

Galileo's Moon: Drawing as Rationalized Observation and its Failure as Forgery¹

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Preface

In 2005, Richard Lan, partner of the esteemed NYC antiquarian bookseller, *Martayan Lan*, purchased a unique copy of Galileo's *Sidereus Nuncius* (Venice, 1610) from two Italian sellers for \$500,000. The *Sidereus Nuncius* ("Starry Messenger" or "Starry Message") was the text that propelled the change in scientific thinking from a geocentric to a heliocentric model, and it provided empirical evidence for Galileo's discoveries of craters and mountains on the moon, stars in the Milky Way, and satellite moons revolving around Jupiter. What is now known as the *Martayan Lan* copy of the *Sidereus Nuncius* (SNML) was considered more valuable than any other first edition copy because it bore Galileo's signature on the title page, and because it contained ink wash illustrations believed to be by Galileo rather than the printed etchings that were found in other extant copies. In 2007, renowned German art historian Horst Bredekamp together with a team of other experts from diverse fields, undertook an exhaustive study of the SNML to determine its authenticity. Following numerous tests and a variety of intensive analyses, they concluded that the SNML was an authentic and unique "proof" copy, and published their findings in the two-volume study, *Galileo's O* (2011). Serious doubts about the SNML, however, had also been expressed by other experts (including Owen Gingerich and Nick Wilding) between the 2007 purchase and the 2011 publication of *Galileo's O*, and in 2012 it was revealed that the book and its drawings were in fact a modern forgery. Marino Massimo De Caro, director of the Girolamini Library in Naples, was arrested in May 2012 for stealing and selling rare books from his library's holdings, as well as for making and selling forgeries of other texts. He confessed to having fabricated the SNML with expert assistance. The extraordinary narrative of these events was recounted by Nicholas Schmidle in a lively, in-depth cover story in *The New Yorker* (December 16, 2013) and in 2014, Bredekamp and his team issued a third volume in the *Galileo's O* series, *A Galileo Forgery: Unmasking the New York Sidereus Nuncius*. Contemporary forgeries of antiquarian books appear far less frequently on the

commercial market than do forgeries of paintings and drawings, and hence the more automatic suspicion that usually informs potential buyers of "old master" paintings and drawings is less practiced within the book trade. In other words, the beginning premise on the part of Lan, Bredekamp, and even Galileo specialist Owen Gingerich in the early stages of evaluation, was that the *SNML* was authentic.

While having all of the ingredients of a best-selling suspense novel in the Dan Brown genre, this contemporary "Galileo Affair" also rekindled scholarly interest about the role of imagery as part of scientific inquiry and empirical evidence for Galileo and his contemporaries, equally as it raised questions about the analytic and interpretive methodologies of art historians, historians, and antiquarian book dealers when pronouncing on authenticity. Furthermore, in an odd challenge to long-held scholarly beliefs, the revelation of the *SNML* as a forgery has also called into question the authenticity and quality of the lunar drawings thought to be in Galileo's own hand within his original notes and drafts for the *SN*, and which have resided in the Biblioteca Nazionale Centrale di Firenze since the early 19th century. In particular, his ink wash drawings of the moon that represent his observations and interpretation of what he saw on a succession of nights through his telescope in 1609, and which likely informed the etchings of the moon that appeared in the first edition (1610) of the *Sidereus Nuncius*, have been doubted. This new suspicion about Galileo's moon drawings is especially ironic, and is no doubt motivated by a lingering critical response to the error made by Bredekamp and his colleagues in authenticating the *SNML*. Much has been written about these drawings over several decades and their importance in demonstrating the pictorial knowledge and graphic skill that Galileo acquired through his friendships and professional associations with artists in and around the Florentine *Accademia del Disegno* during the later 16th and early 17th centuries. The confluence of circumstances and issues occasioned by the *SNML*, its authentication, subsequent revelation as a forgery, and recent doubts raised about what have always been accepted as Galileo's authentic drawings of the moon, forms the context for this essay. In particular, it is important - in my view - that we revisit Galileo's moon drawings (and the etchings in the 1610 *Sidereus Nuncius*) within the cultural and artistic circumstances in which they were produced. For, contrary to the recent assertion that they are perhaps not by Galileo, the *SNML* and its forged drawings only serve to validate the presence and veracity of Galileo's hand and mind as part of a long-standing tradition of Florentine draughtsmanship (both in theory and practice) wherein imagery could function as a form of empirical truth.

I will begin by framing my argument within a broad paradigm sketched out by the philosopher, Isaiah Berlin about the constructs of disciplinary distinctions in modern academic institutions and those operative in Galileo's era during the later 16th and early 17th centuries. I then briefly consider Galileo's drawings as they relate to the published etchings of the moon in the 1610 edition of the *SN* and discuss the very precise language Galileo used to describe the etchings within his argument. The importance of the *Accademia del Disegno* in Florence and its founding principles to the effectiveness of

Galileo's success in rendering visually compelling, representative imagery follows. Finally, I conclude with an analysis and reassessment of Galileo's moon drawings, the etchings in the 1610 edition, and the *SNML* forgery together, which I argue validates Galileo's imagery as an important means for conveying the discovery and demonstration of new knowledge.

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In an insightful and thought-provoking essay, "The Divorce between the Sciences and the Humanities," (1974) the philosopher Isaiah Berlin argued that the origins of a disciplinary split that defines our current academic and cultural landscape was located in the clash between the legacy of Renaissance humanist inquiry and the advent of Cartesian rationalist models at the dawn of the Enlightenment. Berlin exemplified his argument by contrasting Voltaire (François-Marie Arouet, 1694-1778), whom he called the "central figure of the Enlightenment," with Giambattista Vico, the inspired Neapolitan philosopher (1668-1744), who "defended the rich, Italian 'rhetoric,' inherited from the great humanists of the Renaissance, against the austere and deflationary style of the French rationalist science-influenced modernists."² The evolution of these two positions became institutionalized oppositions in modern academia where the sciences and humanities were further bifurcated in the definition of their goals: the acquisition of knowledge through empiricism and objectivity versus the acquisition of knowledge through understanding and interpretation. Although this division is somewhat oversimplified, Berlin's primary observation is well-taken. Namely, that prior to the eighteenth century, this disciplinary contrast was far less distinct. Divisions between the realms of philosophy, history, science, rhetoric, mathematics, and art, were not as sharply drawn during the 16th and early 17th centuries in Italy, and while there were certainly spirited debates about theory and method, a split between the "natural sciences" and the "humanities" such as we perpetuate today, did not exist.

A burgeoning interest by scholars during the past two decades in the relationship between science and art from the 15th through the 18th centuries has produced many enlightening studies, such as those by Martin Kemp, John L. Heilbron, Lyle Massey, Timothy Reiss, Pietro Rocassecca, Carlo Pedretti, and Hans Belting, among others.³ The topic of "Galileo and the Arts" during the period of the late 16th and early 17th centuries, however, has occupied a special place of its own among scholars from a variety of disciplines for quite some time - so much so, that it can be said to be a separate field of inquiry unto itself. Galileo as mathematician, astronomer, artist, and philosopher, epitomizes well Berlin's characterization of Vico and the legacy of Italian Renaissance humanism equally as he heralds the dawn of the Enlightenment - perhaps not so much in Berlin's characterization of Voltaire, but rather in the act of ideation informed by the rationalized observation of nature in demonstrating universal knowledge, or, truth. Erwin Panofsky established the field of inquiry into Galileo and the Arts with his 1954 ground-breaking study, *Galileo as a Critic of the Arts*.⁴ His work was followed by many

other important contributions, including those by Miles Chappell (1975), Samuel Edgerton (1984), Steven Ostrow (1996), Eileen Reeves (1997), and David Freedberg (2002).⁵ There are many more studies than those just mentioned, but I must note the work of Horst Bredekamp who began publishing on Galileo and art and Galileo as an "artist" in 1996, the most recent installment of which appeared in 2015 as *Galileis denkende Hand: Form und Forschung un 1600*.⁶ And, despite his misattribution (and that of his colleagues) of the text and drawings of the *SNML*, his subtle analyses and description of the pictorial representation of knowledge - what he called Galileo's "visual forms of thinking" (*visuelle Denkformen*) - is an important and substantive one.⁷ Bredekamp's work has done much to advance our understanding of the intersection of art and science in and around Galileo since Panofsky.

Galileo's association and friendship with artists in Florence (especially the painter, Ludovico Cigoli, See Figure 1 at <http://blogs.dickinson.edu/schlittgalileo/> **)⁸, and his connection with the Florentine *Accademia del Disegno* was central to the development of his graphic skill and knowledge of perspective - considered a science in the 16th and 17th centuries - with its specialized branch of shadow projections.⁹ Galileo's considerable ability in drawing has also been well-studied, most prominently by Edgerton and Bredekamp. Furthermore, the implications of that ability through his understanding of the theory and practice of Florentine *Disegno*, particularly as it pertained to chiaroscuro and perspective as a fundamental part of the success of his argument in the *Sidereus Nuncius*, represented through the wash drawings and subsequent etchings of the moon included in most copies of the first edition (1610), has been widely accepted since Edgerton's 1984 essay (Figures 2, 3). The fact that Galileo's contemporary, the English mathematician Thomas Harriot, who had also observed the moon through a rudimentary telescope at about the same time as had Galileo and failed to recognize what he called "the strange spottedness" of the moon as the visual effects of highlights and shadows projected from the rims of elevated craters into their depressions, only supported further Galileo's understanding of and ability to represent his observations. Even though Galileo most likely did not render all - if any - of the wash drawings at the telescope during his act of observing the moon, as Owen Gingerich has persuasively suggested, recent speculation in art-historical circles subsequent to the revelation of the *SNML* (Figure 4) as a forgery that the drawings might not be by Galileo at all, is misplaced.¹⁰ As I suggested in my Preface, all evidence points to the contrary, and such speculation only serves to underscore the very point Berlin argued in his essay about modern, disciplinary distinctions and the greater intersection of them during the 16th and early 17th centuries. Furthermore, as I discuss below in greater detail, the virtual certainty that the etchings of the Moon for the first edition of the *Sidereus Nuncius* were made by Galileo himself is also supported by his own very specific references to them in the Latin text, e.g.: "I observed this [phenomenon] near both quadratures and I have imitated it as far as possible in the second figure above" (*hanc prope quadraturas ambas conspexi eandemque in secundis supra positis figuris quantum licuit imitatus sum*).¹¹ Galileo's explicit use of the first-

person perfect indicative ("imitatus sum," "I have imitated"), rather than the more literary and formal first-person plural "nobis," or passive voice can hardly be accidental given his considerable erudition and fluency in Latin.

The etchings in the first edition of the *Sidereus Nuncius* also introduced a new form of visual representation that participated in a larger and more important empirical argument. To paraphrase Thomas Kuhn in *The Structure of Scientific Revolutions*: Galileo's re-orientation of thought about the nature of motion and cosmology represented a new model for scientific thinking that could effectively challenge the Aristotelian and Ptolemaic systems.¹² Galileo's very precise language in the Latin text of the 1610 *Sidereus Nuncius* in explaining the etchings of the moon also clearly demonstrates that they are to be understood by the reader as evidentiary proof for his argument. The images were intended to help make his lunar observations and analyses of them credible, and demonstrable credibility was one thing that Copernicus's earlier heliocentric argument in the *De Revolutionibus orbium coelestium* (1543) lacked.¹³ Galileo used the Latin terms "figura," "imago," and "delineatio" to refer to the etchings as images, and his descriptive language of them is precise. Equally precise and remarkably varied are the verbs he used to convey the representational qualities of the images: "repraesentare," "exhibere," "delineare," "depingere," "describere," "commostrare," "imitare," and "adnotare." Each verb implies a similar demonstrative purpose, but the subtle distinctions between them suggest the depth of representational efficacy that Galileo wants them to impart to the reader. I include several passages here as each context in which the Latin words are used are specific to each image (emphasis in bold is mine):

...we have been led to the conclusion that we certainly see the surface of the Moon to be not smooth, even, and perfectly spherical, as the great crowd of Philosophers have believed about this and other heavenly bodies, but, on the contrary, to be uneven, rough and crowded with depressions and bulges. And it is like the face of the Earth itself, which is marked here and there with chains of mountains and depths of valleys. The observations from which this is inferred are as follows.

On the fourth or fifth day after conjunction, when the Moon displays herself to us with brilliant horns, the boundary dividing the bright from the dark part does not form a uniformly oval line, as would happen in a perfectly spherical solid, but is marked by an uneven, rough, and very sinuous line, **as the figure [here represents]**. (*SN*, 7v; van Helden, 40) (Figure 5).

Not only are the boundaries between light and dark on the Moon perceived to be uneven and sinuous, but, what causes even greater wonder, is that very many bright points appear within the dark part of the Moon, entirely separated and removed from the illuminated region

and located no small distance from it...**An example of this is shown in the same figure.** Now, on Earth, before sunrise, aren't the peaks of the highest mountains illuminated by the Sun's rays while shadows still cover the plain? (SN, 8v; van Helden, 42)

Meanwhile, I would by no means be silent about something deserving notice, observed by me while the Moon was rushing toward first quadrature, **the appearance of which is also [delineated] in the above [image].** For toward the lower horn a vast dark gulf projected into the bright part. (SN, 8v; van Helden, 42)

Also, in the tips of both the upper and lower horns, some bright points emerged, entirely separated from the rest of the light, **as [is seen depicted in the same figure].** (SN, 9r; van Helden, 43)

Moreover, in the Moon the large spots are seen to be lower than the brighter areas, for in her waxing as well as waning, on the border between light and dark, there is always a prominence here or there around these large spots, next to the brighter part, **as [we have paid attention to in depicting the figures]...**the brighter part stands out very much near the ancient spots, so that both before the first and near the second quadrature some huge projections arise around a certain spot in the upper, northern part of the Moon, both above and below it, **as the adjoining [delineations (lit., "sketches") reveal].**" (SN, 9v; van Helden, 44) (Figure 6)

Then, when the bright surface has decreased in size, as soon as almost this entire spot is covered in darkness, brighter ridges of mountains rise loftily out of the darkness. **The following figures clearly demonstrate this double appearance.** (SN, 10r; van Helden, 45)

There is another thing that I noticed not without some admiration and that I may not omit. The area around the middle of the Moon is occupied by a certain cavity larger than all others and of a perfectly round figure. I observed this near both quadratures, **and I have [imitated] it as far as possible in the second figure above.** (SN, 11r; van Helden, 47) (Figure 7)

In the large spots there are some darkish areas, **as we have [signified] in the figures,** but yet those always have the same appearance, and their darkness is not increased or abated. (SN, 11r-11v; van Helden, 47-48)¹⁴

As is clear from the above passages, Galileo intended the images to be equal partners in his intensely descriptive argument that was itself grounded in visual observation rather than in mathematical calculation. In addition to the empirical veracity Galileo attributed to his etchings, Mario Biagioli insightfully noted some years ago that, "for the first time in history, an optical instrument was used to furnish evidence about the materiality of the cosmos, the understanding of which had, until that point, derived almost entirely from philosophical thought."¹⁵ The rationalized observation of nature and the images Galileo was able to render with the aid of his telescope, fell squarely within the theoretical and practical goals of Florentine *Disegno*. Before addressing Galileo's moon drawings, the first edition etchings, and the *SNML* in greater detail, some contextual background on the Florentine *Accademia del Disegno* and Galileo's involvement there is necessary.

In 1563, duke Cosimo I de' Medici oversaw the foundation of the *Accademia del Disegno*. This was the first school of its kind for painters, sculptors, and architects, and it was officially incorporated with the old *Compagnia di San Luca*, a lay confraternity for artists.¹⁶ This cultural and political initiative reformed traditional shop and guild practices for artists in Florence that had been previously organized around professional affiliations, and it also established a new curriculum for the theory, practice, and teaching of art that was to last for generations and promote the primacy of a distinctive Tuscan manner in art. Furthermore, the academy's educational program also included the study of mathematics, natural philosophy, and anatomy, which were taught formally by professors or specialized lecturers in those areas.

With Michelangelo Buonarroti named in absentia as one of its titular heads, many of the ideals that also informed the *Accademia's* teaching principles were grounded in the concepts advocated by Leon Battista Alberti in his *Della Pittura* (1435), and most importantly in the theoretical construct of *Disegno* as it had been articulated by the philosopher, poet, and historian Benedetto Varchi and the painter, architect, and historian Giorgio Vasari in the mid sixteenth century. Although the word *disegno* had a variety of meanings between cities and workshops in Italy from the 14th through 16th centuries, its theoretical implications as defined in the artistic culture of Florence in the mid-sixteenth century was a "...cognitive process ,moving from perception of sensible particulars to a knowledge and understanding of universals."¹⁷ Based in a revision of Aristotelian theories of knowledge as articulated in the *Nicomachean Ethics* and *Metaphysics*, *Disegno* required the concept of practice, for the artist of *Disegno* needed the ability to render visually that which he knew intellectually together with that which he could see - and this was a skill that could only be acquired over time by exercising and training the hand and mind together.¹⁸

Varchi had provided the foundation for the theory of *Disegno* as a process of cognition in his public lectures at the Accademia Fiorentina in 1547, when he also lectured on Michelangelo's poetry and the relative nobility of the arts, the so-called *Paragone* debates.

Earlier Renaissance theorists, like Alberti, had argued that painting and sculpture were legitimately part of the liberal arts, and therefore "noble," through their dependence on geometry as a scientific means to reflect the order of nature and thus, higher truths. Varchi's lectures reoriented the 15th-century debate about the nobility of the arts to a direct association with philosophy, drawn largely from Aristotle's model of cognition in Book 6 of the *Nicomachean Ethics*, and he relocated the arts as belonging to what he called "universal reason" (*la ragione universale*) of the human soul, which itself was divided into "inferior" and "superior parts." As Barzman has noted, Varchi placed the visual arts within the lower part of universal reason and defined them as the consideration of how things come to be that are not necessary and whose origin is not - like things in nature - in themselves, but in their creator, that is, the artist.¹⁹

It is significant that within this scheme science and art belong to the same larger realm of "universal reason" occupying the superior, or speculative, and inferior, or practical, branches respectively. Giorgio Vasari, with the likely collaboration of Vincenzo Borghini, took Varchi's scheme and elaborated it in greater and more specific detail for the theory and practice of art in the *Accademia del Disegno* itself. And it was this formulation, developed within Varchi's Aristotelian theory of knowledge, that defined the making of and discourse about art for several generations of Florentine artists. In Vasari's definition of *Disegno* as a theoretical foundation for the *Accademia*, artists can only perceive the qualities of objects, which are apprehended visually not through line but rather through color and tone, which are also Aristotelian qualities of physical surfaces.²⁰ Galileo's choice to render his first observations of the moon in ink wash, a technique that is entirely about tonal gradations, rather than in line drawings in ink, chalk, or another graphic medium is telling in this respect and underscores his understanding of the visual properties of three-dimensional surfaces.

The study of mathematics was central to the pedagogical program at the *Accademia*, not only for knowledge of proportion and perspective, but also because the investigative study of visible world was believed to depend upon mathematics as the rationale structure of how the natural world was understood and theorized, much as the ancient Greeks had believed. Consequently, the incorporating statutes of the *Accademia del Disegno* called for a *lettore* in mathematics, which was not a permanent professor, but rather a lecturer in the discipline. As Barzman has shown, archival documents record the first *lettore* in mathematics as the Bolognese mathematician, PierAntonio Cataldi who began his professional career at the *Accademia* in 1569 or 1570. He was followed by the geographer and cosmographer, Ignazio Danti (brother of the sculptor, Vincenzo Danti) and then, Ostilio Ricci who taught there beginning in the late 1580s. Galileo had known Ricci and had attended his classes while he was a medical student at the University of Pisa. Documents also indicate that Galileo himself may have applied to teach mathematics at the *Accademia* in 1588, as the only available lectureship in Florence to which he refers in a letter of 1588 to the Marchese Guidobaldo del Monte (*una lezione pubblica*) was at the *Accademia del Disegno*.²¹ Although he became an official member of

the *Accademia del Disegno* in the early seventeenth century, Galileo's association with the institution and most likely its artists, dates to this earlier period. For mathematicians teaching at the *Accademia*, the practice of drawing would have served a variety of instructional purposes for the student artists, and the mathematical use of *Disegno* would have had practical and theoretical benefits. As Barzman has noted, "The drafting of circles, squares, triangles, complex three-dimensional forms including regular and irregular polyhedra, and shadows cast by these forms in ambient or projected light provided fundamental exercises that led to the development of a facility with the pen. They also engendered...a specific way of perceiving the world...[and] both facilities were considered essential in the representation of nature."²² The well-known illustrations of three-dimensional illuminated forms from Lorenzo Sirigatti's *La Pratica di Prospettiva* (1596), for example, (Figure 8), support the intersection of perspective, mathematics, and visual theory in the teaching of *Disegno* discussed above. Furthermore, as Sirigatti was also an active member of the *Accademia*, it is probable that Galileo knew Sirigatti and studied his book.²³

Sometime in 1642, the year of Galileo's death, Grand Duke Ferdinando II of Tuscany sponsored a scientific experiment. It was a contest between painters from the *Accademia* who were asked to draw the moon as they perceived it through one of Galileo's telescopes (although we don't know which one). The event was reported by Filippo Baldinucci (1625-1696) in his *Notizie de' professori del disegno da Cimabue in qua...*, who carefully uses the word *ritrarre*, which means to represent the object as it appears, rather than *imitare*, "to imitate" or represent the ideal, synthesized forms that do not exist in the natural, imperfect world. During the experiment, the artists were not allowed to look at each other's drawings and Baldinucci implies that its purpose was to determine which artist best understood the qualities of the moon's "marvelous spots" (*meravigliose macchie*), thus confirming the veracity of Galileo's discoveries through his use of the telescope.²⁴ As has been convincingly argued by Edgerton, Barzman, and Bredekamp, Galileo's discovery in 1609 about the "truth" of the irregular and imperfect lunar surface through his hand-made telescope, resided equally in his knowledge of *Disegno* with its fundamental grounding in mathematics as it was taught and theorized in the *Accademia*. In particular, the science of linear perspective with its specialized branch of shadow projection, for which facility in chiaroscuro drawing was essential, equipped him to recognize that the unsmooth surface of the moon and its illumination by raking sunlight was composed of peaks and valleys.

Furthermore, the young artists' understanding of these sciences in the *Accademia*, demonstrated by the experiment in 1642 mentioned above, would have led to a felicitous result for Grand Duke Ferdinando as reported by Baldinucci in validating new scientific knowledge that would be associated with Medici patronage and rule.²⁵ Of course the broader cultural and political schism resulting from Galileo's observations and his subsequently published texts like the *Dialogue Concerning the Two Chief World Systems* (1632) are well known, particularly as Catholic theology was grounded in a

belief that the surface of the moon, which was symbolically associated with the Virgin Mary, was "immaculate" and perfect.

It is within this history of the *Accademia* and understanding of *Disegno* that we can now turn to Galileo's moon drawings in the Biblioteca Nazionale, Florence, the etchings in the first edition of the *Sidereus Nuncius* (1610), and the *SNML* forgery. There has been much learned discussion and debate about the precise dates of Galileo's wash drawings, whether or not they preceded the etchings in the 1610 *Sidereus Nuncius*, the publication sequence of the book, how precise the drawings and etchings are in representing the moon in its particular phases, and when on the calendar Galileo would have observed the moon based on the drawings and etchings.²⁶ I will not rehearse or add substantively to these carefully argued and detailed discussions here. Rather, I want to concentrate on a few issues that underscore my point of departure and focus: the intersection of disciplinary competencies in the discovery and conveying of knowledge that Galileo's imagery represents. It is not just that Galileo knew and intersected with artists, or that he was a member of or possibly taught at the *Accademia del Disegno*. Nor is it just that as a scientist, his discoveries undoubtedly had a reciprocal impact on painters and the nature of the imagery they depicted in commissions representing theological and doctrinal themes. Ludovico Cigoli, for example, in painting his fresco of the *Virgin of the Immaculate Conception* in the Pauline Chapel of Santa Maria Maggiore, Rome (1612), boldly showed the Virgin standing on a moon with a cratered, irregular surface (Figure 9) and Andrea Sacchi, in his *Allegory of Divine Wisdom* in the Palazzo Barberini, Rome (1629-1631), represented the earth in orbit around a blazing sun that frames the personification of *Divine Wisdom* (Figure 10), to cite the most prominent examples.²⁷ It is rather in Galileo's moon drawings and also **(to a degree)** in the etchings, that we can see the representation of observational *and* ideated form synthesized - visions of the moon that both validated his argument about its observed nature and surface, and also illustrate the forger's failure in the *SNML* to duplicate that process, resulting in the unconvincing - one might say, meager - wash drawings in that forgery (Figure 4). Gingerich has rightly emphasized the imprecision and intentional exaggeration of some of the lunar features in the authentic drawings and 1610 etchings as being part of Galileo's visual argument in the *Sidereus Nuncius*: "The major thrust of Galileo's lunar work was not to provide an accurate map of the moon, but rather, to characterize the topography more generally: the idea of mountains and valleys, cratered areas and vast plains...Clearly Galileo is not as much interested in cartography as in topography. (sic) He wished to show the evidence for heights and depths, for mountains and plains, but the accidental placement of these features was of secondary importance to his argument."²⁸

Indeed, the inimitability of Galileo's imagery - more precisely, his "hand" and visual "style," as Bredekamp has called it - exemplifies Vasari's well-known admonition in the *Vite* to artists about never striving to duplicate another artist's achievement through copying, but rather seeking to arrive at the discovery of one's own manner - one's unique voice, so to speak - through the judicious study of art, nature, and the formal and

structural foundations that constituted them, such as mathematics, perspective, color, light and shadow, and anatomy. As Vasari described the results of *Disegno* when well-practiced in the trained hands of a talented artist in the 1568 edition of the *Vite*, striving to duplicate another artist's accomplishments always betrayed itself in the failure to communicate an idea with conviction and credibility through a visual expression and technique that was inauthentic, strained, and artificial.²⁹ In addition to the lunar drawings, several of Galileo's own sketches in his surviving notes, which are extensively reproduced and discussed by Bredekamp in *Galilei der Künstler*, illustrate well his well-trained hand and eye. (Figure 11) The quick figure sketches of a male and female nude in this example from Galileo's notes, for example, show clearly a spontaneous yet fluid use of the pen (particularly in the male nude) and the ability to render anatomical proportion, complex movement, and foreshortening with rapid yet precise strokes.

In his important 2009 essay, "The Curious Case of the M-L Sidereus Nuncius," Owen Gingerich presented a tightly argued and persuasive analysis of the publication sequence for the 1610 *Sidereus Nuncius* and the dating of the Galileo's lunar drawings in the Biblioteca Nazionale, along with an analysis of and comparison to the forged drawings in the *SNML*. He rightly concluded that the *SNML* drawings were counterfeit based on his observations of clear, technical inconsistencies in the representation of the lunar surface between the 1610 etchings and Florentine wash drawings, and the imagery of the *SNML* drawings: "The M-L image is a pastiche derived from elements both in the final etching and from the Florentine sheet (sic). In his attempt to link the drawings more firmly to Galileo the forger is caught by being too clever by half."³⁰ In the comparison illustrated in (Figure 12), it is clear that the forged drawing was based directly on the published etching of the same view, supplemented by weak imitative gestures of the original wash drawings in the Biblioteca Nazionale. As was subsequently revealed, the forgery was intended to represent a preliminary proof copy of the *Sidereus Nuncius* with wash drawings by Galileo on the pages where the final etchings would be placed. Complete proof copies, however, were exceedingly rare in publication practices during the 16th and 17th centuries largely owing to the expense of paper and labor. Furthermore, the forged drawings reveal themselves in replicating precisely the orientation of the etchings. Had they in fact served as models on which the etchings were then based, the etchings would have appeared in reverse orientation. The fact that Gingerich was subsequently proven correct in his assessment does not obviate the sensitive reading and analysis of Galileo's graphic imagery more generally by Bredekamp in *Galilei der Künstler*. Indeed, the 2014 installment in the *Galileo's O* series, *A Galileo Forgery - Unmasking the New York Sidereus Nuncius*, is a most fascinating example of scholarly re-evaluation by Bredekamp and his colleagues. Bredekamp's final reflection about the whole scholarly and analytical process, having begun with a false premise of authenticity, is worth quoting: "I have learnt, in a bitter way, what I knew before, but not in this concrete sense: that phenomena can be looked at from different perspectives and that from different viewpoints they tell completely different narratives."³¹

What all of this underscores, however, is the qualitative value and effectiveness of Galileo's moon drawings as expressive vehicles for communicating knowledge, and the inimitability of the graphic process that produced them -- and this process exemplifies the successful understanding and practice of Florentine *Disegno*. Furthermore, Galileo's use of ink wash to represent his observational knowledge was a deliberate and telling choice. Ink wash, as a medium, was intended for the representation of form and relief - *relievo* - in a tonal context, and was not generally for the rendering of detail or description, which was better shown through pen and ink, silver point, or charcoal, all of which were also taught in the curriculum of the *Accademia*. Any number of drawings by Galileo's contemporaries could serve to illustrate the medium of ink wash in this context, such as the study of a "Saint in Prayer" by Ludovico Cigoli (late 1500s) or Andrea Boscoli's study of the "Visitation" (late 1500s) (Figures 13, 14). In these drawings, broad tonal contrasts rendered with a brush articulate volumetric form while defining a clear light source through the effects of *chiaroscuro*, much as Galileo's moon drawings function. Form could of course also be suggested by line alone (provided one understands that line is semantic), but *chiaroscuro* more definitively distinguished the volumetric properties of three-dimensional form, and one of the hallmarks of a successful rendering in *chiaroscuro* was the *absence* of linearity. The transition, sometimes abrupt, between light and dark could suggest an illusion of linear demarcation through a difference in tone, but a good artist never rendered that demarcation explicitly through line.

Galileo's wash drawings have less the character of precise, cartographic images (even though the lunar phases represented have been astronomically confirmed as generally accurate), than they do more artful depiction of three-dimensional form seen and analytically understood. A few examples will suffice here to illustrate my point about *Disegno* and the inimitability of its results, which also reveals the forger's artistic error in the *SNML*. The clumsy dark outline, for example, around the crater in the forger's drawing betrays his lack of understanding of tonal gradations and the practice of *chiaroscuro* in a wash medium, both of which are elegantly and effectively demonstrated in Galileo's drawings (Figures 15, 16). Even in the etchings of the 1610 *Sidereus Nuncius*, there is little linearity as outline in tonal distinctions are largely created through the effects of *chiaroscuro*. In (Figure 17), for example, the tonal distinction along the terminator of the moon (the division between the dark and light sides) and within the large crater in the bottom third, are rendered through parallel lines and crosshatching rather than through a contour line or outline. The lack of convincing tonal gradation more generally in the forger's drawings stands in marked contrast to the well-modulated and controlled tonal range of Galileo's drawings, which create a much more convincing illusion of spherical three-dimensional form and its varied texture.

The medium of etching in the first edition of the *Sidereus Nuncius* also allowed for a freer stroke, analogous to a pen-and-ink drawing technique with which Galileo was adept,

that the slower and more precise technical requirements of an engraving did not allow. The freer movement and curved path of lines in the etchings within and around the sphere of the moon and its craters, even though a bit rough technically, is also the technique we see in many examples of drawings by artists in the Florentine/Tuscan tradition to help define and shape particular volumetric form graphically. In this context, the strokes we see defining the craters in the lower half of Galileo's etching (Figure 18), which follow the shape, depth, and curves of those forms are not dissimilar in concept and effect to many pen and ink drawings of figures by Michelangelo, Raphael, Vasari and others whose style and technique became models for emulation within the *Accademia*. Michelangelo's study of a figure for the "Battle of Cascina" is a particularly good example for comparison with Galileo's etching (Figure 19). That Galileo likely did these first etchings himself is not only supported by the rather rough quality of some of the prints and the breakneck speed at which the first edition was printed and assembled, but also by passages in his well-known letter to Grand Duke Cosimo de' Medici II in March 1610 in which he outlines plans for a second, improved and expanded edition with better quality images.³² Although never realized, this second edition was to be in Italian (*lingua toscana*) and, as Galileo says: "...I want to draw the phases of the moon for an entire period with the greatest diligence (*grandissima diligenza*), and represent them meticulously, because in truth, it is a sight of greatest wonder; and I had thought to have everything engraved in copper by an excellent artist..."³³ Importantly, this second edition was envisioned to have engraved images rather than etchings. *Tagliare in rame* (the phrase Galileo used in the above-cited letter) was the phrase used to indicate engraving in the 16th century, especially in the discourse around the Venetian printing presses, the locus for the production of the 1610 *Sidereus* edition. That they were to be executed by an "excellent artist" (engraver: *artefice eccellente*), seems also to imply that Galileo did not consider himself, or at least the etchings in the first Venetian edition, to be commensurately skilled.

Galileo's wash drawings that survive - and to a certain degree, the etchings in the first edition of the *Sidereus Nuncius* - exemplify drawing as rationalized observation for the representation of knowledge and ideas as it had been conceived and practiced by Florentine artists during the previous two centuries, and which had been institutionalized in curriculum of the *Accademia del Disegno*. There is no doubt, in my view, that the drawings and etchings are in Galileo's hand, despite recent speculation to the contrary as I noted above. Bredekamp and his colleagues - despite their misattribution - provided the great service of investigating the *SNML* in minute detail along with a rigorous analysis of Galileo's imagery. In the forger's failure to grasp the visual representation of observed nature in Galileo's imagery in the *SNML*, lies its efficacy as a means for conveying the discovery of knowledge.

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Notes

¹ This essay is an expanded version of a paper I delivered at the Museo Galileo in Florence as part of the conference, *Genius Loci: Florence and Galileo*, sponsored by Florence University of the Arts and Stony Brook University, in November, 2014. I must thank here the faculty and staff of FUA and Stony Brook for an impeccably organized and stimulating conference. In particular, Prof. Jamie Lynch, Provost of FUA, Prof. Mario Mignone, Conference Coordinator for Stony Brook, and Prof. Thomas Brownlees, Academic Manager and Conference Coordinator for FUA. My thanks also to Prof. Filippo Camerota, Director of Museo Galileo and Prof. Wolf Shafer of Stony Brook University for their helpful comments and questions.

² Isaiah Berlin, "The Divorce Between the Sciences and the Humanities," in *Isaiah Berlin - The Proper Study of Mankind*, eds., Henry Hardy and Roger Hausheer, New York: Farrar, Straus and Giroux, 2000, pp. 326-358.

³ See, for example, Martin Kemp, *The Science of Art: Optical Themes in Western Art from Brunelleschi to Seurat*, New Haven: Yale University Press, 1990; John L. Heilbron, *The Sun in the Church - Cathedrals as Solar Observatories*, Cambridge: Harvard University Press, 2001; Lyle Massey, *Picturing Space, Displacing Bodies: Anamorphosis in Early Modern Theories of Perspective*, University Park, PA.: Pennsylvania State University Press, 2007; Timothy Reiss, ed., *Science, Language and the Perspective Mind: Studies in Literature and Thought from Campanella to Bayle*, New Haven: Yale University Press, 1973; Pietro Roccasceca, "Evidenze materiali per una storia della prospettiva nella pittura italiana su tavola del XV secolo: indagine su un campione di dipinti della National Gallery of Art di Washington," in *L'artiste et l'oeuvre à l'épreuve de la perspective*, eds., Marianne Cojannot-Le Blanc, Marisa Dalai Emiliani, and Pascal Dubourg Glatigny, Rome: Collection de l'École Française de Rome, no. 364, 2006, pp. 323-351; Carlo Pedretti and Gibson Reaves, "Leonardo da Vinci's Drawings of the Surface of the Moon," *Journal for the History of Astronomy*, no.1, Feb. 1987, pp. 55-58; Hans Belting, *Florence and Baghdad: Renaissance Art and Arab Science*, Cambridge: Harvard University Press, 2011. This list is by no means exhaustive. More generally, see also, George Saliba, *Islamic Science and the Making of the European Renaissance*, Cambridge: MIT Press, 2011, and Christiane L. Joost-Gaugier, *Measuring Heaven - Pythagoras and His Influence on Thought and Art in Antiquity and the Middle Ages*, Ithaca: Cornell University Press, 2006.

⁴ Erwin Panofsky, "Galileo as a Critic of the Arts - Aesthetic Attitude and Scientific Thought," *Isis*, vol. 47, no.1 (March, 1956), pp. 3-15.

⁵ Miles Chappell, "Cigoli, Galileo, and Invidia," *The Art Bulletin*, vol. 57, no.1 (March, 1975), pp. 91-98; Samuel Edgerton, "Galileo, Florentine 'Disegno,' and the 'Strange Spottedness' of the Moon," *Art Journal*, vol. 44, no. 3, (Autumn, 1984), pp. 225-232; Steven Ostrow, "Cigoli's Immacolata and Galileo's Moon: Astronomy and the Virgin in Early Seicento Rome," *The Art Bulletin*, vol.78, no.2 (June, 1996), pp. 218-235; Eileen Reeves, *Painting the Heavens: Art and Science in the Age of Galileo*, Princeton: Princeton University Press, 1997; David Freedberg, *The Eye of the Lynx: Galileo, His Friends, and the Beginnings of Modern Natural History*, Chicago: University of Chicago Press, 2002.

⁶ See, for example, Horst Bredekamp, "Zwei frühe Skizzenblätter Galileo Galileis," in *Ars naturam adiuvans: Festschrift für Matthias Winer zum 11 März 1996*, eds., Victoria von Flemming and Sebastian Schütze, Mainz: P. von Zabern, 1996, pp. 477-484; idem, "Gazing Hands and Blind Spots: Galileo as Draftsman," in *Galileo in Context*, ed., Jürgen Renn, New York: Cambridge University Press, 2001, pp. 153-193; idem, "Die Evidenz des Stiles: Galileis Sonnenflecken," in *Evidentia*, eds., Gabriele Wimböck, Karin Leonhard, and Markus Friedrich, Series: Pluralisierung et Autorität, no.9, 2007, pp. 291-308; idem, *Galilei der Künstler: der Mond, die Sonne, die Hand*, Berlin: Akademie Verlag, 2007; idem, "I molteplici volti del 'sidereus nuncius,'" in *Il cannocchiale e il pennello*, eds., Lucia Tomasi Tongiorgi and Alessandro Tosi, Florence, 2009, pp. 165-173; idem, "Style Matters: Galileo's Collaboration with Ludovico Cigoli," in *Medieval Renaissance Baroque*, eds., David A. Levine and Jack Frieberg, New York, NY: 2010, pp. 111-128; idem, Irene Brückle, Oliver Hahn, and Paul Needham, *Galileo's O*, 3 vols., Berlin: Akademie Verlag, 2011-2014 (vol. 1: *Galileo's Sidereus Nuncius: a comparison of the proof copy (New York) with other paradigmatic copies*; vol. 2: *Galileo makes a book: the first edition of Sidereus Nuncius, Venice, 1610*, Paul Needham; vol. 3: *Forgery: unmasking the New York Sidereus Nuncius*); idem, *Galileis denkende Hand: Form und Forschung um 1600*, Berlin/Boston: De Gruyter, 2015. I have not yet seen this most recent volume, which claims to be a fundamental revision of *Galilei der Künstler* with respect to the forgery (2007).

⁷ For the most insightful review of *Galilei der Künstler*, see Michael Cole in *The Art Bulletin*, September, 2009, vol. 91, no. 3, pp. 381-384. Cole suggested that the drawings in what was later revealed as a forgery, the *SNML*, might not be authentic as did other reviewers, for which see, Stefano Gattei in *Nuncius*, vol. 21, Issue 2, 2012, pp. 423-435. See below, n. 25, "The Curious Case of the *M-L Sidereus Nuncius*," for the definitive argument challenging the authenticity of the *SNML* drawings made by Owen Gingerich in 2009. Nick Wilding's recent review of *A Galileo Forgery...* in *Renaissance Quarterly*, vol. 67, no. 4, Winter, 2014, pp. 1337-1340, although informed and critically astute, is also unnecessarily dismissive of art history as a discipline. He suggests that since Bredekamp got it wrong, art history and its methodologies are wrong: "To put it bluntly, as has been done in the German press: if one of the world's foremost art historians is incapable of seeing the difference between a 1610 drawing by Galileo and a 2005 forgery, what does that say about art history (or art historians)?" p. 1338. See also, Wilding, review of volumes 1 & 2 of "Galileo's O," *Renaissance Quarterly*, vol. 65, no. 1, Spring, 2012, pp. 218-218 where he expressed doubt about the authenticity of the *SNML*. For a comprehensive account of the forgery and its exposure, see Nicholas Schmidle, "A Very Rare Book - The Mystery Surrounding a Copy of Galileo's Pivotal Treatise," *The New Yorker*, December 16, 2013, pp. 63-73. See also, Albert Van Helden, "Unmasking a Galileo Forgery - Essay Review," *Journal for the History of Astronomy*, vol. 45, no. 3, 2014, pp.361-376.

⁸ Note: All images for this article are available at <http://blogs.dickinson.edu/schlittgalileo/>

⁹ See Edgerton and Ostrow, above n.5. See also, Karen-edis Barzman, *The Florentine Academy and the Early Modern State - the Discipline of Disegno*, New York: Cambridge University Press, 2000, pp. 154-159.

¹⁰ Filippo Camerota relayed this new speculation to me at the FUA conference, 2014, with Cigoli having been proposed by some art historians as the most likely artist. See Gingerich, "The Curious Case...", n. 25. The evidence for the authenticity of Galileo's wash drawings - stylistically, materially, and comparatively - far outweighs any reasonable argument against it. Bredekamp and Gingerich make the strongest and most recent cases for the authenticity of the drawings.

¹¹ All Latin quotations are from the 1610 edition. Galileo Galileo (sic) Patritio Florentino, *Sidereus Nuncius...*, Venetiis, Apud Thomam Baglionum, 1610, 11r. English translations with my modifications indicated in brackets [] are from Albert van Helden, trans. and ed., *Sidereus Nuncius or The Sidereal Messenger - Galileo Galilei*, Chicago and London: University of Chicago Press, 1989.

¹² Thomas S. Kuhn, *The Structure of Scientific Revolutions*, third edition, Chicago and London: The University of Chicago Press, 1966, pp.118-125.

¹³ On Copernicus's argument and its critical fortune in the 16th and 17th centuries, see Owen Gingerich, *The Book Nobody Read - Chasing the Revolutions of Nicolaus Copernicus*, New York, N.Y.: Walker & Company, 2004.

¹⁴ I have preserved all orthographic inconsistencies as they appear in the 1610 edition.

...in eam deducti sumus sententiam, ut certò intelligamus, Lunae superficiem, non perpositam, aequabilem, exactissimaeque sphaericitatis existere, ut magna Philosophorum coors de ipsa, dequè reliquis corporibus coelestibus optinata est, sed contra inaequalem, asperam, cauitatibus, tumorisubque confertam, non fecus, ac ipsiusmet Telluris facies, quae montium iugis, valliumquè profunditatibus hincindè distinguitur. Apparentiae verò ex quibus haec colligere licuit eiusmodi sunt.

Quarta aut quinta post coniunctionem die, cum splendidis Luna sese nobis cornibus offert, iam terminus, partem obscuram à luminosa diuidens, non aequabiliter secundum oualem lineam extenditur, veluti in solido perfectè sphaerico accideret; sed inaequabili, aspera, & admodum sinuosa linea designatur, veluti apposita figura repraesentat. (SN, 7v)

Verum non modo tenebrarum & luminis confinia in Luna inaequalia, ac sinuosa cernuntur, sed, quod maiorem infert admirationem, permultae apparent lucidae cuspides intra tenebrosam Lunae partem omnino ab illuminata plaga diuisae, & auulsae, ab eaque non per exiguam intercapedinem dissitae, quae paulatim aliqua interiecta mora magnitudine, & lumine augentur;...Huius exemplum eadem figura nobis exhibet. At non ne in terris ante Solis exortum, umbra adhuc planities occupante, altissimorum cacumina montium Solaribus radijs illustrantur? (SN, 8v)

Interim silentio minimè inuoluam quid animaduersione dignum à me observatum dum Luna ad primam quadraturam properaret, cuius etiam imaginem eadem supra posita delineatio praesefert; ingens enim finus tenebrosus in partem luminosam subit, versus inferius cornu locatus; (SN, 8v)

In extremis quoque cornibus tam superiori, quam inferiori splendida quaedam puncta, & omnino à reliquo lumine disiuncta emergebant; veluti in eadem figura depictum cernitur. (SN, 9r)

Depressiores in super in Luna cernuntur magnae maculae, quam clariores plagae; in illa enim tam crescente, quam decrescente semper in lucis tenebrarumque confinio, prominente hinc indè circa ipsas magnas maculas contermini partis lucidioris; veluti in describendis figuris obseruauimus;...Lucidior verò pars maximè propè maculas eminet; adeò vt, & ante quadraturam primam, & in ipsa fermè secunda circa maculam quandam, superiorem, borealem nempè Lunae plagam occupantem valdè attollantur tam supra illam, quam infra ingentes quaedam eminentiae, veluti appositae praeferunt delineationes. (SN, 9v)

Imminuta deinde luminosa superficie, cum primum tota fermè dicta macula tenebris est obducta, clariora motium dorsa eminenter tenebras scandunt. Hanc duplicem apparentiam sequentes figurae commostrant. (SN, 10r)

Vnum quoque obliuioni minimè tradam, quod non nisi aliqua cum admiratione adnotauit: medium quasi Lunae locum à cauitate quadam occupatum esse reliquis omnibus maiori, ac figura perfectae rotunditatis; hanc prope quadraturas ambas conspexi eandemque in secundis supra positis figuris quantum licuit imitatus sum. (SN, 11r)

...at in magnis maculis existunt quidem areolae nonnullae subobscurores veluti in figuris adnotauimus, attamen istae eundem semper faciunt aspectum, neque intenditur earum opacitas, aut remittitur...(SN, 11r-11v)

¹⁵ See Steven Ostrow, "Cigoli's Immacolata and Galileo's Moon...", p. 224, n. 5 above, where Biagoli's observation is paraphrased from a paper he delivered in 1994 at University of California, Riverside. The scholarly literature on Galileo's work, life, and conflict with the Church of Rome is vast, and I am indebted to the work of many others who are experts in these areas. See, for example, the still fundamental work by Stillman Drake, *Dialogue Concerning the Two Chief World Systems*, Berkeley: University of California Press, 1967; idem., *Galileo at Work: His Scientific Biography*, Chicago: University of Chicago Press, 1978; idem., *Galileo: Pioneer Scientist*, Toronto: University of Toronto Press, 1990; idem., *Essays on Galileo and the History and Philosophy of Science*, eds., N.M. Swerdlow and T.H. Levere, Toronto/Buffalo: University of Toronto Press, 1999; Jerome Langford, *Galileo, Science, and the Church*, 3rd edition, Ann Arbor: University of Michigan Press, 1992; Thomas B. Settle, "Galileo's Experiment as a Tool of Investigation," in *Galileo - Man of Science*, ed. Ernan McMullin, New York, N.Y.: 1968, pp. 315-337; Mario Biagoli, *Galileo, Courtier: the Practice of Science in the Culture of Absolutism*, Chicago: University of Chicago Press, 1993; idem., *Galileo's Instruments of Credit: Telescopes, Images, Secrecy*, Chicago: University of Chicago Press, 2006; Paolo Galluzzi, *Momento: Studi Galileiani*, Rome: 1979; Owen Gingerich, op.cit., n. 25 below, among many other essays; Numerous studies by Gingerich have appeared over the past

ten years in *Galileana - Journal of Galilean Studies*, Istituto e Museo di Storia della Scienza, Florence: Leo S. Olschki, 2004-present.

¹⁶ Karen-edis Barzman, "Perception, Knowledge, and the Theory of *Disegno* in Sixteenth-Century Florence," in *From Studio to Studiolo - Florentine Draftsmanship Under the First Medici Grand Dukes*, ed., Larry J. Feinberg, Seattle and London: Oberlin College/University of Washington Press, 1991, pp. 37-48; 38. For the history of the *Accademia*, I draw heavily here on the fundamental work of Barzman. Her archival research and contextual interpretation remains unsurpassed in the scholarly literature. See also, *idem.*, *The Florentine Academy and the Early Modern State: The Discipline of Disegno*, New York, N.Y.: Cambridge University Press, 2000, and Robert Williams, *Art, Theory, and Culture in Sixteenth-Century Italy: From Techne to Metatechne*, New York, N.Y.: Cambridge University Press, 1997, ch. 1, "Vasari's Concept of *Disegno*," pp. 29-72.

¹⁷ Barzman, "Perception, Knowledge...", p. 37.

¹⁸ Barzman, *The Florentine Academy...*, pp. 143-148.

¹⁹ Barzman, *The Florentine Academy...*, pp. 146-150. See p. 147 for a useful scheme of Varchi's restructuring of Aristotle's ordering of the Human Soul. See also, Leatrice Mendelsohn, *Paragoni: Benedetto Varchi's 'Due lezioni' and Cinquecento Art Theory*, Ann Arbor: UMI Research Press.

²⁰ Barzman, *The Florentine Academy...*, p. 145. For Vasari's declarative statement of the theory of *Disegno*, see Giorgio Vasari, *Le vite de' piú eccellenti pittori, scultori, ed architettori, scritte da M. Giorgio Vasari Pittore e Architetto Aretino di nuovo ampliate, con i rtratti loro, et con l'aggiuntat delle vite de' vivi ed d' morti, dall'anno 1550 inson al 1567*, ed. Gaetano Milanese, Florence: Sansoni, 1981, vol.1, pp. 168-169 ("Della Pittura").

²¹ See Barzman, *The Florentine Academy...*, pp. 151-159 for mathematics and Galileo's involvement; p. 154 for the letter to the Marchese.

²² Barzman, *The Florentine Academy...*, p. 156.

²³ See Edgerton, "Galileo...", p. 226.

²⁴ See Filippo Baldinucci, *Notizie de' professor del disegno da Cimabue in qua, per le quali si dimostra come e per chi le bell'arti di pittura, scultura, e architettura lasciata la rozzezza delle maniere greca, e gottica, si siano in questi secoli ridotte all'antica loro perfezione*, Florence: Franchi et.al., 1681-1728, Florence, Rinalli Reprint, 1974-75, vol. 5, pp. 30-31.

²⁵ See Baldinucci, *Notizie de' professor del disegno da Cimabue in qua...*, and Barzman, *The Florentine Academy...*, pp. 157-159.

²⁶ See Paul Needham, *Galileo makes a book...*, n. 6 above; Owen Gingerich, *Dissertatio cum Professore Righini et Sidereo Nuncio*, in *Reason, Experiment and Mysticism in the Scientific Revolution*, eds., Maria Luisa Righini Bonelli and William Shea, New York, N.Y.: Science History Publications, 1975, pp. 77-88; Owen Gingerich and Alberti van Helden, "From Occhiale to Printed

Page: The Making of Galileo's *Sidereus Nuncius*," *Journal for the History of Astronomy*, vol.34, 2003, pp. 251-267; Owen Gingerich, "The Curious Case of the M-L *Sidereus Nuncius*," *Galileana - Journal of Galilean Studies*, vol.6, 2009, pp. 141-165; Ewan A. Whitaker, "Galileo's Lunar Observations and the Dating of the Composition of the '*Sidereus Nuncius*,'" *Journal for the History of Astronomy*, vol.9, 1978, pp. 155-169.

²⁷ See Ostrow, "Cigoli's Immacolata...", and Reeves, *Painting the Heavens*. Anna Ottani Cavina had suggested that Adam Elsheimer had reworked his now-famous oil on copper painting of *The Flight into Egypt* in 1610 after the publication of the *Sidereus Nuncius*, as he showed the Milky Way composed of individual stars and the moon's surface in extraordinary detail. (Cavina, "On the Theme of Landscape - II: Elsheimer and Galileo," *The Burlington Magazine*, vol.118 (876), 1976: 139-145. This suggestion, however, has been disputed by Keith Andrews for which see, *Adam Elsheimer: Paintings, Drawings, Prints* (Oxford: Phaidon, 1977). See also Deborah Howard, "Elsheimer's Flight into Egypt and the Night Sky in the Renaissance," *Zeitschrift für Kunstgeschichte*, no.55 (2): 212-224.

²⁸ Gingerich, "The Curious Case...", p. 144; 152. See especially, pp. 146-152.

²⁹ There are several passages in Vasari's *Vite* that underscore these principles. For some of the more extended and detailed passages, see the lives of Raphael (Vasari/Milanesi, vol.4, pp.311-416; especially 373-379), Francesco Salviati (vol. 7, pp. 5-47), and Michelangelo (vol. 7, pp. 135-404).

³⁰ Gingerich, "The Curious Case...", p. 163.

³¹ Bredekamp, et.al., *A Galileo Forgery...*, p. 102.

³² Also see Bredekamp, *Galilei der Künstler...*, and Gingerich, "The Curious Case...", for the convincing argument that Galileo did his own etchings for the 1610 edition.

³³ "Io poi vo descrivendo altre costellazioni, et voglio disegnare le faccie della [luna] di un periodo intero con grandissima diligenza, et imitarle a capello, perchè in vero è una vista di grandissima meraviglia; et il tutto ho pensiero di far tagliare in rame da artefice eccellente, il quale ho di già appostato et incaparrato..." *Le Opere di Galileo Galileo: Edizione Nazionale sotto gli auspicii di Sua Maestà il re d'Italia*, eds., A. Favaro, I. Del Lungo, V. Cerruti, G.V. Schiaparelli, G. Govi, U. Marchesini, V. Lami, 20 vols., Florence: G. Barbèra, 1890-1909, vol. 10, n. 277, p. 300.