Instruments of Power

State Craft, Reciprocity, and Scientific Instruments at the court of Queen Elizabeth I

Samara Flug

Submitted to Professors Darin Hayton and Kate Mulry
in partial fulfillment of the requirements of
History 400: Senior Thesis Seminar

April 24, 2015

Abstract

In the first year of Queen Elizabeth I's reign over England, Sir Robert Dudley, the queen's favorite courtier, gave Elizabeth a large, ornate astrolabe that he had commissioned from Thomas Gemini, one of the most prominent instrument makers in London. At first glance, Dudley's choice of a technological instrument as a gift for the queen seems strange. Yet given the context of Elizabeth's royal aspirations and the growing practice of supporting scientific experts and collecting scientific instruments within European courts, we begin to understand the values and political goals the astrolabe symbolized for the queen and her court. This thesis argues that Dudley and Elizabeth understood the value of control over scientific knowledge and the ways in which owning an instrument contributed to a carefully constructed image of authority and power. Through owning the astrolabe, Elizabeth demonstrated an ability to understand the field of knowledge expressed through the astrolabe as well as control over the best experts in Europe. The astrolabe served the interests of all of the parties involved in its making and exchange while the materiality of the object itself raises questions about the motivations behind sixteenth-century technological production.

Acknowledgements

To my family and friends, for listening to me talk about astrolabes for two years and still acting interested after all this time. You all mean the world to me.

Mitch Kossoff and Renee Hanson, the generous supporters of the F. Page Newton Internship, who made my research trip to London and Oxford possible and provided me with the opportunity that drove and defined my research experience.

Stephen Johnston, of Museum for the History of Science at Oxford, for giving me his time and expertise and working through the material analysis of the Gemini astrolabe with me, allowing me to encounter and connect with the objects in Oxford's incredible collection.

Louise Devoy, curator at the Royal Observatory at Greenwich, for helping me through the Royal Museums' wonderful exhibits and situating my questions within the context of her own work on instruments.

Monica Azzolini, whose course "Medicine, Science and Politics at the Courts of Early Modern Europe" at the University of Edinburgh opened up the world of the early modern court and whose work and in-depth syllabus provided me with so much guidance over the past two years.

Aline Voldoire, for inspiring my interest in intellectual history and remaining a supportive mentor throughout my college career.

Bethel Saler, for honing my research skills and teaching me how to work with primary source material since freshmen year.

David Sedley, for encouraging and contributing to my fascination with early modern England and its scientific and intellectual history.

Lisa Jane Graham, for working with me throughout the course of my time at Haverford, adding new dimensions to this project, and pushing me towards deeper and more interesting questions.

Kate Mulry, for her constant enthusiasm and support for my research all year and for her essential guidance in shaping and refining my research and writing.

Darin Hayton for supporting me not only as a thesis advisee, history major, and Haverford student but as an individual. For giving me the confidence to be bold and never afraid of my own voice.

Table of Contents

Illustrations

Introduction

The estate inventory of Sir Robert Dudley, Earl of Leicester, lists in 1559 an "item to Jemynie the Frenchman for an instrment [*sic*] of astronymye."[1] 1559 also marked the coronation of Queen Elizabeth I. She ascended the throne at the close of what had been a tumultuous decade in England's history; since Elizabeth's father, King Henry VIII, died in 1547, the national's monarchical leadership jumped from the young, fatally ill Edward VI to Mary I, whose regime and reinstatement of Catholicism ended in conspiracy and war. In taking the throne, Elizabeth had to unite a religiously divided nation while confronting criticism related to her youth, family history, and marital and gender status. As the new royal sovereign drawing from her existing system of support, Elizabeth appointed Dudley, one of her closest advisors and longest friends, as knight of the Order of the Garter, the highest order of chivalry in England. In return for receiving such an honor, Dudley commissioned and gave the astrolabe made by Flemish craftsman Thomas Gemini, mentioned in his inventory notes, to the new queen. That Dudley chose to give Elizabeth an astrolabe at a time of instability provokes questions concerning issues of representation and information in Elizabethan politics as well as the dynamics that defined the relationship between the queen and those working within the structure of her court.

Neatly engraved, the words "Elizabeth Dei Gratia Anglia Franciae & Hiberniae Regina" rest on top of the front of the astrolabe with the initials "E.R." and Elizabeth's coat of arms on the back. The letters engraved on the piece are ornate and elaborate and bolded Roman numeral numbers circle the outer edge of the instrument, signifying both the instrument's artistic nature as well as its

[1] Dudley, Earl of Leiscter, *Household Accounts and Disbursement Books of Robert Dudley, Earl of Leicester, 1558—1561, 1584—1586*. ed. Simon Adams. (London: Cambridge University Press, 1995)

utilitarian capacity. A star spreads out from the center of the instrument—from out of the star comes lines that cover a grid engraved on the plate meant to guide its user in performing calculations. An intricate and intertwining star map, or network of stars, decorates the front, with the metal strap work seemingly overlapping itself; little stars burst out of the pointers stemming from the strap work, representing the real stars the instrument is meant to chart. The rete of the astrolabe forms the outline of a tulip at the center of the astrolabe, an aesthetic addition that appears on all of Gemini's astrolabes as well as those of his fellow Flemish instrument makers.

As an object, Gemini's astrolabe serves as the intersection between early modern forms of expertise, court patronage, technological development, and statecraft. Throughout Europe in this period, courts increasingly employed the use of expertise and practical knowledge to project an image of power in hopes of constructing empires and modern states. The concept of expertise itself developed as well, as practical knowledge and skill-based fields gained more credibility in elite and courtly circles.[2] Expertise as a word or named concept did not emerge until the mid-nineteenth century but nonetheless, the word capture the spirit of what it meant to be a craftsmen valued due to a particular and applied skillset. The patronage culture of sponsoring such experts necessitated the practice of utilitarian skills that a craftsman could apply at will. Since many of these experts studied as apprentices or in the workshop of a more experienced expert, there was no formal process of certification to prove one's aptitude at a particular skill. Rather, practitioners had to demonstrate their expertise through results, by producing an object, text, or demonstration that proved one's grasp over an area of expertise. Because one's work required physical proof to be useful and reputable, the patron needed access to the skill at his will; in this way, patrons owned and dictated the use of the expertise.[3] These objects, as physical evidence of an expert's accomplishments, were always there

[2] Ash, *Power, Knowledge, and Expertise in Elizabethan England*.
[3] Ibid.

and could be used at the patron's will. With royal courts as the patrons for these activities, monarchs owned such expertise and could project an image of the state's capacity for knowledge and control over information. The construction of information states was thus closely linked to larger efforts related to statecraft and imperial activities.

Earlier appearances of astronomical instruments at court indicate the Tudors' interest in such objects even before Elizabeth's rise to power. Renowned German instrument maker Nicolaus Kratzer brought his skills to England by the early 1520s, where he befriended German artist Hans Holbein, the artist who painted not only Henry VIII's and Kratzer's portrait but the dual portrait known as The Ambassadors, which prominently depicts a series of scientific instruments.[4] By the mid-1540s, Gemini was among the foreign experts who found patronage within the Tudor court, receiving a stipend of £10 a year for dedicating his 1545 printed anatomical text to Henry VIII. Beginning with Henry VIII and down through Edward VI and Elizabeth I, records of Gemini's instruments and engravings demonstrate his presence at court for several decades in the mid-16th century. His dedications to Tudor royalty also reveal a breadth of knowledge and expertise in terms of subject area: he devoted his book on anatomy to Henry VIII as well as produced astrolabes for Edward VI and Elizabeth I.[5]

Elizabeth and her court collected information from across Europe, building an empire founded on sound technological knowledge in the hopes it would give England a political advantage over other European powers. In the context of England's global strategy and use of technology to its achieve imperial ambitions, Gemini developed the Flemish style of instrument making unique to the workshops of Louvain and brought his distinct skillset to London as early modern structures of patronage and expertise gave the Gemini astrolabes significant political meaning. While the distinct

[4] Oestmann, "Kratzer, Nicolaus (b. 14886/7, d. after 1550)."
[5] Jones, "Gemini, Thomas (fl. 1540-1562)."

Flemish style and craft embodied by Gemini's work attested to a unique artisanal and national identity for the Low Countries, Gemini's work also solidified his position in the network of expert instrument makers at court. Finally, through incorporating these Flemish aesthetics and technical abilities that marked his instruments as of the highest quality, the Elizabethan court asserted its control over these foreign technologies, their growing collection an attempt to signal their rising power to other European empires.

Spain's global trading empire, exploration and New World discoveries had given the Elizabethan court reason to reflect with anxiety upon their state of information technological advancement. As a component of Spain's imperial program, they had advanced methods of navigational astronomy, developing a system for calculating longitude and altitude measurements for the stars. Navigational and astronomical technologies were therefore closely integrated with the strength of the Spanish empire—Spanish ship captains were well trained in the use of astronomical instruments and navigational methods.[6] Spain's ownership over these objects helps explain why a monarch like Elizabeth would want to build her own collection of instruments. Ownership over an object suggested the ability to use it whenever the owner wished; these objects, tangible and collectible, served as proof of a country's technological capabilities. With its unlimited capacity for use, the presence of scientific objects at court suggested to the rest of Europe that the state could use this information as they pleased. As the aesthetic design of the astrolabe along with its status coming from an important maker suggests they held a more symbolic significance for the court than simply their purported utilitarian function.

Throughout Europe, courts increasingly employed and controlled expertise and practical knowledge to project an image power in the construction of modern states. The concept of expertise

[6] Ash, *Power, Knowledge, and Expertise in Elizabethan England*. 99

evolved as practical knowledge and skill-based fields gained more credibility in elite and courtly circles.[7] Early modern systems of patronage and the demands of growing European empires necessitated utilitarian skills that a craftsman could apply at will. Since many of these craftsmen learned their trade through apprenticeship or workshop experience, there was no formal process of certification to prove one's aptitude at a particular skill. Rather, practitioners had to demonstrate their expertise through results, by producing an object, text, or demonstration that proved their grasp over an area of expertise.[8] Given the need for physical proof of one's skill, craftsmen and experts were forced to continue producing in order to maintain their status as valuable to their patron. Through the continued production of these physical objects, courts began to value the power and authority of the objects through the projection of control that owning such items implied. The symbolic nature of these seemingly utilitarian instruments rendered the objects valuable in the gift economy that dominated court culture.

Historical perspectives on court dynamics and the use of knowledge at court provide a framework for understanding and interpreting the presence of the astrolabe at Elizabeth's court as well as Dudley's choice of the Gemini astrolabe as a gift in return for his induction into the Order of the Garter. As experts produced tangible evidence of their expertise, courts started to value those objects as markers of their own power through the projection of control that owning such objects implied. The value thus acquired by these technological objects made them important items in the gift economy that dominated court culture. A variety of gifts could have fulfilled the gift exchange relationship expected of early modern court participants, yet the astrolabe's ability to project an image of authority and control renders Dudley's choice politically advantageous and powerful.

---

[7] Ash. *Introduction: Expertise and the Early Modern State*.
[8] Ibid.

As a technological device, astrolabes were never the highest form of technological innovation in terms of their capacity to perform measurements and calculations efficiently but were instead owned primarily for their prestige and valued for their ingenuity of construction. The early modern owner of an astrolabe would have been aware of its technical abilities but would have only acknowledged its functions as a means to demonstrate control over such fields of knowledge and expertise. Gemini's 1559 astrolabe is more than simply representative of this phenomenon. Rather, the level of sophistication, execution, and multifaceted ability of the astrolabe to assert Elizabeth's power distinguished Gemini's instrument from other objects of the era. The astrolabe's role as a gift within a courtly system of reciprocity also plays into Elizabeth's projection of power through the control of not only the instrument's associated body of knowledge but also over her court and her subjects. This thesis explores the systems of reciprocity at work within the early modern court as well as the way in which Queen Elizabeth constructed and projected an image of power to ultimately argue that the 1559 Gemini astrolabe served the political interests of those involved in its production and exchange.

I. A Beautiful Technology

Though sophisticated and complex in their making, astrolabes have been a less efficient technology in performing their purported utilitarian functions even since the time of their invention. Sundials and then clocks could tell time without the necessary calculations required by astrolabes and more sophisticated instruments could perform a greater variety of navigational functions. In particular, the 1559 Gemini astrolabe—brass and 357 millimeters in diameter—is fairly heavy and relatively large compared to instruments designed for practical, regular use. Thus, the instrument was far less valuable to the queen for its purported functions of time telling, horoscope casting, and land surveying than it was for its aesthetic and political symbolism. Rather, astrolabes were regarded for their symbolic capacity to help their users understand and control nature while their sophisticated aesthetic value contributed to the perception of the instruments' elite status and allowed instrument makers to differentiate themselves by the quality of their work.

Gemini's astrolabe reflected the height of technical sophistication of the time, mainly through Gemini's execution of the metalwork and decorative detail. The astrolabe is comprised of several plates stacked on top of each other to create a series of rotating pieces used for performing calculations. The body of the astrolabe, called the mater, has a raised outer rim called the limb, which is marked by indicators of each hour. Sitting within the space within the mater, called the womb, is the rete, a rotating series of star pointers that indicated the positions of twenty-three stars. Held to the instrument by a pin at the center, the rete rotates around the mater, allowing its user to adjust the pointers based on the time of day and to calculate both star and sun positions.[9]

The use and production of astrolabes can be traced back to late antiquity but their growing popularity in medieval Europe was accompanied by the rise of established workshops in larger

[9] Hayton, "An Introduction to the Astrolabe."

European cities. The established workshops emerged from prominent instrument makers in Europe, leading to lines of astrolabe production with localized innovations and styles.[10] From the 14th century to the 16th century, the central hub of astrolabe production moved from Paris to Nuremberg and ultimately to Louvain, in the Low Countries, where Gemma Frisius established his workshop and craftsmanship tradition. Craftsmen in each of these placed developed distinct styles through their workshops that connected the quality of an instrument with the workshop's localized tradition of aesthetic choices. Scholars and educated elite interested could turn to reputable craftsmen and commission their own instrument; this opened up opportunities for members of the nobility to participate in this system of technological production and own an expensive object with its imagined area of expertise.

Changes in 16th century politics and court dynamics brought astronomical instruments such as astrolabes into the political consciousness of European princes and nobility and became markers of authority for monarchs who appeared to understand technological fields of expertise. Not only did courts increasingly sponsor mathematicians and provided a space alternative to universities for scholarly work, but several notable princes themselves began participating in intellectual pursuits and activities.[11] Nuremberg mathematician Andreas Schöner reflected on the growing number of German prince practitioners, writing, "There are now many princes who even excel in the knowledge of the mathematical arts… 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."[12] Schöner's recognition of these practitioners, especially by noting, "there are *now* many princes,"[13] highlights a shift in royal practices, as princes did not previously

---

[10] Ibid.
[11] Moran, "German Prince-Practitioners." 245.
[12] Ibid. 254.
[13] Italics added for emphasis.

practice this type of work and that they now hoped to be recognized for their expertise in these subjects. This new interest in mathematics, calculations, and the instruments that both facilitated and demonstrated such calculations grew out of a political context increasingly concerned with territorial exploration, expansion, and resource use. Mathematical and astronomical skills increased a court's capacity for surveying, cartography, and navigation, among many other politically and economically useful activities.[14] The princes, however, did not carry out these activities and achieve actual territorial expansion or secure access to advantageous resources. The political value of mathematical practices came less from a prince's ability to translate such calculations into economic, material value for his state but rather from a projected sense of authority through the imagined control over a particular field of knowledge or expertise.

The emperor Rudolf II understood the political value of owning scientific instruments and integrated these objects into a larger collection reflective of Rudolf's interest in understanding and controlling bodies of knowledge. Rudolf, who served as the emperor of the Holy Roman empire from 1576-1612 and was well educated from an early age, was not only a patron of these activities but participated himself through collecting and engaging with art, exotic objects, and science. The culmination of his collecting efforts was the *Kunstkammer,* a massive cabinet of curiosities or museum, in which he organized his material through three categories and sections: *naturalia, artificialia,* and *scientifica*[15]. The entrance to the *Kunstkammer* was decorated with images of the natural elements earth, wind, and fire and imagery of the twelve months underneath the control of Jupiter. Clocks fascinated the emperor, as did scientific instruments; it is believed that Erasmus Habermal, an esteemed instrument-maker, produced over three hundred instruments for Rudolf. His collection included celestial globes, astrolabes, quadrants, and compasses, to name a few, and

[14] Moran, "German Prince-Practitioners." 259.
[15] These categories roughly correspond to nature, art, and science, although Rudolf's categorization of objects was often subjective. Marshall, *The Magic Circle of Rudolf II*.

ranged from antique objects to more contemporary innovations. Rudolf's interest in these instruments stemmed from a desire to understand the natural world and the heavens, though an interest in mortality suggests an attempt to control natural processes through learning and interacting with them.[16]

Rudolf II's *Kunstkammer*—and the court dynamic around his collecting— was motivated by the emperor's personal motivations regarding the natural and occult sciences. He sought a truth that was deeply connected to a desire to understand and control nature through categorization and organization. He recognized both the technological as well as the artistic value of objects in his *Kunstkammer* to connect him with the world and lead him towards greater understanding and power. More than personal fulfillment, however, his collection was also about putting both the objects and his own intellectual capacity on display as a performance of authority for all who came to visit his collection. The vast assemblage of astronomical instruments was a defining feature of the emperor's personality, court, and political image, marking the instruments as valuable commodities for royals and nobility. Many of which the instruments Rudolf felt were scientifically powerful and innovative were also extremely elaborate and beautiful as if they were works of art. For the emperor, the instruments' artistic value played a large role in their function at court and within his collection. Rudolf was a patron of the arts as well as the sciences: for the emperor, there was little distinction between the two.[17] For Rudolf, the mathematical and scientific instruments were vessels of knowledge as they carried the ability to calculate, measure, and understand the world, but their artistic nature contributed to their appeal, wonder, and extravagance. For someone like Rudolf who saw the natural world as beautiful and fascinating, the aesthetics of his scientific objects and instruments confirmed such a view of the universe.

---

[16] Ibid.
[17] Ibid.

Rudolf II was not alone in connecting what are now considered the separate fields of art and science. The 1553 painting, The Ambassadors, by German artist Hans Holbein depicts two figures standing on either side of shelves that hold books, musical instruments, and scientific objects. The information on the celestial globe as well as the terrestrial one suggest potential links to actual models that came out of early 16th century developments in astronomical and cartographical practices.[18] In placing the objects as the central features of the portrait, Holbein recognized the significance of these instruments. The painting thus communicates the powerful nature of these mathematical and astronomical instruments while also recognizing their aesthetically pleasing appeal. Holbein, a German painter, found inspiration from artists from the Low Countries, the place renowned for their beautifully decorative instruments.

[18] Dekker and Schmidt, "THE GLOBES IN HOLBEIN'S PAINTING 'The Ambassadors' / DIE GLOBEN AUF HOLBEINS GEMÄLDE."

Figure 1. The Ambassadors, by Hans Holbein the Younger. 1553.[19]

[19] The National Gallery, London. Collection Inventory number NG1314.

The Flemish extended the European tradition of astrolabe and instrument innovation by elevating the aesthetic standard for instruments through the execution of decorative detail and sophisticated craftsmanship. Emphasizing the aesthetic elements of the instruments appealed to elite audiences interested in these ornate and expensive objects; these kinds of details also rendered the instruments works of art rather than strictly utilitarian calculators. As these instruments were intended for an aristocratic audience, their extravagance is reflective of courtly styles, expectations, and artistic preferences.[20] Gemini's astrolabe comes directly out of this tradition and through its engraved dedication and sophisticated metalwork, found its way to the most powerful patron in England—the queen herself.

Gemini clearly follows in the tradition of his predecessors, as evidenced by the similarities in aesthetic and design such as the formation of a tulip on the rete, but elevated his decorations to involve more detail and elegance. The rete of Gemini's astrolabe forms the outline of a tulip, a decorative detail typical and indicative of the Flemish workshop from which he came. Yet Gemini's tulip is simpler than earlier Flemish instruments but as a result, stands out much more as a noticeable feature at the center of the instrument. His presentation of the information provides a clean and focused aesthetic while a star coming out of the middle includes fine detail and centralizes the piece by connecting the grid to the center. In the middle of the piece, the point around which the alidade rotates, Gemini's work shows sophisticated engraving techniques through delicate floral design and varied shadings throughout the pattern—this pattern matches the design he engraved at the very top of the instrument, below the ring at the top of the instrument. Moving outward on the instrument to the limb, Gemini included the degree and hour markings but darkened

[20] Moran, "German Prince-Practitioners." 259.

Figure 2. Astrolabe for Queen Elizabeth I, by Thomas Gemini London. 1559. Mater and rete.[21]

[21] Museum of the History of Science, Oxford. Collection Database inventory number: 42223. Accession Number: 1937-6.

Figure 3. Astrolabe for Queen Elizabeth I, by Thomas Gemini London. 1559. Rete.[22]

[22] Museum of the History of Science, Oxford. Collection Database inventory number: 42223. Accession Number: 1937-6.

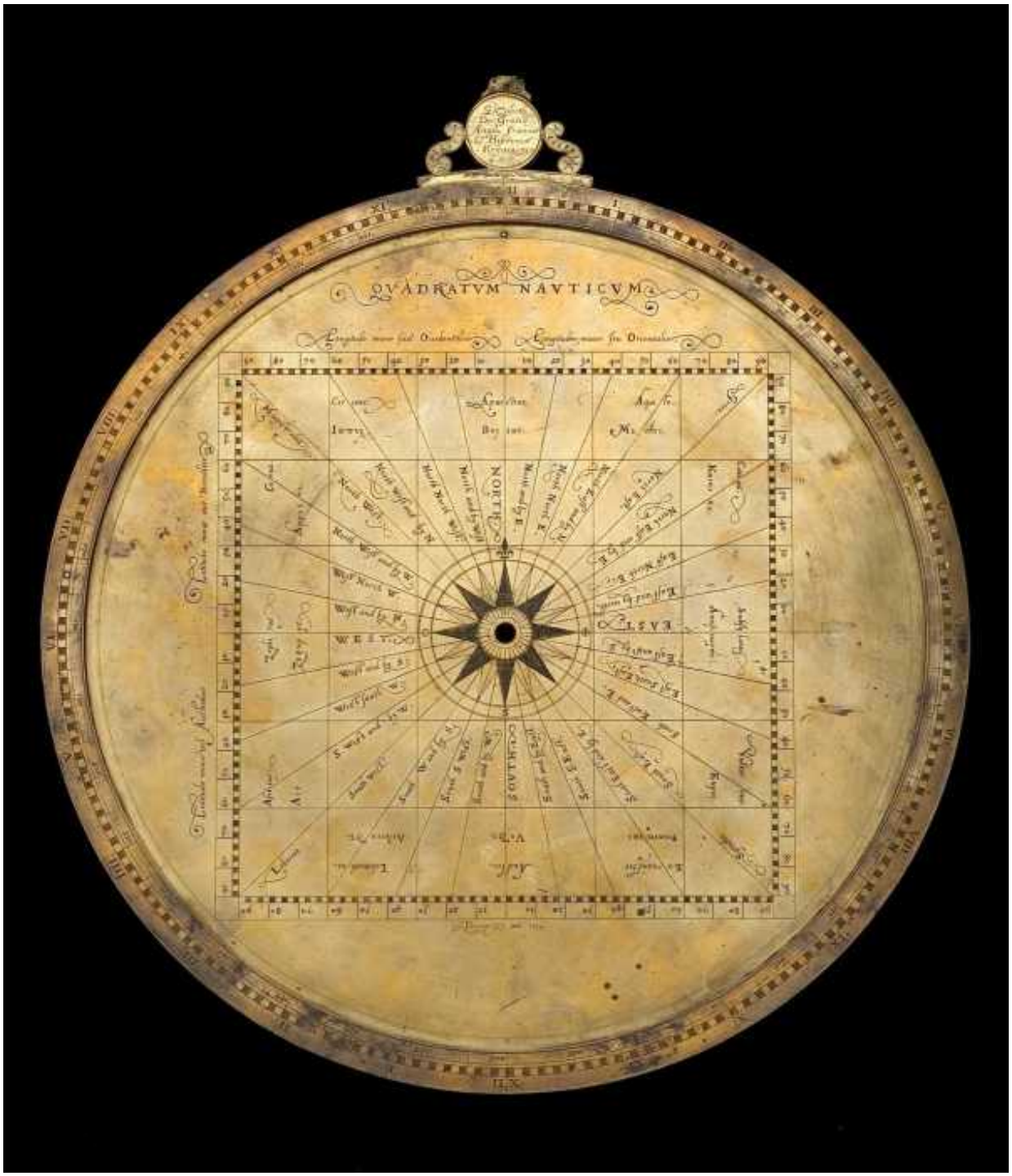

Figure 4. Astrolabe for Queen Elizabeth I, by Thomas Gemini London. 1559. Mater without rete. [23]

[23] Museum of the History of Science, Oxford. Collection Database inventory number: 42223. Accession Number: 1937-6.

Figure 5. Astrolabe for Queen Elizabeth I, by Thomas Gemini London. 1559. Dedication on the throne front. [24]

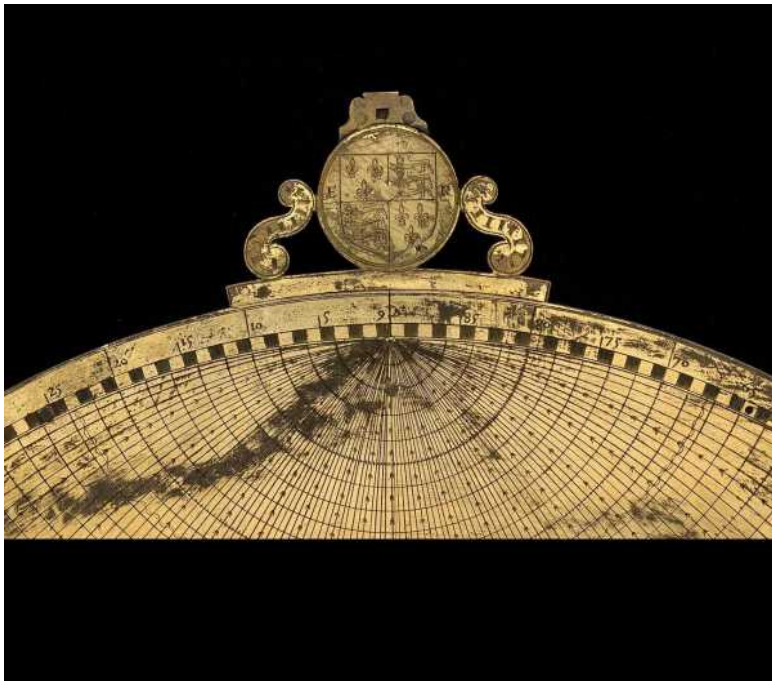

Figure 6. Astrolabe for Queen Elizabeth I, by Thomas Gemini London. 1559. Coat of arms on the back of the throne. [25]

[24] Museum of the History of Science, Oxford. Database inventory number: 42223. Accession Number: 1937-6.
[25] Ibid.

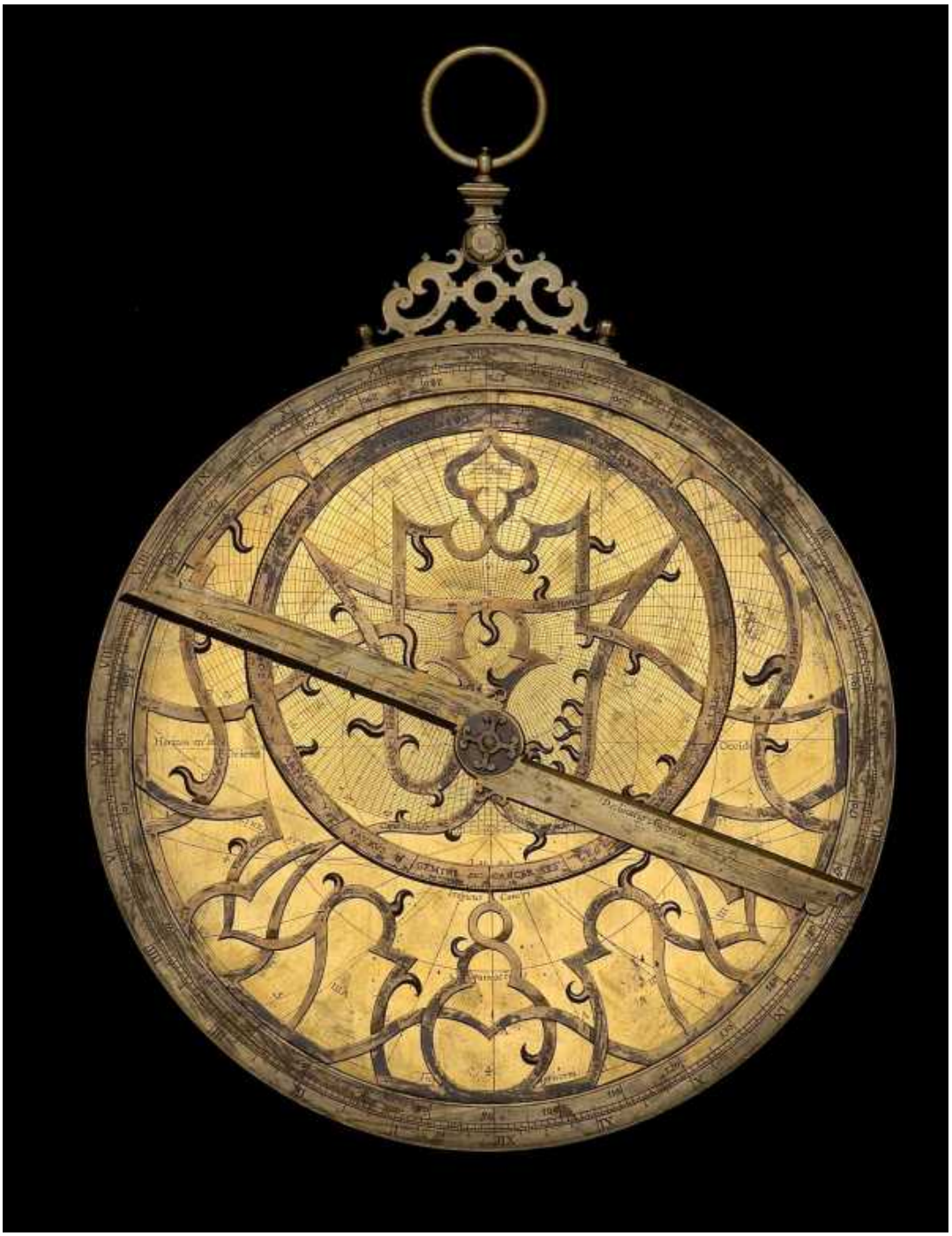

Figure 7. Astrolabe by Ferdinand Arsenius, 16th century, The Netherlands.[26] Arsenius was a craftsman in the same Frisius workshop in Louvain as Gemini. This astrolabe contains decorative features, such as the tulip shape at the center of the rete, similar to Gemini's 1559 instrument. Relative to Gemini's instrument, however, the star pointers are less detailed and the use of overlapping strap work is limited. When Arsenius does use this overlapping technique, the visual effect is much simpler than Gemini's seemingly intertwining metal work.

[26] Museum of the History of Science, Oxford. Database inventory number: 45365. Accession Number: 1952-1.

Figure 8. Astrolabe by Georg Hartmann, 1545, Nuremberg.[27] This astrolabe is an example of a German astrolabe produced at the same time Gemini was working in London. Georg Hartmann was a renowned German craftsman and coming from a different background and instrument making tradition, there are significant aesthetic differences between his work and the Gemini instruments. In this Hartmann astrolabe, there is no illusion of overlapping strap work, nor are there engraved decorative elements or shading.

[27] Instituto e Museo di Storia della Scienza, Firenze. Inventory number 1111.

the markings in an alternating pattern while also adding bold Roman numerals to each section of markings, adding a level of sophistication and detail to the decorative program. Finally, his work on the rete and star pointers demonstrate a superior level of stylistic maturity. The strap work of Gemini's rete creates the illusion of overlapping to a greater extent than his predecessors and their seemingly overlapping metalwork. Gemini's overlapping pieces of the rete are pronounced, shaded to evoke the sense that the metal, intertwined, wraps itself around the instrument. Gemini's strap work is thinner and finer than earlier Flemish astrolabes, demonstrating the precision of an expert craftsman who actively developed, and not simply copied, the Flemish tradition and style. The decorative tulips at the center of the Flemish retes employ an aesthetic that is literally intertwined with the rete's technical purpose of imitating star placement. Gemini's production of an instrument in which the aesthetic components function alongside the technical metalwork gave his work a unique identity and expertise distinct from any other instrument tradition in Europe but also reinforces a worldview that did not distinguish between art and science.

When Dudley commissioned Gemini to make an astrolabe for Elizabeth, European princes collected coveted astrolabes that represented both their ability to understand and control nature as well as imperial ambitions associated with territorial exploration and expansion. Growing collections displayed the patron's personal interest in these objects as well as their economic ability to collect and hold expensive and valuable objects. Princes that practiced astronomical and mathematical activities, however, demonstrated that these collections were not mere projections of power and wealth. Their practices suggest that these activities were personally fascinating and important for the educated elite. Furthermore, a worldview that integrated artistic value and scientific practices led to the production of aesthetically sophisticated objects sought after by nobility and royal courts. Through the ownership of the Gemini astrolabe, Elizabeth situated herself

within the model of prince practitioners who had used the display of scientific knowledge and instruments as a means of projecting their own political authority. With the astrolabe as a symbol of owning bodies of knowledge, Elizabeth began to construct an image and narrative of political authority and control.

II. A Queen in the Making

The tumultuous political milieu of Queen Elizabeth's rise to power necessitated a carefully constructed image of the new queen that would legitimize her place on the throne without the standard markers of legitimacy and masculine authority. The story of Queen Elizabeth I's rise to power begins with her birth in September of 1533, born to Anne Boleyn and King Henry VIII, while the challenges to her future rule began with the instability surrounding Henry VIII's reign. Elizabeth's traditional claims to legitimacy became complicated when Elizabeth's mother, Anne, was executed, delegitimizing Elizabeth as an heir to the throne and placing her alongside her half sister Mary, who had been delegitimized upon her parents' divorce. Shortly after Anne's death, however, Edward VI was born to Jane Seymour, providing the king with an obvious, male heir.

Edward VI died young, at fifteen years old, and declared Lady Jane Grey heir to his throne. This appointment was largely unpopular and soon enough, Henry VIII's first daughter, Mary, daughter of Catherine Aragon, took the throne. Elizabeth initially supported Mary in her rise to power but their relationship soon deteriorated due to religious and political differences. Thus, when an uprising, known as Wyatt's rebellion, broke out in response to Mary's rule and Catholicization of England, Mary charged Elizabeth with conspiring and plotting against the queen. Elizabeth lived under house arrest until her inevitable succession to throne upon Mary's death became apparent.[28] In January of 1559, Elizabeth was crowned as the queen of England.

In her early days as queen, Elizabeth worked to both settle the religious divisions between Protestants and Catholics, which had been particularly vexed throughout Mary's reign, and legitimize herself as queen. Elizabeth also faced immediate criticism stemming from both her technical illegitimacy as a result of her parents' divorce and problems surrounding her gender and

[28] Montrose, *The Subject of Elizabeth*. 11.

marital status.[29] 16th-century Scottish politician John Knox argued against the ascension of Queen Elizabeth before she even took the throne, representing a common view at the time in writing that "to promote a Woman to beare rule, superioritie, dominion, or empire above any Realme, Nation, or Citie, is repugnant to Nature; contumelie to God, a thing most contrarious to his reveled will and approved ordinance; and finaallie, it is the subversion of good Order, of all equity and justice."[30] Although Knox eventually agreed with other skeptics who decided to treat Elizabeth as an exception granted power under divine providence, the sentiment that a female leader was "repugnant to Nature" did not wane so easily. Her unmarried status rendered her the sole royal power, as she did not have to relinquish any of her power to a king, but continually raised questions and criticism given this unusual circumstance in regards to her gender. Marriage had long been used as a political tactic within courts or between foreign powers as well as a means to ensure a successor; while courtiers and foreign suitors presented the queen with opportunities for marriage, she avoided these opportunities for both strategic and personal reasons. Thus, she remained an unmarried, virgin queen and cultivated much of her image around a virgin archetype.[31] Following decades of a continuous struggle for stability, Elizabeth entered her role as queen with her own personal challenges and subsequent strategies in legitimizing her rule.

Elizabeth followed a precedent of carefully constructed modes of representation in the Tudor court that influenced and dictated Elizabeth's image building practices. The need for political stability accelerated the Tudor court's intentional and calculated attention to the monarchical image while tracing Henry VIII's propaganda activities and their influence on Elizabeth's means of claiming and expressing authority.[32] The political instability that contextualized both Henry VIII

---

[29] Ibid. 43.
[30] Ibid. 16.
[31] Ibid. 43.
[32] Sharpe, *Selling the Tudor Monarchy*. 6.

and Elizabeth's reign presented each monarch with both challenges in legitimizing their authority as well as opportunities for new tactics designed to demonstrate their power; furthermore, the Tudors were not the only monarchs to project an image of power based on intellectual authority as demonstrated by fifteenth-century Hungarian king Martin Corvinus. In employing a variety of methods, with similar motivations as Henry VIII and Corvinus, Elizabeth's court used printed material, the proliferation of image, and the aggregation of scientific expertise and objects to construct an image of authority, information, and knowledge.

Printing and the ability to reproduce exact copies of texts and images in the early modern period proliferated material representations that would have never been available to the public audiences otherwise.[33] The first in the English monarchy to do so, Henry VIII and his court produced and distributed images of the king meant to emphasize particularly masculine and dominant aspects of his personality and rule. Portraits of the king by court portrait artist Hans Holbein survive and testify to his imperial power through the masculinity of his representation and powerful stances and body positioning. The king also published collections of personal letters for a public audience and wrote treatises defending his divorce. His press also produced new copies of prayers and religious texts that removed all language indicative of the Pope, such as the word "papa," in order to create a new religious paradigm erasing England's past connections with the papacy.[34]

Elizabeth learned these methods of representation and understood the significance of image building in gaining political authority. Elizabeth faced a very different set of criticism than her father, but employed similar tactics in order to present her people with the image of a powerful, authoritative queen. Subsequently, her efforts to promote and project her supremacy leave

---

[33] Smith, "Art, Science, and Visual Culture in Early Modern Europe." 83-100.
[34] Sharpe, *Selling the Tudor Monarchy*. 69.

historians with a rich collection of textual and material evidence through which to evaluate her political priorities and agenda. A source of textual evidence regarding Elizabeth's claims to authority is the number of publications and proclamations advertising royal and political policies. These proclamations provided the queen with opportunities to address issues and explain actions, giving her direct access to the people and their attention; to make these proclamations as effective as possible, she used selective word choice and references to emphasize her claims to the throne. Her proclamations repeatedly referred to her father, as a way of connecting his place in national memory to her status as a Tudor, as well as thanked God for bestowing power upon her.[35] The subjects of these proclamations varied, but one proclamation from early in Elizabeth's reign is particular relevant to Elizabeth's political image as it addressed the nature of the queen's physical representation. The proclamation was meant to "curtain the grievous and offensive 'errors and deformities' in widely available representations of the Queen" and goes on to read,

> All manner of painters have already and do daily attempt to make in short manner portraiture of her majesty in painting, graving, and printing, wherein is evidently seen that hitherto none hath sufficiently expressed the natural representation of her majesty's person, favor, or grace, but most have so far erred therein as thereof daily are heard complaints amongst her most loving subjects.[36]

This excerpt from the proclamation works to control the production of the queen's image but the wording also suggests that it was the queen's subjects, not the queen herself, who were most disturbed by the false and misrepresentative images. Whether or not the queen's subjects reported their concerns over these representations, this suggestion elevates the problem beyond the queen's personal offense to an issue of national concern. Claims of misrepresentation discredits images that may not contain the proper symbols of status, power, and authority that appear in official portraits of Elizabeth. Moreover, the proclamation insinuates that the queen's image is one to be revered and

---

[35] Ibid. 345.
[36] Hamrick, *The Catholic Imaginary and the Cults of Elizabeth, 1558-1582*. 68.

respected; creating false representations of the queen is an egregious act because it violates her physical and emblematic sanctity.

The court also published Elizabeth's writings, letters, speeches, and translations, all of which contributed to Elizabeth's demonstration of supremacy. Henry VIII had published his letters as a way of appealing to the public through the disclosure of private discourse. Elizabeth, in a similar fashion, published collections of her private prayers as a way to share her personal voice with her subjects. Through these prayers, she revealed her humanity, demonstrated her piety, and exerted her royal authority through her personal connection to God.[37] It was her translations, however, that revealed her intellectual capacity and talent. Her ability to translate texts revealed her intellectual capacity and talent, but it was her choice of texts and her ability to exert control over them through translation that carried greater significance for her audience. Her choice to translate Boethius's *Consolation of Philosophy,* a text that suggests the world was ruled by reason, order, and obedience to a king, expressed her sole supremacy but through the words of Boethius (words that are really translated, and thus controlled, by Elizabeth).[38] Texts such as these demonstrated that it was not only Elizabeth's translation abilities that rendered her a strong, intellectual leader, but also her choice to translate and publish texts with political interpretation beneficial to her political agenda. Through choosing, translating, and publishing texts, Elizabeth exerted authority over the texts themselves as well as her readership through the promotion of very particular political texts.

While publications were a direct way for her to communicate with a literate audience, there were other material means used to convey the queen's supremacy through symbolism and suggestion. In describing a portrait of Elizabeth, poet Sir John Davies writes, "…We see how the Soul doth use the eyes/ As instruments of her quick power of sight;/ Hence do the arts optic and fair

---

[37] Sharpe, *Selling the Tudor Monarchy*. 333.
[38] Ibid. 326.

painting rise;/ Painting, which doth all gentle minds delight."[39] Davies's poem articulates the connection one felt to Elizabeth through her physical representations, particularly through her eyes as the insight into her soul, and is suggestive of what came to be known as the cult of Queen Elizabeth. Similarly to the publication of her personal writings, the proliferation of images from Elizabeth's reign conveyed an array of visual symbols to the English population. At times, their political motives were direct. For example, portraits of the queen were given to Irish nobility as an attempt to gain loyalty and support; while such gestures were unsuccessful in securing the queen Irish support, their production reveals the strategic nature of these portraits' existence and trade. The purpose of official portraits of the queen, however, went far beyond gaining loyalty; rather, the portraits are emblems rich with symbols meant to demonstrate the queen's sanctity and power.

The portraits and their symbols vary from apparent signs of power to allegorical symbolism. The Rainbow Portrait, completed c. 1600-1603, depicts Elizabeth in orange robes while holding a rainbow in her hand and contains clear icons of power and authority. In the painting, she is wearing strings of pearls and elaborately decorated clothing, with a jeweled snake on one of her sleeves. The most notable detail of the portrait, however, is the subtle images of eyes and ears decorating the robe wrapped around her dress. Wrapped in the robe with these decorations, all eyes and ears are on Elizabeth, but the eyes look and the ears listen outwardly, suggesting that Elizabeth and her court are all seeing. As information was a crucial component of Elizabeth's political program, the eyes and the ears directly depict her authority through the collection of information.

Symbols of the Greek virgin and hunting goddess also appear throughout Elizabethan portraiture, as the goddess provided a fitting analogy for Elizabeth's status as a virgin queen and powerful female figure. Even a portrait of Sir Walter Ralegh, one of Elizabeth's favorite courtiers, uses symbols of

[39] Davies, quoted by Strong, *The Cult of Elizabeth*. 16.

Queen Elizabeth and Diana to demonstrate his relationship with the queen and reinforce her own power within her court.[40] In a 1588 portrait of the courtier, Ralegh wears the queen's colors, black and white, on clothing decorated with pearls, a symbol of chastity that appears in much of the queen's portraiture. A crescent moon, the symbol of Elizabeth related to the Greek virgin and hunting goddess Diana, also appears in the top left-hand corner.[41] In an extension of the symbolic references to Diana, the allegorical painting titled *Queen Elizabeth and the Three Goddesses*, 1569, depicts Elizabeth not as the goddess Diana herself, but as a figure among Greek goddesses in story of the Judgment of Paris, where Paris, a Trojan prince, must decide the most beautiful goddess among Hera, Aphrodite, and Athena. In the 1569 painting, Elizabeth stands, as Paris did, before the three goddesses, with judgment and superiority over them. This allegory presents Elizabeth as a commanding figure equal to, if not more powerful than, the goddesses of ancient Greece.

In addition to utilizing publication and portraiture as the media of political representation, Elizabeth situated herself within a monarchical tradition of using expertise and practical knowledge as a means of asserting control and power. Throughout Europe, courts increasingly employed the use of expertise and practical knowledge to gain power and construct modern states. The concept of expertise itself developed as well, as practical knowledge and skill-based fields gained more credibility in elite and courtly circles.[42] Expertise was not a word or a named concept in early modern Europe and did not emerge until the mid-nineteenth century but nonetheless, the word capture the spirit of what it meant to be a craftsmen with a particular and applied skillset.[43] Early modern patronage culture necessitated utilitarian skills that a craftsman could apply at will.

---

[40] Montrose, *The Subject of Elizabeth*. 91.
[41] Ibid. 91.
[42] Eric Ash. *Introduction: Expertise and the Early Modern State*.
[43] Ibid.

Figure 9. The Rainbow Portrait, by Isaac Oliver, c. 1600[44]

[44] Hatfield House and Estate, United Kingdom.

Figure 10. Elizabeth I and the Three Goddesses, by Hans Eworth. 1569.[45]

Since many of these experts studied as apprentices or in workshops of an older expert, there was no formal process of certification to prove one's aptitude at a particular skill. Rather, practitioners had to demonstrate their expertise through results, by producing an object, text, or demonstration that proved one's grasp over an area of expertise. Because one's work required physical proof to be useful and reputable, the patron needed access to the skill at his will; in this way, patrons owned

[45] The Royal Collection, Queen's Drawing Room, Windsor Castle. RCIN 403446.

and dictated the use of the expertise.[46] These objects, as physical evidence of an expert's accomplishments, were always there and could be used at the patron's will.

Advisors to the Elizabethan court participated in the international search and collection for technological information, looking to European centers of technological information to collect information and experts from abroad. John Dee, geographer, magician, and advisor in the Elizabethan court, was an unwavering advocate for the expansion of the British Empire and used navigational and scientific knowledge to further England's political interests. In 1547, Dee visited the Low Countries, where he spent time with famous mathematicians and cartographers, including Gemma Frisius and Gerard Mercator. He traveled throughout Europe but returned to the Low Countries at least twice more as he developed an international network of experts in a variety of fields.[47] Upon his return, he spoke of all the wealth and power that could be England's through colonization and imperialism as a means to compete with powerful empires such as Spain and Portugal.[48] To keep from falling further behind Spain and other dominant European powers, England needed to establish its place within a competitive global market.[49] By creating a network of experts across Europe and actively engaging with them through his travels, Dee gained access to information in the fields of cartography and instrument making that he could then bring into the knowledge base of the English court.

While Elizabeth surely had a personal interest in learning, as evidenced by her engagement in her studies from a young age, her court's collection of technical expertise was driven by more than just a curious and intellectual mind. Collecting was a political action that demonstrated the

---

[46] Ibid.
[47] Bruno Almeida. *On the origins of Dee's mathematical programme: The John Dee-Pedro Nunes connection*. Studies in History and Philosophy of Science Part A, Vol. 43, Issue 3: John Dee and the Sciences: Early Modern Networks of Knowledge. 2012. 460-469.
[48] Richard Deacon. *John Dee: Scientist, Geographer, Astrologer and Secret Agent to Elizabeth I*. London; Frederick Muller Ltd. 1968. 11; 37.
[49] Samuel Bawlf. *The Secret Voyage of Sir Francis Drake: 1577-1580*. United States: Bloomsbury. 2009. 40.

queen's physical control over material objects that held, or represented, the capacity for knowledge. It was the potential inherent in an object's capacity for knowledge that gave it its political power; it could, at any point, be utilized or employed at its owner's will. At the same time, however, this ability was constructed on behalf of Elizabeth's court in an attempt to build respect and reverence for the queen in order to compensate for her lack of immediate, unanimous support. In fashioning an image of the queen based on information control, her exertion of authority through expertise was of a performative nature, performative in its reliability in presenting a particular, calculated image that could be proliferated at the queen's will.

Elizabeth's efforts to use experts and expertise to project authority built upon a practice that European sovereigns had been developing for nearly a century and placed the queen in a tradition of statecraft through the control of information and scientific information. A century before Elizabeth's ascension, Hungarian king Martin Corvinus was the first Hungarian king who lacked noble descent, elected into power in 1458. As a result of his unusual rise to power, Corvinus lacked the dynastic succession that would have immediately legitimized his rule. In an attempt to compensate for his lack of noble background and create alternative markers of his kingly authority, Corvinus surrounded himself with expert advisors to help solidify his political power.[50] A closer look at the role Corvinus created for himself within the astrology community demonstrates the ways in which monarchs could perform the role of intellectual experts and translate such authority into political legitimacy.

Corvinus was particularly interested in astrology and hosted a debate between two prominent astrologers to choose who would cast his horoscopes and predictions. Astrology was a particularly apt choice for Corvinus's patronage. Though he could not claim dynastic authority

[50] Hayton, "Politics and Astrology in Renaissance Hungary."

through generations of noble and royal lineage, astrological predictions could still render his political authority celestially auspicious and even preordained.[51] Yet in addition practice of predictive astrology itself, Corvinus's performance as the mediator of the astrological debate marked him as an intellectual authority. By demonstrating his ability to adjudicate the debate, Corvinus acted as the ultimate authority on the subject, for he, as the decider, had the intellectual ability to discern the better astrologer. It was not the actual astrological predictions or methodologies that held any kind of enduring power for the king but the image of Corvinus presiding over the experts and the bodies of knowledge personified by the astrologers that contributed to Corvinus's claims to authority through image building.

Corvinus went even further to establish himself as a knowledgeable force and authority; he tried to establish an observatory as well as a library that served more than simply a physical space containing his collection of books. The library served as a stage for Corvinus's performance of intellectual authority and aimed to facilitate an experience for visitors to truly feel the strength of Corvinus's power. Corvinus would convene meetings under ceilings lined with frescos of his auspicious horoscopes, symbolically making decisions under a ceiling that worked to confirm his legitimacy and authority.[52] Through intellectual activities, Corvinus created an image of himself that sourced its power through politically motivated and constructed activities alterative to standard monarchical practices.

Such astronomical activities at Corvinus's court created an image of the king as an intellectual authority while the presence of a court astronomer gave Corvinus the capacity to use the astronomer's expertise at his will. While this gave Corvinus control over such knowledge, the astronomical debate was like a performance in which Corvinus played the role of deciding authority

---

[51] Hayton, "Expertise Ex Stellis: Comets, Horoscopes, and Politics in Renaissance Hungary." 46.
[52] Ibid. 30.

over the intellectual debate. Corvinus was not a trained astronomer in the way the experts visiting his court were, but constructing an intellectual problem before naming himself as the deciding and executive authority was a performance meant to give him agency along the way to develop the court as he pleased. Corvinus's creation of the astrological debate placed himself at the center of the field's intellectual activity, thus legitimizing himself as a politically powerful authority, and provides a framework for understanding how Elizabeth could translate her own intellectual activity into political power.

In the way that Corvinus's crafted his image not from the actual astrological predictions presented to him at court but a perfomative role as the adjudicating figure at the head of the astrological debate, Elizabeth's means of claiming power were performative in that her image was carefully constructed rather than externally determined by standard markers of power. Through various means of written communication and visual representation, she projected her dominance and preeminence as if it had been handed to her while she worked to garner real, actual authority during the early years of her reign. Just as the astrological debate of the time provided Corvinus with an opportunity to involve himself as an intellectual and political force, Elizabeth's ownership of the 1559 Gemini astrolabe projected her purported control over bodies of knowledge and expertise.

III. The Instrument Maker

Elizabeth's ability to gain political legitimacy and authority from the production of scientific knowledge depended on both craftsmen, such as Gemini, to produce highly sophisticated instruments as well as the increasing significance of mathematical technologies in England and across Europe. Elizabethan London experienced several societal and political shifts leading up to and throughout the queen's rule that gave way to the development of various navigational fields, including both maritime and land surveying. For one, London's population grew dramatically throughout Elizabeth's reign, nearly doubling in size from 1525 to 4 million people.[53] London reflected England's expanding society and political, territorial agenda. From the needs of a growing population as well as the political pressure to remain competitive with other European powers emerged the demands of an expanding society—the fields of surveying and navigational technology developed from this impulse.[54]

At the onset of Elizabeth's reign, England lacked the industrial capacity and native craftsmen to fill the demand for engraved maps and scientific instruments and participate as producers of technology in an increasingly competitive European political landscape. Prominent printers and engravers from Continental Europe, particularly the Low Countries, recognized this deficit as a patronage opportunity and relocated to England, establishing themselves by printing prominent scientific or mathematical works. These craftsmen began to supply a growing demand and economy around such information but also served as actors in the transfer of knowledge from Continental Europe to England, bringing over skills and technologies that did not exist locally in England.[55] They were skilled in working with brass and copper, enabling them to engrave maps and

---

[53] Turner, *Elizabethan Instrument Makers*. 3.
[54] Ibid. 3.
[55] Ibid. 7-8.

mathematical texts and produce objects and instruments that found increasing demand from wealthy patrons, included noblemen, courtiers, and the royal court itself.[56] These craftsmen came from well-established workshops in their home country to relocate in city and country in which there existed only the potential for a greater market around their craft, yet came for the promise of participating in a patronage system of great scale that London offered as a growing center of political and economic significance in Europe. England was stronger as a political force than it had been half a century earlier and the heightened quality of instruments that appear in London in the middle of the sixteenth century speaks to an increased interest on the behalf of the elite for these objects.

John Blagrave's *Mathematical Jewel* reflects contemporary ideas on how scientific objects embodied elite forms of knowledge as an instructive text on the technical elements of an astrolabe, while still placing the instrument within the realm of the Elizabethan court and an elite audience. Published in 1585, the 124-page text introduces its reader to the instrument's significance immediately; in the piece's title, Blagrave called the astrolabe a "mathematical jewel," the "jewel" indicating the significance, elegance, and sophistication of the instrument.[57] Yet despite its sophistication, the instrument is also easy to use, as Blagrave claimed on the text's title page:

> The use of which Jewel, is so aboundant and ample, that it leads any man using it, from the first step to the last, through all the arts of astronomy, cosmography, geography… and briefly of whatever concerns the globe or sphere, with great and incredible speed, plainness, facility, and pleasure.[58]

On the one hand, this description invites his reader to participate in the use of the astrolabe by presenting it as an accessible instrument. Simultaneously, Blagrave's description of the instrument's functional capabilities encompasses large fields of scientific knowledge, inclusive of

---

[56] Ibid. 4-5.
[57] Blagrave, *The Mathematical Ievvel Shewing the Making, and Most Excellent vse of a Singuler Instrument so Called*. Title page.
[58] Ibid. Title page.

"all the arts of astronomy, cosmography, geography… and briefly of whatever concerns the globe or sphere," marking, through the author's claims, the astrolabe's supposed significance as a technological object. Its in-depth and broad range of uses, yet apparently ease in use, makes it a clear symbol of knowledge for Blagrave and for the larger Elizabethan intellectual community to whom Blagrave is writing.

On a page titled "Margarita Mathematica," Blagrave includes a mathematical table surrounding by illustrations. The illustrations around the central image represent geometry, astronomy, navigation, and cosmography. While all employ obvious imagery surrounding that field, the man in the astronomy illustration in the upper right hand corner is wearing a crown and is dressed in a nobler, more kingly manner. In contrast to geometer and cosmographer depicted in their shops, the astronomer is practicing his work outside, holding the instrument directly to the moon and stars, signifying a proximity to the heavens. The visible differences between the representation of the astronomer and his counterparts as well as the character's placement among celestial entities marks him as a nobler, more elite figure. Representing the astronomer in this way speaks to Blagrave's higher opinion of astronomers versus the other, albeit important, sciences.

The associations between astronomical practices and a noble audience appear throughout the text and work to reinforce the astrolabe as a desired symbol of status. On the title page, Blagrave describes the purpose and intended readership for his text, intending its publication "for gentlemen and others desirous of speculative knowledge, and private practice: as also for the furnishings of such worthy minds, navigators, and travelers, that pretend long voyages or new discoveries."[59] Through Blagrave's specific definition of gentlemen and "worthy minds" as his audience, it is clear that such a text was not purely an instruction manual for craftsmen or artisans. Rather, the text is

[59] Ibid. Title page.

designed for members of an educated elite class who placed themselves intellectually among noble travelers and navigators. Blagrave allows his audience, gentlemen of "worthy minds," to imagine themselves alongside the navigators and travelers they would have envisioned using the astrolabe while on a long voyage or expedition. By dedicating his text to Elizabethan court advisor William Cecil, Blagrave draws the ultimate connection between his astronomical work and members of the royal court. In naming his audience as he does on the title page and specifically appealing to one of Elizabeth's closest advisors, Blagrave deepened the connection between the noble classes and the performance of astronomical practices.

Blagrave's text is a later articulation of scientific instruments' power and political value that the Low Country craftsmen encountered upon their arrival in London in the mid-sixteenth century. Foremost among the Flemish craftsmen was Thomas Gemini, who imported to London the skills, aesthetic styles, and authority over instrument production that marked Flemish instruments. Thomas Gemini was originally named Thomas Lambert and was born Low Countries, or present day Belgium and the Netherlands—an area that was developing communities of engravers who were actively contributing to information and technology production.[60] Gemini relocated and became established engraver in London with his own shop by 1540, where he also worked as a publisher and an editor.[61] Given the instruments surviving from England and the time period, Gemini was likely one of the first and assuredly most prominent Flemish craftsmen in London shortly after his arrival.

Evidence suggests that while in Louvain, Gemini learned his craft in the tradition and workshop of Gemma Frisius, Gerard Mercator and Gualterus Arsenius, significant craftsmen in the

---

[60] Samson, "Mapping the Marriage: Thomas Geminus's 'Brittaniae Insulae Nova Descriptio' and 'Nova Descriptio Hispaniae' (1555)."
[61] Van Cleempoel, *Astrolabes at Greenwich: A Catalogue of the Astrolabes in the National Maritime Museum, Greenwich*. 151.

history of instrument making. Louvain was a center of intellectual activity and provided a environment conducive for Frisius, a mathematician and physician who studied at the university in Louvain and opened a workshop in 1530, to begin a Flemish tradition of instrument making. The workshop not only elevated the aesthetic elements of scientific instruments but also executed their craft with greater precision and technical skill relative to other instrument makers of the period. Thus, Gemini came to London bringing the finest technical skills of his trade along with an internationally established tradition of craftsmen, craftsmen active in the technical evolution of instrument making. His work in London, therefore, did not simply meet the English demand for scientific instruments but appealed especially to patrons interested in the best and the finest work that symbolized patronage, wealth, and status, alongside the knowledge the instruments themselves represented.

Gemini gained recognition as a printer in 1545 shortly after moving to London following his edition of *Compendiosa totius anatomie delineato, aere exarata* and their illustrative engravings. The *Compendiosa* was a version of from Vesalius's *De humani corporis fabrica libri septem,* a groundbreaking anatomical study and text published in 1543 by an anatomist from the Low Countries named Andreas Vesalius.[62] Vesalius's text was groundbreaking in the anatomical sciences but Gemini's version comes only two years after Vesalius's original edition at the very beginning of the text's wide circulation. Not only is Gemini's edition a testament to Vesalius's immediate success but through his copy, Gemini serves as an agent in the spread and dissemination of the text across Europe. Furthermore, Gemini's engraved illustrations of the text were the first of their kind produced in England, signifying Gemini's expertise and skill with metal work and marking the beginning of a shift from woodcut printing to engraved copper plates in the 16th

[62] Donaldson, "Two States of Some Plates in the Compendiosa of Thomas Geminus (1545)."

century. Through the *Compendiosa,* Gemini transferred innovations in the anatomical sciences and techniques in artisanal metalwork from his home in the Low Countries to England

The *Compendiosa* was an important work for Gemini for reasons beyond the innovative craftsmanship. Gemini produced several editions of the text, each of which was dedicated to a member of the Tudor monarchy. The first, 1545 edition bears the Tudor crest along with a dedication to the "serene and invincible king of England, France, and Ireland, King Henry VIII, the defender of faith and founder of the Church of England…"[63] This dedication secured Gemini a royal stipend of £10 a year, or over £5,000 today. This marked the beginning of Gemini's relationship with the Tudor court, which continued throughout Mary's, Edward's, and Elizabeth's rule. Even throughout political unrest between members of the Tudor monarchy, Gemini continued to produce work and dedications for the court. In celebration of Mary's marriage to King Philip of Spain, for example, Gemini dedicated two engraved maps, one of England and one of Spain, to the newly wed king and queen.[64]

In 1551, Gemini produced an astrolabe dedicated to Edward VI. Its decorative program is similar to the astrolabe later made for Elizabeth and is similar in its brass make as well as its dimensions. Similar to the Elizabethan instrument, the astrolabe's rete is made up of intertwining strap work, with stars placed on the star pointers around a table centered on an engraved star. It is thus likely that Elizabeth would have seen and been exposed to instruments like these before receiving her own as a gift. Due to its technical production and physical similarity, as well as its presence in the Tudor court, the astrolabe for Edward VI is a relevant precursor to the Elizabethan astrolabe and serves as an indication of the court's interest in such objects. Dudley recognized

---

[63] Gemini, *Compendiosa Totius Anatomie Delineatio, Aere Exarata*. Translated from Latin from the original text: "Serenissimo Invictissimo Angliae, Franciae, & Hiberniae Regi, Henry octavo, fidei defensori, Ecclesiae Anglicanae simul & Hibernicae sub Christo, capiti supremo: soelicitatem perpetuam precatur." 1545.
[64] Samson, "Mapping the Marriage: Thomas Geminus's 'Brittaniae Insulae Nova Descriptio' and 'Nova Descriptio Hispaniae' (1555)."

Gemini's skill when he commissioned the 1559 astrolabe, the making of which worked to solidify Gemini's place within the Tudor network of experts and technological production.

The astrolabe's materiality is an important indicator of its political role as a scientific object as the elaborate decor of the object suggests that while the astrolabe did not serve a practical, time-telling function at court, it held symbolic and decorative meaning for the queen. Gemini's works contributed to the burgeoning English collection of scientific instruments and objects, lending Flemish aesthetics and technical abilities to Queen Elizabeth's collection of foreign technologies. As the distinct Flemish style and craft embodied by Gemini's work attested to a unique artisanal and national identity for the Low Countries, Gemini's work also contributed to England's identity as an imperial power through Elizabeth's collection of scientific objects and the production of knowledge in Elizabethan England. The giving of the astrolabe to Elizabeth solidified this transfer of international symbolism but was part of a larger network of reciprocal relationships in the Elizabethan court, a cycle of giving that involved Gemini as the instrument maker, the queen as its recipient, and Dudley as the link between the two.

IV. The Favorite Courtier

Sir Robert Dudley, earl of Leicester, was born in 1532 to John Dudley, duke of Northumberland. He displayed an early interest in mathematics, engineering, and navigation through his education and academic studies while also developing a friendship with Princess Elizabeth as a young child. By Elizabeth's ascension to the throne, Dudley was one of the queen's favorites at court.

Dudley's interest in mathematical activities and his role within the Elizabethan court gave him access to the network of instrument makers producing technological objects as well as the explorers setting sail for New World territories. While many Elizabethan courtiers, Dudley's contemporaries, traveled across Europe or to the New World performing both navigational and imperial activities, Dudley was often kept in England as Elizabeth's favorite courtier and engaged with navigational and mathematical practices from court. He advised navigators John Hawkins and Sir Francis Drake on their voyages and sponsored Drake's travels as well explorer Martin Frobisher's search for the Northwest Passage.[65] He also held an interest in scientific instruments beyond commissioning one for the queen; through his travels around Europe, he also acquired an instrument used to calculate longitude using the lunar distance method.[66] Furthermore, he worked with John Dee in commissioning Dee's 1570 signature imperial text, *Bryntannicae reipublicae synopsis,* in which Dee coined the phrase "the British Empire" and suggested ancient English territorial claims to the New World.[67] His interest and work in territorial navigation and expansion didn't come from direct travels, like those of Dee, Frobisher, and Drake, but from an early educational background and later, a commitment to Elizabeth's imperial program of learning about

---

[65] Adams, "Dudley, Robert, Earl of Leicester."
[66] Turner, *Elizabethan Instrument Makers*. 4.
[67] Deacon, *John Dee: Scientist, Geographer, Astrologer and Secret Agent to Elizabeth I*.

and conquering New World territories. Personal engagement with these mathematical and navigational fields, even without practicing them himself, would have exposed him to a variety of astronomical and navigational instruments and it is likely that Dudley was familiarized with Gemini through this interest. His personal interest in these fields alongside his understanding of the queen's and Dee's plans for the British Empire suggest that Dudley recognized these navigational methods' and instruments' technical and political significance.

Elizabeth kept Dudley close to court as a sign of her partiality for him and formally expressed her favor by inducting him into the Order of the Garter. The Order of the Garter was, and still is in England today, the highest form of knighthood and therefore the highest honor a monarch could bestow. A 1593 poem by the Elizabethan writer George Peele describes the Order of the Garter and its history upon seeing a

> "Gaarter brightly glistring in mine eye/ A worthy ornament. Then I cald to minde,/ What Princely Edward, of that name the third,/ Kind Edward for his great achievements famed,/ What he began; The order of St. George,/ That at this day is honoured through the world… [on which I] sawe a Virgin Queene, attyrde in white,/ Leading with her a fort of goodly Knights, /With Garters and with Collers of St. George… She was the Sovereign of the Knights she led."[68]

Peele's description demonstrates the awe and respect for the knights, both for the honor they received and the way in which the queen is glorified by their procession. On the one hand, the queen is glorified by the procession around her and is also made powerful by her ability to bestow such a prestigious title to the noblemen at her court. On the other, receiving the highest title a non-royal could receive was clearly beneficial in elevating a courtier's social and political standing. As Peele's description as an observer of the procession notes both the queen's glory as well as the

[68] Peele, *The Honour of the Garter*. 9.

"worthy ornament" given to the recipients of the Order, his poetry recognizes the reciprocal nature of the relationship between the queen and her knights.

After his induction into the Order of the Garter, Dudley, in return for the high honor, commissioned and gave Elizabeth the 1599 astrolabe produced by Gemini. The giving of the astrolabe from Gemini to Dudley and finally to the queen in return for Dudley's knighting places a particular emphasis on the astrolabe's role within the cycle of reciprocity characteristic of royal courts in the early modern period, as the gift giving economy in which the astrolabe was exchanged valued gifts based on their social symbolism and status rather than strictly their monetary value.[69] The astrolabe and its reciprocal nature as a gift mirrored honor of the Order of the Garter through its symbolic, aesthetic, and technical value. In return for receiving the highest honor the queen could give him, Dudley gave Elizabeth the astrolabe knowing that was the best of its kind, coming from a renowned Flemish maker, and that it contributed to Elizabeth's image as an intellectually authoritative sovereign.

The obligatory nature of the exchange system created a social economy in which giving was not a voluntary display of thanks or deference, yet the system also worked to legitimize both the giver and recipient of a gift in terms of social status and political standing. The gift was the physical embodiment of necessary participation, or the tool in the mechanism of reciprocation at court, and depended on proper timing to ensure the relationship was not violated.[70] Dudley returned the favor almost immediately after receiving his honor, characteristic of a system of balanced reciprocity, or when the response arrives soon after the initial gesture, or in this case, where Dudley's induction into the Order of the Garter acts as a gift given from the queen to her courtier.[71] In such cases, the nature of the gift plays a crucial role as a signifier of the giver and recipient's relationship and had

[69] Davis, *The Gift in Sixteenth-Century France*. 4.
[70] Ibid. 5.
[71] Ibid. 5.

the ability legitimize both the giver and receiver in terms of social standing. The recipient of the gift is clearly honored or recognized in some way, as Dudley was in his induction into the Order of the Garter and as Elizabeth was in receiving the beautiful Gemini astrolabe. Yet the gift is equally important for the giver of the gift, who is legitimized through their participation in the gift giving cycle; without giving a gift, one is no longer an active participant in a court culture so dependent on social signifiers and decorum.[72] Both patrons and clients, and by extension the gift givers and gift recipients who functioned within similar courtly structures, were bound to involuntarily participate in systems of reciprocity—failure to participate would be an unthinkable act of one's social degradation. Furthermore, the gift had to be appropriate in regards to the giver's social status but also had to be equal to the original gift in terms relative to the social difference between the giver and the recipient. Thus, the giver must calculate the value of the gift as appropriate and take care in choosing what gifts and honors are given. For Dudley following his induction into the Order of the Garter, the gift he gave the queen would have to signify a proportional amount of power and honor.

The gift of the astrolabe is on one hand a material object but as a product of an expert maker, it also functions as a transactional item commissioned by Dudley; the exchange between Dudley and Gemini adds another layer of reciprocity in the astrolabe's role at court. Dudley's inventory accounts note what the courtier owed Gemini while the dedication to Elizabeth engraved into the instrument serves as Dudley's symbolic repayment for having been bestowed the honor of knighthood. The giving of the astrolabe from Gemini to Dudley and finally to the queen as a reciprocation of Dudley's knighting positions the gift to embody the symbolic relationship between each side of the exchange. Dudley paid Gemini for the astrolabe in cash, according to his household inventories, a payment of economic value outside the symbolic nature of gift exchange. Yet through

[72] Biagioli, *Galileo, Courtier*.

the instrument, Dudley and Gemini entered into a mutually beneficial exchange that helped each man further establish himself at court. Dudley benefitted from Gemini's status as a well-known craftsman already participating in courtly activities; as Gemini already received an annual stipend from the Tudor court, he had already been deemed valuable by the monarchy. By presenting Elizabeth with this particular astrolabe, he was sure the astrolabe would be received as a fine piece of craftsmanship.

Meanwhile, Gemini had been working under the Tudor monarchy since the rule of King Henry VIII through the production of engraved dedications as well as an astrolabe dedicated to King Edward VI. While he had already dedicated one of the engravings on the cover of his printed anatomical text to the queen, having an instrument, a larger instrument and project, commissioned by a courtier for the queen in the first year of her rule was a significant opportunity for the Flemish craftsman to further establish himself within the court and specifically in her favor. Dudley's commission was thus another step in the evolving relationship Gemini maintained with the court and was a way to elevate his standing as a craftsman at court.

Made by Gemini, commissioned by Dudley, and given to Queen Elizabeth, the astrolabe thus represents the reciprocal nature of gift exchange at court. At each stage of the instruments exchange lie various motivations for each figure's participation in the game of gift giving, patronage, and reciprocity. In this gift giving economy, however, the reciprocal relationship is not purely categorized by financial motivations. Rather, these gifts are not means to an end necessarily, but instead represent a process of positioning oneself within the social structure of the European court.[73] The Gemini astrolabe played a role in the self-fashioning of each figure in the chain of giving and receiving. As Gemini received a stipend from the court of £10 a year, he had to continue

[73] Ibid. 14.

producing works in order to remain relevant to court activities of sponsorship and patronage. Dudley, meanwhile, was bound by a relationship of balanced reciprocity, which required an immediate return equal to the honor bestowed upon him by the queen.

Any failure on Dudley's part to acknowledge the queen's favor would be not only to ignore the queen's gesture but would have been seen as a dismissal of the honor. The lack of an appropriate response, therefore, would decrease Dudley's favor in the eyes of Elizabeth, according to historiographical theories of gift giving. Furthermore, the gift, as an acknowledgement and symbol of gratitude for the queen's favor, would have to hold some special significance and be proportionally valuable relative to Dudley's social standing versus that of the queen.

At a first look, it is difficult to see how Dudley's gift of the astrolabe was proportionally significant, in regards to his status relative to the queen's, to his induction into the Order of the Garter. After all, Elizabeth granted Dudley the highest honor she could have through knighting him in such a way; an astrolabe, meanwhile, does not at first seem like the highest honor Dudley could have given the queen. Yet Elizabeth's honoring of Dudley through the Order of the Garter represented the highest political position Dudley could have achieved, recognizing the role he played for her at court as a politically significant one and satisfying any political ambition Dudley would have had upon the queen's ascension to the throne. While Dudley was not politically capable of elevating the queen's political status as a non-royal courtier, his gift was proportionally similar to Elizabeth's as it recognized the queen's highest political aspirations of imperial expansion through the advantages of navigational expertise. The gift in one sense demonstrated Dudley's connection to the network of experts surrounding the court, hinting at his role in contributing to Elizabeth's political success, but also acknowledged the highest of the queen's political ambitions for the English empire.

Conclusion

Elizabeth, Gemini, and Dudley each perform a different function in the production and exchange of the astrolabe and represent a different piece of the instrument's contribution to the intellectual foundation of the English Empire. Gemini, who passed away in 1562 and was thus not able to contribute much more to the Tudor collection after the 1559 astrolabe, was the expert who was involved early on in the Tudor's network. Dudley, in giving the astrolabe, served the mechanism of reciprocity at court, elevated both Gemini's and his own political status through the activity of gift exchange. Finally, Elizabeth, who went on to rule over England for nearly fifty years, built an empire with an extraordinary legacy that stemmed from her ability to create authority and project an image of imperial power based on largely based on information politics. In the gift giving economy of the early modern European court, each character in this historical narrative participated at court with different rules and social standards which dictated the ways in which they gave and received gifts, honors, and patronage at court. Despite these differences, however, the astrolabe, made by Gemini and given to Elizabeth by Dudley, bound each figure to each other through the obligatory relationships that made up a courtly dynamic of decorum and reciprocity.

These relationships, while internally significant within the social construct of the court, revolved around the political context of the mid-16th century and Elizabeth's ascension to the English throne. Her rise to power hung in a fragile balance that necessitated a particular attentiveness to the construction of the queen's political image. Due to the increasing power of printed text and image as well as the symbolic nature of navigational sciences as a representation of imperial capabilities, the Elizabethan court worked to craft an image of the queen and of the state based on information and expertise. Such expertise allowed the court to appear technologically

advanced and thus capable of imperial expansion as they built a world-class navy and sent privateers and explorers to the New World, thus challenging the Spanish and Portuguese stronghold on those contested territories.

In the context of Elizabeth's political ambitions, the astrolabe itself, as a combination of technological expression and aesthetic cultural identity, is a representative piece of the court's collection of foreign expertise. Through the patronage of foreign experts, such as Gemini, the court built out its technological capabilities by integrating navigational instruments and practices into their own political program; the technical instruments themselves were physical embodiments of such an agenda. In the 1559 Gemini astrolabe was the capacity for knowledge, the ability to use the instrument for its practical, intended purpose, even if the queen never did so herself. In connecting the instrument's distinct, international aesthetic power of the instrument with its purported utilitarian capabilities, Dudley's gift recognized the vast potential of the English empire through an advanced and sophisticated instrument of power.

Bibliography

Primary Sources

Arsenius, Ferdinand. Astrolabe, 16th century, The Netherlands. Museum of the History of Science, Oxford. Collection database inventory number 45365. Accession number 1952-1.

Blagrave, John. *The Mathematical Ievvel Shewing the Making, and Most Excellent vse of a Singuler Instrument so Called*. London: Walter Venge, dwelling in Fleetelane ouer against the Maiden head, 1585.

Dudley, Earl of Leiscter. *Household Accounts and Disbursement Books of Robert Dudley, Earl of Leicester, 1558—1561, 1584—1586. Ed. Simon Adams. London, Great Britain: Cambridge University Press. 1995.*, n.d.

Eworth, Hans. Elizabeth I and the Three Goddesses, 1569. The Royal Collection. RCIN 403446.

Gemini, Thomas. Astrolabe for Queen Elizabeth I, 1559, London. Museum of the History of Science, Oxford. Collection database inventory number 42223. Accession number 1937-6.

Gemini, Thomas. *Compendiosa Totius Anatomie Delineatio, Aere Exarata: Per Thomam Geminum*. Early English Books, 1475-1640 / 101:08. Londini : [In officina Ioanni Herfordie, anno Domini. 1545. Mense Octobri], 1545.

Hartmann, Georg. Astrolabe, 1545, Nuremberg. Istituto e Museo di Storia della Scienza, Firenze. Collection database inventory number 1111.

Oliver, Isaac. The Rainbow Portrait of Queen Elizabeth I. c. 1600. Hatfield House and Estate, United Kingdom.

Peele, George. *The Honour of the Garter*. London, England: Printed by the Widdowe Charlewood, for John Busbie, and are to be sold at the West doore of the Paules., 1593.

Secondary Sources

Adams, Simon. "Dudley, Robert, Earl of Leicester," n.d.

Ash, Eric. *Power, Knowledge, and Expertise in Elizabethan England*. Baltimore, MD: The Johns Hopkins University Press, 2004.

Biagioli, Mario. *Galileo, Courtier: The Practice of Science in the Culture of Absolutism*. University of Chicago Press, 1994.

Davis, Natalie Zemon. *The Gift in Sixteenth-Century France*. Univ of Wisconsin Press, 2000.

Deacon, Richard. *John Dee: Scientist, Geographer, Astrologer and Secret Agent to Elizabeth I*. London: Frederick Muller Lt.d, 1968.

Dekker, Elly, and Rudolf Schmidt. "THE GLOBES IN HOLBEIN'S PAINTING 'The Ambassadors' / DIE GLOBEN AUF HOLBEINS GEMÄLDE: „Die Gesandten"." *Der Globusfreund*, no. 47/48 (November 1, 1999): 19–52.

Donaldson, I.M.L. "Two States of Some Plates in the Compendiosa of Thomas Geminus (1545)." *Transactions of the Bibliographical Society* 11, no. 1 (March 2010).

Hamrick, Stephen. *The Catholic Imaginary and the Cults of Elizabeth, 1558-1582*. Ashgate Publishing, Ltd., 2009.

Hayton, Darin. "An Introduction to the Astrolabe," 2012.
———. "Expertise Ex Stellis: Comets, Horoscopes, and Politics in Renaissance Hungary." *Osiris* 25, no. 1 (2010): 27–46.
———. "Politics and Astrology in Renaissance Hungary," n.d.

Jones, Peter Murray. "Peter Murray Jones. Gemini, Thomas (fl. 15=40-1562)." *Oxford Dictionary of National Biography*, 2004.

Marshall, Peter. *The Magic Circle of Rudolf II: Alchemy and Astrology in Renaissance Prague*. Bloomsbury Publishing USA, 2009.

Montrose, Louis. *The Subject of Elizabeth: Authority, Gender, and Representation*. University of Chicago Press, 2006.

Moran, Bruce T. "German Prince-Practitioners: Aspects in the Development of Courtly Science, Technology, and Procedures in the Renaissance." *Technology and Culture* 22, no. 2 (April 1, 1981): 253–74. doi:10.2307/3104900.

Samson, Alexander. "Mapping the Marriage: Thomas Geminus's 'Brittaniae Insulae Nova Descriptio' and 'Nova Descriptio Hispaniae' (1555)." *University College of London: Renaissance and Reformation/Renaissance et Réforme* Vol. 31, no. No. 1 (Winter 2008).

Sharpe, Kevin M. *Selling the Tudor Monarchy: Authority and Image in Sixteenth-Century England*. Yale University Press, 2009.

Smith, Pamela H. "Art, Science, and Visual Culture in Early Modern Europe." *Isis* 97, no. 1 (March 2006).

Strong, Roy C. *The Cult of Elizabeth: Elizabethan Portraiture and Pageantry*. University of California Press, 1977.

Turner, Gerard L'Estrange. *Elizabethan Instrument Makers: The Origins of the London Trade in Precision Instrument Making*. Oxford University Press, 2000.

Van Cleempoel, Koenraad. *Astrolabes at Greenwich: A Catalogue of the Astrolabes in the National Maritime Museum, Greenwich*. Oxford: Oxford University Press, n.d.