a lack of origin that connects them.'[160] The very heart of this method evades us in two ways: by escaping historic record, and by centring itself on a point that is but a hole in the picture, an absence in a very real sense.

With no origin to orient our understanding, we inevitably lose our way when exploring perspective from a historical standpoint. Moreover, by orienting our bodies

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[158] Damisch, *The Origin of Perspective*, p. 172.
[159] Spicer, 'The Ideal City', p. 65. While in the Berlin panel this hole is evident, x-ray has exposed the hole within the Baltimore panel. Spicer notes that in addition to this hole, x-ray has also uncovered many of the orthogonal lines fanning out from the central hole, or vanishing point, that have been incised in the panel, further evincing the strict perspectival makeup of the painting.
[160] H. Grootenboer, *The Rhetoric of Perspective: Realism and Illusioniam in Seventeenth-Century Dutch Still-Life Painting* (Chicago and London, 2005), p. 165.

according to a void in the picture, it can be said that we are metaphorically feeling our way in the dark. Returning to Cigoli's account that without perspective we are but 'a Sailor at Sea with neither rudder nor compass,' I would like to focus on the scene that opens up in the central *vedute* of the Berlin panel: the seascape between the central portico (fig. 154b). These ships quietly infer human presence through the billowing of their sails.[161] Pushing this analysis further, these vessels, enveloping the vanishing point at the centre of the painting, both signify and signal the navigational quality of perspective. Encircling the void, the ships convey how it is possible to orient oneself around a point that will never acquiesce visual grasp.

In this way, I propose that Cigoli's perspectograph functions as a perspectival compass that guides the artist's exploration of representational space. As a navigational tool, it aids the artist in orienting the placement of his hand and eye so that he may record his findings accurately and with ease. As discussed in regard to the practical applicability of the device, it can be said that in practising drawing with the perspectograph, the draughtsman is learning to guide his movements and understand the correlations between his body, pen, and two-dimensional space. What is more, the perspectograph orients the draughtsman in the right direction all the while eschewing written theory. While outlining an object with the perspectograph is undoubtedly a lengthy process, the device nonetheless shortcuts the practice, or study, of perspective. This instrument allows those interested in drawing in perspective, without any prior skills, to learn how to translate three dimensions into two, kinetically. Without the perspectograph's mechanical ingenuity to orient our exploration of perspectival space, we are lost at sea.

[161] Damisch, *The Origin of Perspective*, p. 309.

XI. Conclusion: Monocular Drawing

As detailed in this chapter, the perspectograph fuses the movements of the hand and eye with a mechanised system that assures accurate results. In ameliorating the various difficulties with previous innovations, Cigoli not only devised an instrument that could trace any object at any distance, but he successfully reintegrated the body of the draughtsman back into the process of drawing in perspective, providing physical immediacy. Unlike Dürer's, Jamnitzer's, or De Keyser's devices, the perspectograph allows the draughtsman's very own eye to serve as the point of view in lieu of a disembodied apex behind him. What is more, the perspectograph ameliorates the brief discontinuity that inevitably arises when an artist turns away from their subject to trace its likeness on the canvas. Cigoli's draughtsman does not 'trace blindly', as Derrida would have it, for the perspectograph's engineering assures that he need not look away in order to mark a point.

Like the perspective box and catoptric peep-boxes previously discussed, the perspectograph was regarded as a collectible object in the seventeenth century. Revered for both its functional capabilities and craftsmanship, the instrument made a welcome addition to a courtly collection designed to awe visitors and guests. The perspectograph can also be said to participate in the cultural shift of the study of mathematics in the sixteenth and seventeenth centuries as an instrument that can be used to study the abstract principles of perspective as well as acting as an object of study itself. While it may not serve a practical purpose for the artist's practice, its ingenuity was appreciated nonetheless as a marvel of design and craftsmanship.

Central to the concerns of my study, the monocular foundations of early modern drawings technologies discussed throughout this chapter demonstrate that perspective is optimally studied in the space of 'one-eyed, stationary vision',[162] for two crucial reasons. For one, looking with one through the eyepiece focuses the draughtsman's attention on a point and assures that binocular parallax does not impede close observation. Monocular vision remedies the superimposition of the disparate retinal images produced by our two eyes. The perspectograph's bead, aligned with a point on an object must be perceived monocularly in order to render both points opaque and static. If seen with two eyes, the precise juxtaposition of the bead with the object would be out of focus. Secondly, looking monocularly, the draughtsman can assure that his line of sight is in direct relation to the object, he can establish a one-to-one relationship between the point of view and the vanishing point, which is perspective's key premise. Thus, while the picture drawn by the perspectograph can be appreciated binocularly, the translation of three dimensions into two requires monocular focus.

[162] E. Gombrich, *Art and Illusion: A Study in the Psychology of Pictorial Representation* (New York, 1960), p. 278.

Conclusion

CONTESTING MONOCULAR PERSPECTIVE IN THE ACADÉMIE DE PEINTURE ET DE SCULPTURE

Holding the tail end of four strings up to his left eye, Abraham Bosse's (1602-1678) stately gentleman peers down toward a square drawn on the floor before him (fig. 158). Attached at corners *b c d f*, the strings, pulled taut, signify the invisible visual rays that connect this man's left eye to the shape before him. This exercise, presented in his treatise *Manière Universelle de Mr. Desargue pour pratiquer la perspective* (1648),[1] illustrates the tenets behind Bosse's perspectival method and also serves as a set of visual instructions for the reader to carry out empirically. He instructs the reader to do exactly like the gentleman in his picture:[2] 'It is as if you see the corners of the square through the strings,' writes Bosse, 'the space within the boundaries of the four strings represents the mass of the all the visual rays through which you see the square.'[3] The strings act, in fact, as a visual passage from eye to image, physically embodying the spatial field between observer and observed. In another illustration, two pairs of disembodied hands grab hold

[1] All of the following translations of Bosse's text are my own.

[2] A. Bosse, *Manière Universelle de Mr. Desargues pour pratiquer la perspective par petit-pied, comme le Geometral. Ensemble le places et proportions des fortes & foibles touches, teintes, ou couleurs* (Paris, 1648), p. 60. '…portez à l'un de vos yeux les doigts dont vous tenez comme cy-devant les filets attachez aux coins d'un carreau tendus en ligne droite, une fois si vous le voulez estant debout, une autre fois estant assis, puis s'il vous plaist, une autre fois estant monté sur quell que chose, qui est à dire en toute situation que vous sçauriez penser.'

[3] Bosse, *Manière Universelle*, p. 60. Et tenant ainsi l'assemblage de ces filets à vostre oeil, regardez ce carreau *b c d f*, d'un mesme temps, & vous en verrez les coins au droit & le long de ces filets, comme si chacun de ces coins venoit le long d'un de ces filets à vostre oeil, ou comme si vostre oeil voyoit ces coins par le long de ces filets, alants de luy jusques à eux; & de mesme de chaqu'autre point du carreau so vous y voulez adjuster un semblable filet; & par ce moyen ces filets vous representeront les rayons qu'on nomme visuels, & vous en pouront faire incontinent venir l'imagination, & l'espace qu'ils enferment entr'eux, vous represente la forme de la masse entire de tous les rayons visuels ensemble, par lesquels vostre oeil voit lors ce Carreau; qui est ce que M. D. [Desargues] nomme le *rayonnement* de la veuë.'

of four strings as they straighten under the weight of the square outlined on the page (fig. 159). The curly tendrils springing from the fingertips of the hands emphasise the force of the pull on the strings as well as their malleability.

I would suggest that what we see in these illustrations, and others like I have shown in this thesis, is how an abstract geometrical concept is reimagined as a tactile exercise. Acting as octagonal lines leading up to the vanishing point, Bosse's strings masterfully embody the precepts of perspective's theoretically monocular character. Implicit in these illustrations is the understanding that the outline of the square exists within the realm of representation, drawn on the page as an image proper, while the strings exist within the space of the observer, who pulls them toward his eye for observation (fig. 160). Like the sighting devices outlined in chapter four, Bosse's strings align the viewer's sight in order to perceive the represented shape, and visualise an otherwise imperceptible transaction.

Manière Universelle was dedicated to Girard Desargues (1591-1661) whose methods of perspective Bosse wholeheartedly supported. Desargues' publication on perspective, *Exemple de l'une de manieres universelles touchant la pratique de la perspective sans employer aucun tiers point, de distance ny d'autre nature, qui soit hors du champs de l'ouvrage* (1636) was published in a brief, twelve-page pamphlet and contained one illustration that was an amalgamation of his theories. In this work, Desargues aimed to 'provide a technique which would subsume all previous methods,' and tackle any circumstance that the artist would come up against in his work.[4] What made Desargues' method particularly note-worthy was that he did not employ the use of

[4] M. Kemp, *The Science of Art: Optical Themes in Western Art from Brunelleschi to Seurat* (New Haven, 1989), p. 120.

points (vanishing points, distance points) outside the frame of the painting or within, save for the one principal vanishing point, and used two sets of scales at the base of the picture plane to manipulate the viewing distance.[5] Bosse re-printed Desargues' technique in *Manière Universelle*, and added three hundred more pages of his own expansion.[6] He was principally concerned with marrying the practitioner's use of perspective with the geometric understanding of it. Thus, the treatise, much like Dubreuil's *Perspective Pratique* discussed in chapter three*,* is organised in such a way that the text comments upon the illustrations (numbering over a hundred and fifty in total), which take precedence over the commentary.

In the same year as the publication of *Manière Universelle*, Bosse was invited to teach geometric perspective at the newly founded *Académie de peinture et de sculpture* in Paris.[7] He heralded Desargues rules of perspective, which became central to his syllabus. However, Bosse's methods soon came under attack at the *Académie* leading to what Martin Kemp has coined the 'perspective wars.'[8] This historical anecdote concerning Bosse's troubles in the *Académie*, I suggest, is an apt illustration of how controversial the terrain of monocular, one-point perspective actually was within the discipline of painting. While the disagreements and heated debates in the *Académie* have been outlined in several studies, the role of monocularity in these disputes has not been discussed. As I

[5] K. Andersen, *The Geometry of an Art: The History of the Mathematical Theory of Perspective from Alberti to Monge* (New York: Springer, 2007), p. 433.
[6] For a detail analysis of Bosse's career in the early modern print industry, see C. Goldstein's recent study, *Print Culture in Early Modern France: Abraham Bosse and the Purpose of Print* (Cambridge, 2012).
[7] S. McTighe, 'Abraham Bosse and the Language of Artisans: Genre and Perspective in the Académie royale de peinture et de sculpture, 1648-1670', *Oxford Art Journal* 21, no. 1 (1998), p. 3. McTighe writes that as an engraver, Bosse could only be admitted to the Académie as an honorary member. While engravers were soon permitted to enter the Académie under their own category, but were relegated to the engraver's sphere alone, not allowed to move into the domain of painting. Bosse did not push to be admitted under this distinction. Instead, he sought to teach perspective as a manual skill.
[8] Kemp, *The Science of Art,* p. 119.

share, a chief argument against Bosse's methods was that monocular perspective is unrepresentative of how we actually see. However, the vehement reaction against Bosse's methods by *Académie* colleague Grégoire Huret (1609-1670) are ultimately founded on hypocrisy, for, as will be shown, Huret employs the monocular principle when demonstrating anamorphosis, thereby reaffirming monocularity's efficacy in conveying illusion.

Sheila McTighe has argued that Bosse's dual role as both a teacher of perspective and an engraver led to his expulsion from the *Académie* in 1661.[9] His particular mission to teach a method of perspective to an audience wider than strictly artistic—he wanted to extend the craft of perspective to builders and masons—put him in poor standing in the *Académie*. In addition, the method as such was abstract, solely based on geometrical principles.[10] For that reason, Thomas Puttfarken named Bosse the 'last champion of rigorous perspective,' as the engraver pushed for an acutely distilled method of Renaissance perspective, firmly based on single-point, monocular principles.[11]

Apparently, his rigour met with resistance in a steadily changing academic environment. Bosse pressed to have his perspective treatises published as official textbooks at the *Académie* and was denied this privilege.[12] He sought to get Desargues' methods endorsed as both a publication and a requisite course, however this also fell through. Despite being pushed to the sidelines of the *Académie*'s activities, Bosse continued to publish his work independently.[13] His work later received appreciation

[9] McTighe, 'Abraham Bosse', pp. 4-5.
[10] McTighe, 'Abraham Bosse', pp. 8-9.
[11] T. Puttfarken, *The Discovery of Pictorial Composition. Theories of Visual Order in Painting 1400-1800* (New Haven, 2000), p. 213.
[12] T. Senkevitch, 'The Printmaker's Perpsectives: Abraham Bosse and the Pedagogic Debates at the *Académie de Peinture et de Sculpture*, 1648-1661' (University of Michigan PhD thesis, 2005), p. 19.
[13] Senkevitch, Printmaker's Perpsectives, p. 20.

outside of France; *Manière Universelle* was translated into Dutch in 1664, and later translated into German in 1724.[14] Even more, his 'string' illustrations also stand as some of the most famous visual explications of the perspectival method in contemporary discussions on the subject.

In the French context, the distaste for Bosse's methods lead to a split in approaches to spatial representation between the geometrical approach of linear perspective (one-point perspective), and the optical mode of perspective (introduced by Leonardo a century prior). The antagonism towards Bosse's methods of perspective was largely lead by the famous *Académie* member and court painter, Charles LeBrun. LeBrun held that Bosse's instructions were far too technical, and pushed for a more general introductory syllabus on the art of painting. The split was complete when, in 1653, he proposed that Bosse's teachings be replaced by a recent French translation of selected portions of Leonardo's *Trattato della pittura*.[15] LeBrun would later also tout the perspective writings of Jacques LeBicheur, whom he deemed as more easily accessible.

Put simply, Bosse's methods were deemed too abstract and removed from the physical realities of vision to serve as an optimum method of teaching and instruction for artists. Particularly, academician Huret, who took over Bosse's position at the *Académie* in 1663, vehemently opposed the geometrical approach, and denounced single-point perspective as espoused in Bosse's teachings and publications.[16] In his treatise *Optique de portraiture* (1670),[17] Huret argues that a picture must represent how the eye sees, and

[14] Andersen, *Geometry of an Art,* p. 465.
[15] C. Goldstein, 'Studies in Seventeenth Century French Art Theory and Ceiling Painting', *The Art Bulletin* 47, no. 2 (June, 1965), p. 233.
[16] Andersen, *Geometry of an Art*, p. 465.
[17] All of the following translations of Huret's text are my own.

shouldn't be reduced to abstract geometrical principles because it is unrepresentative of natural vision:

> Because the straightness of the panel [perspective grid] has no correspondence or analogy with the subjects of natural relief or various depressions or lengths that we wish to represent, Geometry [one-point perspective] would like to sever sensation entirely, and to this end, simply find the right points, by means of the rules of perspective, where the natural subjects intersect the panel (a pane of glass between the artist and the natural subject) and visit one eye of the beholder, and not both together…[18]

In Huret's account, the monocular nature of the one-point perspective method disunites normal visual sensations in so far as it is based in calculations, points, and abstractions, rather than embodied vision. Huret further elucidates:

> It will come as no surprise to those who are aware of the authority, might & power of Geometry [one point perspective], that we succumb (as will be shown) to the insurmountable necessity of having half of our vision hidden from perspectival representation of their Optics (as well as those of Catoptrics and Dioptrics), and how they do not give us license to see but with one of our eyes only, and moreover how they fix us at a certain point, to stop ever so precisely, how it places a gate[19] from which they wish us to see, and not from any other, and I do not doubt that some among you would like to uncover the secret, and for time's sake, I present it here.[20]

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[18] G. Huret, *Optique de Portaiture et Peinture, en Deux Parties* (Paris, 1670), p. 59. 'Parce que la superficie ou rectitude d'un Tableau n'a aucune correspondence ou analogie avec les superficies connexes, & c., des sujets de relief naturels, & les divers enfoncemens ou éloignemens, &c. qu'on veut representer, la Geometrie veut faire en sorte d'en oster entierement la sensation; & pour cet effet, elle veut faire trouver sur les dits Tableaux, par les regles qu'elle a instituées en la Perspective, les vrais points apparens ausquels les apparences des sujets naturels couperont le Tableau (qu'elle pose ester un verre ou transparence interposée entre le Peintre & les sujets naturels) pour se venir rendre à un seul œil du regardant, mais non pas aux deux ensemble…'

[19] Huret uses the word 'pertuis' here which translates to 'sluice': a moveable gate used to control and direct the flow of water.

[20] Huret, *Optique de Portaiture,* p. 59. 'Ce ne pourra estre sans l'étonnement de ceux qui connoissent l'autorité, la force & la grande puissance de la Geometrie, la voyant succomber (ainsi qu'il va estre montré) sous la necessité insurmontable de cacher les artifices perspectifs de son Optique (ainsi que ceux de sa Catropique & Dioptrique) à la moitié de nostre vûë, & de ne donner la licence de les voir qu'a un de nos yeux seulement, & encore à la charge qu'il se tiendra fixé à un point auquel, pour l'arrêter plus précisement, elle fait poser un pertuis par lequel elle veut qu'il voye, & non par ailleurs; & je ne doute pas que quelqu'un d'entre-eux n'en voulust chercher le secret , lequel, pour épargner leur temps, je leur presente icy.'

Huret is principally opposed to the restricting quality of one-point perspective, specifically how the viewer is discouraged from observing the representation with both of their eyes at once. This method 'hides' one half of our vision from engaging with the exercises, which, in Huret's estimation, is necessary for the illusion to take place. Moreover, paintings that employ the one-point schema will appear distorted to the viewer when seen from angles other than the ideal vantage point (directly in line with the vanishing point) lending figures within the painting a truly 'monstrous' appearance, replete with frightful 'visions of sorcerers,' capable of aborting the fetuses of pregnant women![21] Huret's hyperbolic denouncement of one-point perspective illustrates the enmity cast against its proponents, Bosse and Desargues.

Yet, while Huret may have strongly opposed a monocular, geometric approach, the illustrations that accompany his treatise indicate that he made an exception in regard to anamorphic imagery. In diagram 38 (fig. 161) we see that he uses a technique very similar to Niceron's for creating an anamorphically stretched mural portrait (as outlined in chapter three). Evidently, while Huret argued against the precepts of single-point perspective in theory, in practice he advocates it when engaged with distorted forms of perspective. Lyle Massey has rightly pointed out that Huret disparages the single-point method because it does not correspond to a natural or embodied mode of visuality. Effectively, he employs it here because it takes 'perspective out of the realm of projective geometry and reaffirms its place on the inhabited side of the picture plane.'[22] I would further stress that the very fact

[21] Huret, *Optique de Portaiture,* pp. 64-65. 'Ces tableaux ne sembleroient ils pas ester plûtot faits pour representer des visions des conges lugubres, ou de sabats de sorciers, seulement capables de donner de la tristesse & frayeur, & mesme faire avorter ou depraver le fruit des femme enceintes, qu pour representer des sujets naturels & agreables à l'ordinaire.'
[22] L. Massey*, Picturing Space, Displacing Bodies: Anamorphosis in Early Modern Theories of Perspective* (University Park, 2007), p. 118.

that Huret makes such an exception points to the efficacy of monocularity where anamorphic illusions are concerned. While Huret so strongly opposed the disunity of Bosse's methods because it hides and severs the picture plane from one half of our visual faculties, his anamorphic illusions are presented as nonetheless contingent upon this very cut. Moreover, as has been shown throughout the chapters of this thesis, the 'severing of sensation' involved in a monocular picture that Huret so decries is a moot point. In order to comprehend an illusion that aligns from one point and one point only, the observer's body is very much engaged in the process, despite the seemingly 'unnatural' act of looking with one eye only.

The contents of this thesis have shown that contorting one's body to meet the precepts of the perspectival and anamorphic method is a participatory, often choreographed, exercise. As illustrated in the previous chapters, whether a peep-box, catoptric cone, or dioptric telescope, a monocular point of view primes our body to focus in on the demonstration before us, believe in its validity, and succumb to the artifice. Academicians such as LeBrun and Huret may have thought that they could do away with the monocular method, but as we have seen, there will always be the marginal modes of image making (we may call them 'curious') that will compel them to return to it when they wish to awe and surprise their spectator.

This dissertation has revealed the complex and previously unattended symbiotic relationship between the dynamics of linear perspective, optical illusionism, and monocular vision through a special class of art forms that includes anamorphoses, perspective boxes, catoptric peep-boxes, dioptric perspective tubes, and drawing instruments. As I have shown, these devices were collected as *artificialia* and *scientifica*

in early modern Kunstkammern and cabinets of curiosity because they pushed the methods of perspective to rather ludic ends. They offered the Kunstkammer visitor moments of private visual respite through peepholes and apertures, and also incited curiosity by keeping their illusions behind closed doors. In addition, catoptric peep-boxes and drawing instruments were shown to act as purveyors of erudition within elite circles, as they pointed to the optical and mathematical knowledge held by their esteemed collectors. What is more, monocular optical illusions often acted as educational mediums within religious circles by partaking in the revelation that divine forces organise even the most cunning and seemingly supernatural occurences. Ultimately, as distilled forms of the perspectival technique, these marginal monocular art forms splendidly convey the metaphorical potential of perspective by revealing their illusion from a very precise point of view.

In sum, by perusing the ludic lengths to which artists and perspective theorists went to trick their observers, this thesis has shed light on worlds unearthed when looking with one eye open and one wide shut.

Epilogue

MONOCULARITY'S LEGACY

In this thesis I have largely limited myself to investigating the monocular foundations of Continental one-point perspective within the confines of the seventeenth century. In the eighteenth century, the publishing pace of perspective treatises largely begins to slow, save for England, where, exceptionally, we see a continued interest in the monocular principle of perspective in several significant contributions on the subject. In two instances, Brook Taylor's treatise, *Linear Perspective* (1719) (fig. 162), and Joshua Kirby's later publication of Taylor's methods, *Dr. Brook Taylor's Method of Perspective Made Easy, Both in Theory and Practice* (1751), we see an adaption of one-point perspective after Bosse, replete with strings leading up to the figure's eye. Furthermore, an illustration of Kirby's perspective device by Royal Academician Samuel Wale, demonstrates that monocular apertures, too, continued to be used in the service of perspective drawing aids in the eighteenth century (fig. 163). [1]

In regard to the nineteenth century, the device known as the *camera lucida* demonstrates that the static space of one-eyed stationary vision continued to hold fair prominence in drawing technologies. The *camera lucida* is an instrument consisting of a tiny prism attached to a stem and mounted on a table top or drawing board. Looking down through the prism towards the page, the draughtsman can simultaneously see her hand and the world before her, perfectly superimposed. The *camera lucida* erases the

[1] See M. Kemp, *The Science of Art: Optical Themes in Western Art from Brunelleschi to Seurat* (New Haven, 1989), pp. 148-156. As Kemp explains, in the eighteenth and nineteenth centuries the geometrical approach to perspective continues, though with more investigation into different forms of depth cues that could involve binocularity.

time lapse between perceiving an object, turning towards the paper, and sketching an outline. Like Cigoli's perspectograph, this instrument allows the draughtsman to keep her eye continuously on the space before her, although in this case, the hand, eye, and image are wholly fused.[2]

A self-portrait attributed to Reverend Calvert Jones illustrates the peculiar monocular dynamics of the device (fig. 164). Jones created this self-portrait by placing himself in front of a mirror, so that the *camera lucida*'s prism reflected his mirrored image onto the page before him. The prism, on the other hand, reflects the eye that is engaged in the process of study and observation (fig. 164b). While Jones is looking down towards the paper, sketching his mirrored likeness, the prism reflects and externalises his studious eye for the world to see. As Erna Fiorentini writes, 'outside and inside are intriguingly interwoven in this process of looking, reflecting, and drawing, which is frozen in the final image.'[3] What we are privy to in this drawing is the monocular site of pictorial observation; the eye caught in the matrix that relates the draughtsman's body to his chosen object of study back to the final representation.

Modern photography, too, presents an interesting parallel to perspective, as it arguably takes 'over from the painter' in regard to presenting a perspectival vista in the nineteenth and twentieth centuries.[4] This is the stance taken by both Gombrich and Pirenne, who hold that perspective's theoretically monocular principle is just as

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[2] In Erna Fiorentini's analysis, she argues that this device ushered in a new mode of visuality in the nineteenth century, which she terms 'prismatic seeing,' which is defined in contrast to the *camera obscura*'s 'projective' vision. E. Fiorentini 'Camera Obscura vs. Camera Lucida: Distinguishing Early Nineteenth Century Modes of Seeing', *Preprints of the Max-Planck Institut für Wissenschaftsgeschichte Berlin*, no. 307 (2006), p. 21.
[3] Fiorentini 'Camera Obscura vs. Camera Lucida', p. 35.
[4] E. Gombrich, *The Image and the Eye: Further Studies in the Psychology of Pictorial Representation* (London, 1982), p. 260.

applicable to a photographic image as it is in perspective or anamorphosis.[5] While the span of my study is largely centred on the seventeenth century, the role of monocularity in photography would nonetheless be a productive avenue of inquiry to pursue.

Finally, while drawing instruments and photography may have capitalised on one-eyed, stationary vision in the nineteenth century, binocularity, too, gained prominence as a prime condition under which to view stereoscopic illusions. As Crary theorises in *Techniques of the Observer,* nineteenth-century theorists and artists became more engaged with ascertaining how our two eyes unify disparate images. A reification of this interest in binocularity is seen in the popularity and proliferation of stereoscopes, which simulate depth by presenting both eyes with separate images that our visual faculties then translate into one.[6] While the stereoscope presents a convincing argument for the cessation of the special class of objects discussed in this thesis, more work needs to be done on tracing such marginal practices through the eighteenth and nineteenth centuries in order to see how they were contested and, allegedly, rivalled by binocular devices.

[5] Gombrich, *Image and the Eye*, p. 260; and M.H. Pirenne, *Optics, Painting & Photography* (Cambridge, 1970), pp. 95-114.

[6] Crary cautions, however, that the stereoscope does not always produce a realistic image, as certain areas that should be endowed with depth are often perceived as flat, and vice versa: 'If perspective implied a homogeneous and potentially metric space, the stereoscope discloses a fundamentally disunified and aggregate field of disjunct elements.' J. Crary, *Techniques of the Observer: On Vision and Modernity in the 19th Century* (Cambridge, 1992), p. 119.

GLOSSARY

Anamorphosis
A distorted form of perspective where the picture plane looks deformed from head on. In order to see the image in its proper form, the observer must occupy a position at an angle that foreshortens the picture plane enough to negate the distortion. Leonardo da Vinci was one of the first artists to demonstrate the method. The term was coined by Gaspar Schott in 1657, and is based upon the Greek *morphe*, meaning 'form,' along with the presupposition 'ana' (re-, or again), loosely translating to 'reform' or 'distortion.' Prior to Schott, Gian Paolo Lomazzo (1538-1600) called it '*prospettiva inversa*' (reverse perspective), and later, Jean-François Niceron (1613-1646) referred to it as 'la perspective curieuse' (curious perspective).

Catoptrics
The study of the phenomena of light reflection using mirrors. In perspective studies, a catoptric illusion often reforms a distorted picture, as in anamorphosis. Two of the earliest studies of catoptrics were conducted by Euclid and Hero of Alexandria.

Costruzione legittima
Costruzione legittima (legitimate construction) is the classic demonstration of spatial projection, also known as linear perspective or single-point perspective. While *construzione legittima* is sometimes used to refer to Albertian perspective, this is in fact an anachronism as Pietro Accolti first coined the term in his treatise *Lo ignanno de gl'occhi, prospettiva pratica* in 1625.

Dioptrics
The study of light refraction through mediums such as lenses, water, and crystals. In perspective studies, a dioptric exercise often involves the use of a multi-faceted crystal that amalgamates a fractured or distorted picture. Ptolemy, whose ideas were later expanded on by Alhazen, conducted one of the earliest studies of dioptrics.

Distance Point
In linear perspective, the distance point is a point on the horizon line where diagonal lines drawn through opposite corners of the squares of a tiled floor plan converge, when the horizontal lines of the tiles are parallel to the picture plane. The distance point determines the ideal viewing distance for the picture, which is indicated by the distance between the vanishing point and the distance point. The distance point is normally placed at the edge of the composition or outside of the pictorial field altogether. If it is placed further from the vanishing point, the objects within the picture will appear more distant. Contrarily, if the distance point is positioned close to the vanishing point, the objects within the picture will appear closer to the viewer. The earliest description of the distance point is found in Piero della Francesca's treatise *De Prospectiva Pingendi* (1480).

Linear perspective
Linear perspective is the use of geometry to create an image that is obtained by a central projection. This method aims to replicate a series of light rays as they pass between one stationary point (the eye), to a point on a given object. The word 'perspective' derives from the Latin *perspectiva* which in the Middle Ages was understood as a science of optics. Later, the term was split between *perspectiva artificialis* and *perspectiva naturalis.*

Perspectiva artificialis
Perspectiva artificialis, also known as linear perspective, is the method used by painters to project forms onto a two-dimensional surface. It is differentiated from *perspectiva naturalis* in that it is a geometrical technique for drawing.

Persectiva naturalis
Perspectiva naturalis, also known as *perspectiva communis,* refers to the science of optics and spans the fields of physiology, mathematics, physics, and anatomy. It is differentiated from *perspectiva artificialis* in that it is centrally concerned with vision, not painting.

Perspective box
Perspectve boxes are three-dimensional structures that were created in the Netherlands between 1650-1675. They are painted on their interior in an illusionistic fashion. A peephole is cut into one of the box's panels for the observer to peep through. Through the effects of anamorphosis, the interior scene appears as if in three dimensions.

Vanishing point
A point of convergence for the orthogonal lines extending through the picture plane. It is typically located opposite the eye of the observer and at the same height as the horizon line. Lines extending towards the vanishing point create the illusion of depth recession. More than one vanishing point can be employed in a painting, as in two-point perspective. The vanishing point was called the 'centric point' in Alberti's *Della pittura* (1435).

Orthogonal
In linear perspective, orthogonal lines are diagonal lines that are drawn from the base of the picture plane and run parallel to the ground plan of a given scene. They extend away from the viewer along receding parallel lines joining up with the vanishing point. Orthogonals are used in Alberti's *Della pittura* (1435), and originate from Euclidean geometry.

Transversal
In linear perspective, transversal lines run at right angles to the orthogonal lines and are parallel to the picture plane. They establish a fixed height or width between two orthogonal lines. Transversals are used in Alberti's *Della pittura* (1435), and originate from Euclidean geometry.

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