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DELLA PORTA, COLONNA, AND FONTANA: THE ROLE OF NEAPOLITAN SCIENTISTS AT THE BEGINNING OF THE TELESCOPE ERA

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Abstract: Giovan Battista Della Porta is best known for his theory of experimental science; Fabio Colonna is well-known for his botanical studies; and Francesco Fontana for his powerful telescopes and the exact observations of the Moon and planets, particularly of Mars. All three were interested in astronomy. But when were the first observations in Naples? And what did they observe? And by whom? This paper, based on the correspondence of the protagonists, attempts to retrace the events of the first Neapolitan astronomical observations.

Keywords: telescopes, astronomical observations, Giovan Battista Della Porta, Fabio Colonna, Francesco Fontana

1 INTRODUCTION

The role of Galileo Galilei in the technological development of lenses and telescopes, along with his primary role in defining a method to explain and decode natural phenomena, has been studied and analyzed by many authors over the past four hundred years. Just as Galileo's astronomical observations of planets, satellites, sunspots and stars opened new frontiers in the study of the cosmos, the multitalented figure of Giovan Battista della Porta played a central role in many fields of scientific, alchemical and literary knowledge. The charisma of Galileo and della Porta went beyond national borders and helped to give great prestige to the Accademia dei Lincei. Moreover, the optical studies of Della Porta contributed to, if not anticipated, the development of technologies for the construction of the first optical devices, leading up to the telescope, as he stated in a letter to Federico Cesi. Although primarily interested in botany, Fabio Colonna had an experimental approach to the sciences and natural phenomena, so much so that he was also interested in optics and astronomy. Finally, Francesco Fontana, a much discussed scientist who made telescopes and astronomical observations, aroused great interest and some envy.

The scientific debate in Naples in the first half of the seventeenth century appeared Manichaean and vain in its extreme contrast between modernity and obedience to the scholastic tradition. The presence in Naples of Della Porta, Colonna, and Fontana as well as Campanella, Imparato and Stelliola, revived the Neapolitan panorama of cultural and philosophical discussion. The collaboration between the elderly 'Della Porta Mago' and the young botanist Colonna produced interesting developments in the construction of both Galilean telescopes and those of a new optical design, the so-called 'Keplerians'. Studies and the advancements presented by Della Porta and Colonna merged with the great skills of Fontana, an obscure Neapolitan personality who has been talked about for decades because of his instruments and scientific results.

Based on the original documents and correspondence of the Neapolitan scientists, this paper traces the first steps in the development of astronomy and optical technology in Naples, a short but exciting period characterised by great enthusiasm and interesting scientific results.

2 THE TELESCOPE OF GALILEO GALILEI

"Mister Galileo of Galilei family, true mentor of the mathematical sciences, and highest professor of his studies for students in the University of Padua." (Gagliardi, 1608).[1] This is the heading of a dedication written by the jovial Padua poet and painter Giuseppe Gagliardi in March 1608. At this time Galilei (1564–1642; Figure 1) was undoubtedly a revered Professor at the University of Padua and an excellent manufacturer of mathematical instruments. He knew ancient and modern astronomical theories, confiding to Kepler that he had "… embraced Copernicus' opinion already for many years …" (Galilei, 1597), and he corresponded with Tycho Brahe about different cosmological hypotheses (Brahe, 1600). Galilei began practicing astronomy towards the end of October 1604, following the appearance of Kepler's Supernova in Serpens.

This extraordinary event, the second after the supernova of 1572 observed by Tycho Brahe in Cassiopeia, marked the beginning of Galilei's great interest in the study of the cosmos. He delivered three passionate lectures at the University of Padua about this unusual astronomical event (Rosino, 1995: 16–17) in the presence of very large audiences:

> On 10 October 1604 a certain strange light was first observed in the heavens ... ooh guys! Many of you rushed here to listen to my dissertation, you are witnesses of this marvellous appearance, [you stay here] with

> great care and unanimous interest to learn the substance, the motion, the place and the reason for that appearance. Desire amazing and worthy of your minds, my goodness! (Galilei, 1604).

With his instruments and observations, the Tuscan scholar would transform the ancient science of the heavens into the 'new astronomy'.

The tale of the first telescope made by Galilei is told in a letter that Galilei wrote to his brother-in-law Benedetto Landucci (1569–?) on 29 August 1609, four days before he presented this instrument to the Doge and the Venetian Senate:

> I haven't written to you after receiving the wine you shipped to me because of the lack of arguments, I write to you now ... Therefore you must know that about two months ago the fame of a spyglass presented in Flanders to Count Maurice has here spread, it is made in such a way that very distant things appear quite close, so that a man can be distinctly seen two miles away ... It seemed to me that having to rely on the perspective science, I began thinking how to make it, finally I found the manner, and I have made one so perfectly that it far exceeds the reputation of the Flanders one. (Galilei, 1609).

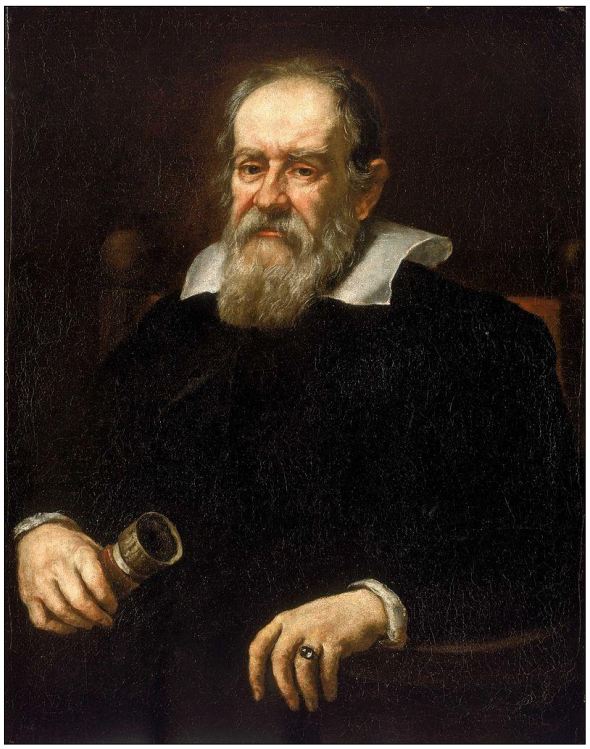

Figure 1: A painting of Galileo Galilei by Justus Sustermans in 1636, now in the National Maritime Museum, London (https://commons.wikimedia.org/wiki/File:Justus_Sustermans_-_Portrait_of_Galileo_Galilei,_1636.jpg).

Commenting on the news of the spyglass, Paolo Sarpi (1552–1623) wrote to Francesco Castrino (ca.1560–1630) that he considered it uninteresting and not really useful:

> In Italy we haven't news, except the appearance of the eyepiece showing things far away, I admire it very much for the beauty of the invention and for the dignity of art, but I do not consider it useable both in terrestrial or maritime war. (Sarpi, 1609).

In scientific literature there were many well-known examples about the idea and the concept of using lenses that magnified distant objects. Almost certainly the oldest text describing the magnifying effects of 'refracted light' was the *Opus Majus* by Roger Bacon written in 1267, in which the English philosopher and scientist says:

> Thus from an incredible distance we may read the smallest letters, and count the smallest grains of dust and sand owing to the magnitude of the angle under which we viewed them ... So also we might cause the Sun, Moon and stars in appearance to descend here below, and similarly to appear above the head of our enemies. (Bacon, 1733: 357).

In the sixteenth century, Girolamo Fracastoro (1538: 58) dealt with the topic of reflected and refracted light in the volume *Homocentrica* published in 1538, where he wrote that the use of lenses would make the Moon and the stars appear very near and not farther off than the tops of towers. Leonardo da Vinci argued in his studies on optics about some devices that allowed him "… to see the Moon enlarged …" (Da Vinci: 518r). Finally, Francesco Sizzi, a bitter opponent of Galilei, wrote that Pope Leo X held an excellent telescope, allowing him to clearly observe from Florence the birds flying in the mountains of Fiesole (Sizzi, 1611: 57r).

The first document attesting the use of a telescope is a report to Prince Maurice of Nassau (1567–1625), Stadtholder of the States General of the Hague, of a visit in 1608 by a Siamese diplomatic delegation.[2] In the presence of Ambrogio Spinola Doria (1569–1630), a Genoan General, the optician Hans Lippershey (1570–1619) showed how his 'optical tube' allowed one to see objects 12–16 km away as though they were in the foreground. In mid-September 1608, Lippershey applied for the patent for his device,[3] and fifteen days later Jacob Metius (ca.1571–1628), another Dutch instrument-maker, did the same (*Minute Book …*, 1608a: 169r; *Minute Book …*, 1608b: 178v). Although Lippershey's request was not approved—the Commission asked him to improve the spyglass to make it suitable for binocular observation—the States General of the Hague ordered three samples of the 'Dutch perspective glass'. News of the device spread rapidly throughout Europe, and in April 1609 some French magazines, such as *Le Mercure François* and the *Journal du Regne de Henry IV*, reported that many Parisians were interested,

with the glasses, "… allowing people to see distant objects clearly." (*Le Mercure …*, 1611: 338v–339r; cf. De L'Etoile, 1741: 513– 514).

The telescope also became a stylish element for distinguished men in paintings done at this time, such as General Spinola at the Breda fortress in the canvas of Diego Velasquez (ca. 1624), and Archduke Albert VII of Habsburg in the painting by Pieter Bruegel the Elder (ca. 1609). The telescope seemed to be a status symbol that was flaunted, as in *The Allegory of the Vision* by Bruegel (1617) and Paul Rubens (1617). In these paintings, the spyglasses appear to be decorative objects to show off in society, or a new garden 'divertissement'. Even the first known astronomical observation, made by Thomas Harriot (1560–1621) seemed more like a logbook note to remember a night spent with the "… silvery face of the beautiful Cynthia." (Capocci, 1857: 11). In the London house of the Earl of Northumberland, this prolific mathematician and shrewd astronomer who studied Halley's Comet in 1607, observed the Moon on 26 July 1609 and made a small portrait of it. Although the sketch was very simple, it was interesting to understand the real capabilities of the lenses. It showed that the terminator and the contours of the main craters were somewhat uncertain. It would be Galileo's observations, made in the last weeks of 1609, that showed the 'true' face of the Moon, the irregularities of its surface, the craters, mountains and valleys:

> When I gave up observation of terrestrial objects, I turned my attention to the celestial bodies; and first I saw the Moon so close as if it was barely two terrestrial diameters distant. After that, with incredible delight I observed several times the stars fixed as well as wandering; and when I saw their very great number, I began to study the method by which I might be able to measure their distances, and I finally found it. (Galilei, 1610: 6r–v).

Galilei's observations were not only phenomenal but they immediately created incredible enjoyment for the soul. Galilei analyzed the observational data, studied the physical aspects, and refined his investigation techniques. The scientific method applied to the analysis of the cosmos was born. Modern astronomy was born!

3 THE EARLIEST ASTRONOMICAL OBSERVATIONS MADE IN NAPLES

Who invented the telescope? Galileo? Lippershey? Or was the telescope invented 'ex nihilo', as van Helden (1977) writes? In Naples, Giovan Battista Della Porta and Francesco Fontana both claimed to have conceived and built telescopes. Did the city of the mermaid Parthenope provide a fruitful background to stimulate such scientific and technological developments?

Throughout the sixteenth and seventeenth centuries Naples and its Kingdom were under viceroy control from Austria and Spain and the cultural and academic fabric was conditioned by imperial rule, transforming the 'very noble Naples' into the 'very loyal Naples', as the historian Giuseppe Galasso (1996) defines these sweeping changes in an insightful analysis of that era. Scholastic doctrine was the beacon of cultural debate, including the scientific one. The tradition of the great academies of Giovanni Pontano and Jacopo Sannazaro appeared blurred by sectarian meetings more inclined to "… vain pompous rumours … [than to] useful and elevated readings." (Cesi, 1616). The fertile ground to promote a scientific debate in Naples, like the rest of Europe, could be found in some private circles and academies such as the Oziosi of Giovan Battista Manso (1567–1645), the Secrets of Della Porta, and the Lincei.

Figure 2: The frontispiece of *Magiae Naturalis* (Lugduni Batavorum, 1650) with a portrait of Giovan Battista della Porta.

Among the personalities who animated these assemblies, men like Giovan Battista Della Porta, Fabio Colonna, Ferrante Imperato, Marco Aurelio Severino and Niccolò Stelliola were known

beyond Neapolitan borders. They imposed themselves as representatives of the physical, medical and botanical sciences. To the circles of these prestigious scientists, we can add Francesco Fontana, who attracted the worthy consideration of most astronomers of the time because of his telescopes and observations.

Giovan Battista Della Porta (ca.1535–1615; Figure 2) was a scientist who "… with the fast wings of the mind …" (Crasso, 1666: 170) investigated various aspects of physics: alchemy, astrology, physiognomy and optics. He engaged in many philosophical and scientific discussions with Tommaso Campanella, until they held a public debate in 1589 in the monastery of San Domenico, in the room where Thomas Aquinas con-

Figure 3: An etching of Fontana's portrait printed in his *Novae Colestium Terrestriumque Observationes ...*

ducted his lessons. In his best known volume, *Magiae Naturalis*, published first in 1558 and reprinted in 1589,[4] Della Porta deepened his studies of optics, including the configuration of different kinds of lenses, both concave and convex, and exhorted: "… if you know how to use them correctly together, you will see things, both nearby and in the distance, clearly and enlarged." (Della Porta, 1611: 647).

We do not know if Della Porta had access to the Dutch optical tube, but when he was aware of Galilei's telescope, he wrote to Federico Cesi reminding him that the 'eyeglass secret' refered to his insight, described in *Magiae Naturalis*, to combine two different lenses and obtain a great advantage in telescopic observation. However, he recognized that Galilei had improved the instrument and obtained astonishing results:

> The invention of eyeglasses in the tube was mine. Galileo, professor of Padua, adapted it, and with it he found 4 new planets in the sky and thousands of fixed stars, and just as many, never seen in the Milky Way, and great things on the orb of the Moon. They fill the world with astonishment. (Della Porta, n.d.).

Della Porta's argument seemed to satisfy everyone. In reality, Giovan Battista Manso provided further and different details on Della Porta's feelings. In a letter addressed to Galilei, Manso (1610a) expressed admiration for the 'new Columbus', because the "… discoveries of the new skies …", indicated he was "… a person of such rare virtues and singular doctrine." But in a letter to Paolo Beni (1552–1625), a Reader in Padua, Manso (1610b) pointed out that "Mr. Galileo has provoked no small jealousy in our Mr. Porta for making the invention of glasses so perfectly." In his *Dissertatio cum Nuncio Sidereo* that confirmed the validity of the Galilean discoveries, Kepler also highlighted his thoughts on this controversy:

> So powerful a *telescope* seems an incredible undertaking to many people, yet it is neither impossible nor new. Nor was it recently produced by the Dutch, but many years ago it was announced by Giovan Battista della Porta in chap. X, on the properties of lenses, in book XVII of *Magiae Naturalis* [Second Edition, published in 1586]. (Kepler, 1610).

The dispute seemed to end with the publication of *Il Saggiatore* in 1623. This text is introduced with the poem 'Ad Galilæum Galilæi' by Johann Faber (1574–1629), the German scientist who in 1608 stayed for some months in Naples, and said: "Della Porta holds the first, the German has the second, [but you], Galileo, shine before others." (Galilei, 1623: a1r). A few years later, another claim would reopen the quarrel: that the Neapolitan Francesco Fontana in his *Novæ Cœlestium Terrestriumque Observationes* claimed to have built a telescope as early as 1608.

Francesco Fontana (Figure 3) studied law at the University of Naples and then he became a lawyer in the court at the Capuano Castel. But failing to always find truth in the Court, he began to study mathematics and astronomy. During his studies Fontana made a long series of observations of the Moon, creating the first selenographic 'atlas', and of the planets, noting the rotation of Mars, drawing the 'bands' on the surface of Jupiter and hypothesizing on the structure of Saturn's rings (Molaro, 2017). Father Giovan Battista Zupi (1590–1650), a Professor of Mathematics at the Jesuit College in Naples

and a good friend of Fontana, observed Mercury and its phases for the first time on 23 May 1639 with Fontana's telescope. This was clear evidence that even Mercury revolved round the Sun.[5] But when did Fontana begin his observations? With which instruments, and where did he observe from? The biographical accounts of Fontana are very fragmentary, starting from the date of his birth, which could be between 1585 and 1589, as referenced in the portrait published in his book (see Figure 3).[6] Crasso (1666: 296–300) instead, informs us that Fontana and his whole family died in July 1656 when the plague descended on Naples. Records of where Fontana lived and made his observations are even more obscure, but a report on the damage produced by the 1688 earthquake gives us an important piece of information:

> On San Biagio dei Librari street, parts of the stairs collapsed belonging to our late distinguished mathematician Francesco Fontana, of which there were 121 steps in total. They fell onto the Palace of Duke of Marzano, crushing two horses. Due to this collapse, the upper apartment in the palace of the late Dr. Luigi Caracciolo also collapsed. (Bulifon, 1698: 80).

Therefore, Fontana lived in the historical heart of Naples, in the Decumanus Inferiore (see Figure 4), now known as Spaccanapoli, close to the church of San Gennaro all'Olmo, the palaces of Diomede Carafa and Marigliano, and not far from the Jesuit College where Girolamo Sirsale (1584–1654) taught theology. The Jesuit testified that in 1625 he saw a telescope with two convex lenses, and a microscope, built by Fontana. Meanwhile, the Mathematics Professors from the College, Zupi and Giovanni Giacomo Staserio (1565–1635), both claim to have observ-

Figure 4: A detailed drawing of Naples, engraved by Joachim von Sandrart and published in *Itinerarium Italiae Nov-Antiquae* (1640).

ed from Fontana's house in 1614 using a telescope composed of two convex lenses, and "… not without the admiration and joy of both of us." (Fontana, 1646: 5). Zupi certified that Fontana had achieved this perfection in polishing lenses and building telescopes after many years of study and persistent work. Zupi pointed out that he and his confrere advised Fontana to mount in the optical tube two convex lenses. Instead, Fontana claimed that he made a telescope with a double convex lens as early as 1608. Furthermore, he wrote that Kepler had reached the same optical hypothesis in an independent way, they having no knowledge of each other's ongoing studies.

Fontana's first known astronomical observation was only made on 31 October 1629. His drawing of the Moon was full of detail, and has been well analyzed by Molaro (2017). Fontana's reputation for his 'exquisite' lenses and observations only began to spread in 1637. A letter from that year by Benedetto Castelli (1578–1643) to Galilei testified that Neapolitan lenses were already circulating in Rome, and Raffaello Magiotti (1597–1656) asserted that "… the lens gives great enjoyment in observing the Medicean Stars." (Magiotti, 1637). To the skeptics, Magiotti (ibid.) suggested a strong therapy based on hellebore! In a letter of 1638 to Vincenzo de' Medici, agent of the Grand Duchy of Tuscany in Naples, Fontana tells us that

> I give perfectly the spherical shape to any glass … the art of polishing glass has never been my profession, hence the idea that all the glasses I composed are marked. (Fontana, 1638a).

In the same letter Fontana added that he had donated some telescopes

> … to the late Duke of Alcalà, to the most eminent the Cardinal Boncompagni, and to the most illustrious the Monsignor Nuncio of His reigning Holiness; furthermore he has sold some instruments to the Jesuit Father Girolamo Sersale and to the most Reverend Father Lord Benedetto Castelli. (Fontana, 1638a).[7]

In October 1639 Fontana sent the Grand Duke "… a convex lens of 22 palms surpassing any other by far." To testify as to the goodness of his lenses, Fontana enclosed with the letter a drawing of Jupiter with the horizontal bands of its atmosphere well traced: "… these stripes that I see on Jupiter are new things from what anybody else has ever observed." (Fontana, 1638b). Finally, in a letter to Antonio Santini, Giovanni Camillo Gloriosi (1572–1643), Galilei's successor at the University of Padua, described the Neapolitan telescope:

> … we see the objects clearly and very close, although upside down, it is amazing for the celestial things, especially for the Moon making it seem so close to say that you can touch it with your hand. (Gloriosi, 1638a).

In a subsequent letter Gloriosi sent Santini a drawing of Saturn, that sometimes appeared 'ovate' and at other times 'circular', due to the "… different positions of the Sun." Moreover, Gloriosi (1638b) pointed out that the 'vacuum' between the 'handles' was sky.

The known correspondence does not allow us to fully understand if Fontana was really the inventor of the telescope. However, in 1644 the physicist Evangelista Torricelli (1608–1647) wrote to Magiotti saying he had made an excellent lens comparable to the perfect one produced by Fontana and owned by the Grand Duke. Torricelli (1644) emphasized how his lens was the best compared to the many made by Fontana over a period of about 30 years. This indicates that Fontana had began making telescopes by 1614, at very least. Therefore, Galilei's comments below about "... the Telescopes and the new observations by Fontana of Naples …", appear quite biting:

> It is really true that they magnify objects more than our telescopes that are shorter; about the blow-up the Moon, showing it greater than the Naples market square, this is an ordinary phrase indicating the little competence of the Neapolitan craftsman ... He does not observe new and different objects compared to the first discoveries made by me and confirmed by many others. (Galilei, 1639).

The diffusion of Neapolitan telescopes continued to create debate, as did skepticism about the quality of the lenses made by Fontana. Studies of the technological improvements and scientific analyses that Fontana carried out on his own, combined with his liberal arts background, do not strengthen his case.

The scientist Carlo Antonio Manzini (1600–1677) was a pupil of Magini, and he maintained good relationships with famous scientists from Bologna such as Marsili and Riccioli. Manzini carried out a long series of astronomical observations with telescopes of the highest quality, including those made by Torricelli, Divini and Fontana. In 1660 Manzini published the book *L'occhiale all'occhio*, in which he appreciated the "… perfection …" of the Neapolitan telescopes. Much earlier, in 1641 Manzini had arrived in Naples, looking forward to meeting Fontana and enhancing his knowledge of "… the admirable applied Dioptric Art." In the preface of his book, which was published four years after Fontana's death, Manzini described the Neapolitan's telescope as "… a fragile tube with lenses at each end …", which he used for the first time in the garden of the palace of Francesco I d'Este, the Duke of Modena (known locally as the 'Mars of Lombardy'). Manzini really regret-

ed the loss of the "… wonderful secrets …" that Fontana conceived in Naples (Bellé, 2009).

After the observations that he made for his 1646 book, we are not told of any other astronomical observations made by Fontana. Another strange feature of his book is that it was published in February 1646, according to what the printer, Giacomo Gaffaro, wrote in the frontispiece, yet the last astronomical observation made by Fontana was dated 14 March 1646. Two hours after sunset he observed 'Venus corniculata', which means horned Venus. At this time the planet was in the decreasing phase, with about 35% of the disk illuminated.

In May 1647 Torricelli made a telling comment about Fontana in a letter that he sent to the astronomer and mathematician Vincenzo Renieri, who was a friend of Galilei. Torricelli (1647) poked fun at Fontana's observations and his book:

> I hold the book of idiocies observed in the sky, or rather dreamed of by Fontana. If you want to see crazy things namely over-kills, fiction, insolences, and a thousand similar invectives, I could send you the book: perhaps you can extract laughter for your own work.

Yet this jaundiced viewpoint does not tally with Fontana's claims. For example, he wrote that he and Father Zupi had observed Jupiter many times and with different telescopes, all of which were made by himself. They noted up to three bands on the surface and four satellites on the equatorial plane of the giant planet. Note that Father Zupi confirmed these observations in two letters to Riccioli dated 23 January and 4 February 1644 (Riccioli, 1651: 489).

According to Colangelo (1833: 246–268), in addition to Riccioli, Huygens, Hevelius and Bailly, other astronomers appreciated and studied Fontana's astronomical observations

4 TELESCOPIC OBSERVATIONS BY COLONNA AND DELLA PORTA

At the Cesi-Gaddi Palace on Maschera d'Oro Street in Rome, Federico Cesi established the Accademia dei Lincei on 17 August 1603 together with three other young peers, the scientist Francesco Stelluti (1577–1653), the physician Johannes van Heeck (1574–1616), and the astronomer Attanasio de Filiis (1577–1608), to replicate the lynx's eye in the examination of natural phenomena. Cesi wanted to set up Academy branches throughout Europe, but apart from the Rome branch, only in Naples would another branch be established. The 'Neapolitan Linceo' was linked personally to Della Porta, who had enrolled as a Linceo as early as 8 July 1610.[8] The partnership between the young 'Lincean Prince' and the old Neapolitan scientist—who was very famous throughout Europe—was fruitful both for Cesi, who saw his institution growing in importance, and for Della Porta, who succeeded in readily publishing his books *De Aeris Transmutationibus* (1608), *Elementorum Curvilineorum* (1610) and *De Distillazione* (1610) due to Cesi's influence with the Roman censors. All three books were dedicated to Federico Cesi.

In 1612 Della Porta established the Neapolitan seat of Lincei, and he asked Cesi for funds to give the Academy a suitable home.[9] Della Porta (1612) also provided a list of "… very excellent men, since the Neapolitan stables are full of philosophers, doctors and ordinary men." He also proposed as members:

> Mr. Nicola Antonio Stelliola, philosopher and mathematician of a high culture, and an uncommon inventor in architecture ... Mr. Fabio Colonna, a scholar in fine Greek and Latin literature, and of excellent judgment on the natural things ... Mr. Filesio Costanzo Della Porta, the 18 year old grandson of Mr. Giobatta, talented and of great character ... and also Mr. Diego D'Urrea, a noble knight with extraordinary knowledge since he is fluent in the Arabic, Persian and Turkish languages, in addition to philosophy and has a vast knowledge of other sciences. (Cesi, 1612).

During 1612 Della Porta became ill, but he did not relinquish his role as Vice-Prince of the Neapolitan Linceo, suggesting to Cesi the creation of a new Academy seat in Palermo to be led by the scholar Mariano Valguarnera (1564–1634) (Paolella, 2002). In August, Della Porta had "… almost recovered …", and Cesi and Galilei rejoiced upon hearing this news:

> … our Mr. Porta, who at an elderly age, has a sharp and tireless talent; he does not stop working hard and studying, and he will put many things into practice. (Cesi, 1613).

Thus, Della Porta would continue to produce new scientific and technological advances until shortly before his death on 4 February 1615.

Fabio Colonna (1567–1640; Figure 5) was one of Fontana's closest collaborators. Nephew of Cardinal Pompeo, he was a lawyer "… for he needed a living". But because of faltering health, Colonna approached the study of medicine and pharmacological methods, convincing himself of the usefulness of botanical gardens. He became a friend of Ferrante Imperato and was a regular at the garden of Giovanni Vincenzo Spinelli. More broadly, Colonna was interested in any kind of investigation of nature without being "… a slave to either Aristotle or another Philosopher …", in full agreement with Della Porta's unitary conception of nature and the scientific methodologies followed by Cesi and Galilei. The aims of Lincean scientists were

Figure 5: A portrait of Fabio Colonna, published in *La Sambuca Lincea* (1618) (https://it.wikipedia.org/wiki/Fabio_Colonna).

> … to get the most comprehensive knowledge of the sciences ... after observation, and experimentation ... and also to extend the sciences, to communicate and transmit knowledge to the public. Cesi, 1616).

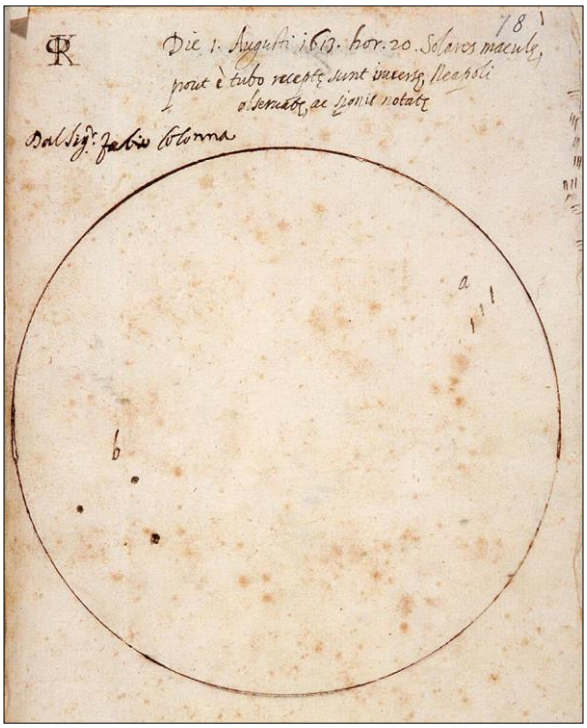

Figure 6: Sunspots observed by Fabio Colonna on 1 August 1613 at about 3 p.m. (after Colonna, 1613a).

This statement anticipates the modern concepts of public outreach activities and 'third mission' projects.

The partnership with Della Porta led Colonna to also be interested in the construction of telescopes, and astronomical observations. In March 1613 Galilei published his *Istoria e Dimostrazioni Intorno alle Macchie Solari e Loro Accidenti* with a long series of observations made from 21 October to 14 December 1611 and then from 2 June to 21 August 1612. In this volume Galilei argued that sunspots were "… clouds … [like the] smokiness around the Earth". Colonna also conducted a similar survey, taking 57 observations of sunspots that he illustrated and noted. To our knowledge, his drawing of 1 August 1613 (see Figure 6) was the first telescopic astronomical observation carried out in Naples. Colonna's mention also of 'clouds' is hard to interpret due to his lacking of observing experience and the 'bad' telescope that he used, as he pointed out in a letter to Galilei:

> I observed sunspots for two months, if Your Lordship will have pleasure to see what I have done, I could send all drawings even if they are not as well observed, as in your book where they are painted with light and shade. They are similar in size, using a sheet of paper placed at the distance of two palms length from the telescope I made by myself. (Colonna, 1613a).

Galilei, however, appreciated Colonna's enthusiasm and interest, for which Colonna was grateful:

> I have gladly surmised that you appreciate the sunspot [drawings] I made, although I am a beginner and without help; here nobody takes delight in nor makes such observations with whom I can learn to observe, nevertheless I will gladly make them in the future. (Colonna, 1613b).

In this letter Colonna regretted that "… in Naples there is no one who knows how to make perfect telescopes …", which contrasts markedly with Fontana's claim that he was building telescopes from 1608. Colonna was a tenacious person and he told Galilei he was working at making a telescope himself. He pointed out all the difficulties that he encountered in polishing the lens:

> For three days I worked to make some lenses by myself and to obtain, if I'm able, a good convex that allows me to see clearly without any little cloud; I find many defects both in the glass and in the work; I'm going to produce one with a length of eight and ten palms to magnify things without the tube being too long; I find that when the convex lens has a greater circumference, there will be greater magnification in the observations; but the difficulty is to work it in a good way, the bad ones show objects as double or shady. (Colonna, 1613a).

We do not have Galilei's reply to this letter, but he must have sensed something promising because he offered the young Neapolitan astronomer some of his lenses, which Colonna willingly accepted: "

> When you send me the lenses, put them in a well-checked, sealed box so that there is no chance they will be stolen during the journey … (Colonna, 1613a).

Colonna improved his technique of polishing lenses, and informed Galilei that he used one to observe Saturn, and the Sun, Moon and stars.

In mid-1614 Della Porta fell ill again but he continued to support Colonna's initiative by advising him on observing techniques and improvements in lens production. Colonna excitedly continued his planetary observations and writing to Galilei. Between 15 and 18 June 1614 Colonna observed the Medicean satellites:

> … with great joy of mine, and with great admiration of your knowledge and wisdom, I observed what you have forecasted and calculated with great accuracy, and recently again corrected some small details. (Colonna, 1614a).

Back in good health, Della Porta returned to take an interest in some of his own optical studies (e.g. see Figure 7) that he began in 1610 and

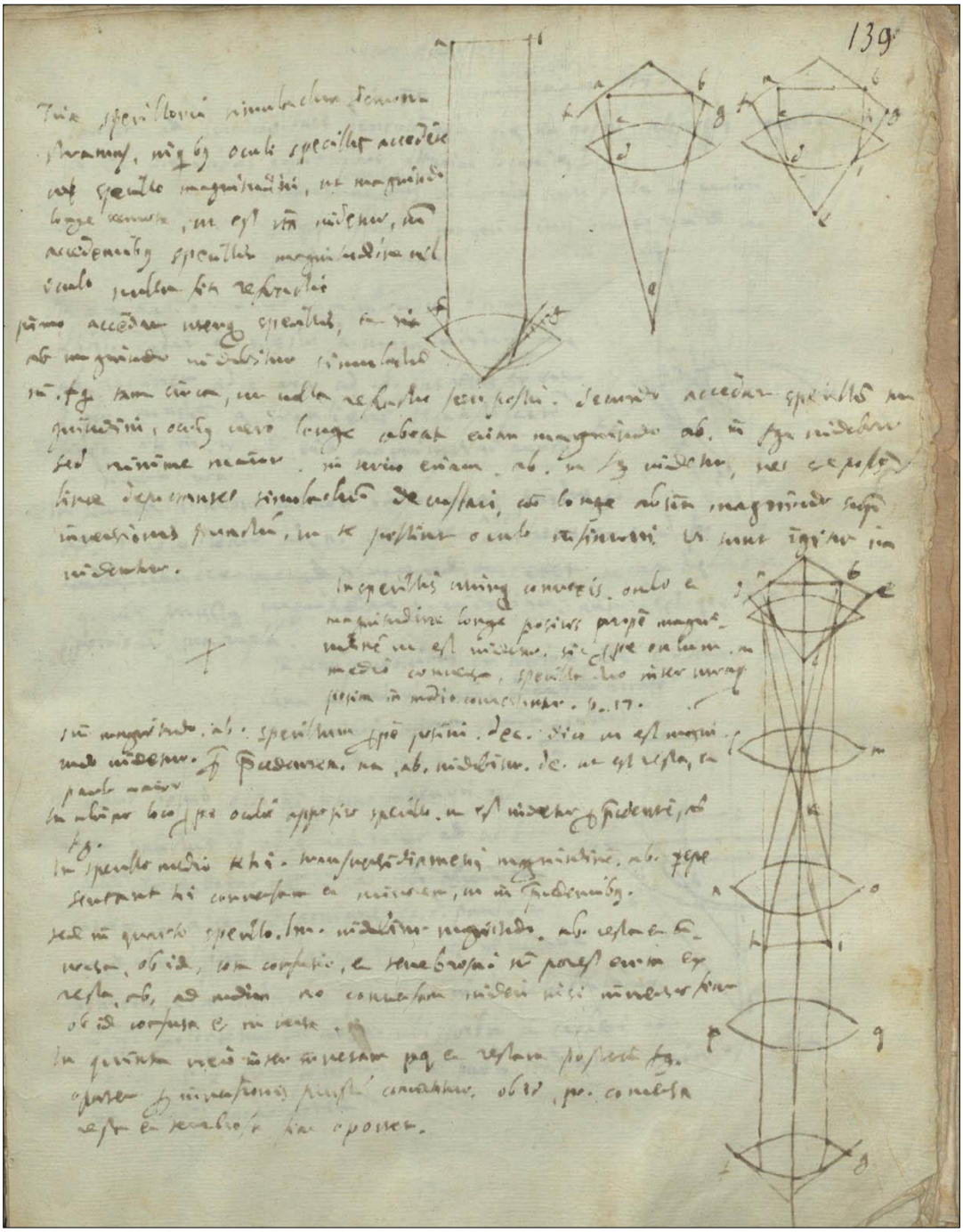

Figure 7: Part of the manuscript of *De Telescopio* by Della Porta, dating to about 1610 (c. 139r, Library of the Accademia dei Lincei e Corsiniana. Archivio Linceo 14).

wanted to bring together in a new book titled *De Telescopio*, "… a most difficult and complicated challenging undertaking and the most difficult of all he had ever taken." (Stelliola, 1615). The manuscript, which remained unpublished until 1962,[10] enhanced the studies on optics already evaluated in the *Magiae Naturalis* and *De Refractione* and anticipated some concepts that Kepler analyzed in his *Dioptrice* (Borrelli, 2017). Della Porta's new studies on convex and plano-convex lenses and Colonna's scientific progress, spurred Della Porta to get back to work. The enthusiasm of the 'Lincean Vice-Prince' is evident in the following letter to Galileo of 26 September 1614, showing the great expectations that the two Neapolitan astronomers held for the new telescope they were making:

> I am working with Mr. Fabio Colonna, who is very ingenious and a mechanic, to realize a new kind of telescope, which will multiply the effect more than usual; if we see until the eighth sphere with the usual one, we will be able to the highest heaven with this new one; God willing, we will investigate what is above, and we will publish the Empyrean Messenger. (Della Porta, 1614).

This new Neapolitan telescope was used to observe the solar eclipse of 3 October 1614. On that day, Colonna ignored commitments in court and he returned home in time to follow the astronomical event that he observed "… as best I could." Immediately afterwards, he wrote a long letter to Galilei:

> I send you six images of today's eclipse … marking both the path of the Moon, or better to say of the Sun, which moved rapidly, and the precise sunspots and their size; due to the rush and the little thought I could not do better … Your Lordship will see a very rough sketch; you will be able to recognize the accurate parts, taking what is possible, and you will invert them ... I know that Your Lordship and other scholars would have done likewise, I would like to see any of those learn how to make a good one next times. (Colonna, 1614b).

Upon reading this letter it is evident that Colonna used a telescope and not a Galilean spyglass. Therefore, this was the first astronomical observation made from Naples using a Keplerian-like refractor. The new optical configuration did not derive from Kepler's studies or those of Fontana, but was the result of the combined theoretical and practical skills of Della Porta and Colonna. The lines in the drawings are rough, however the six images taken between 12:32 and 1:40 pm offer adequate detail of the astronomical event and of the sunspots present (see Figure 8), thus providing a basis from which to improve lens polishing techniques and to enhance the astronomical studies. Unfortunately, at the beginning of 1615 Della

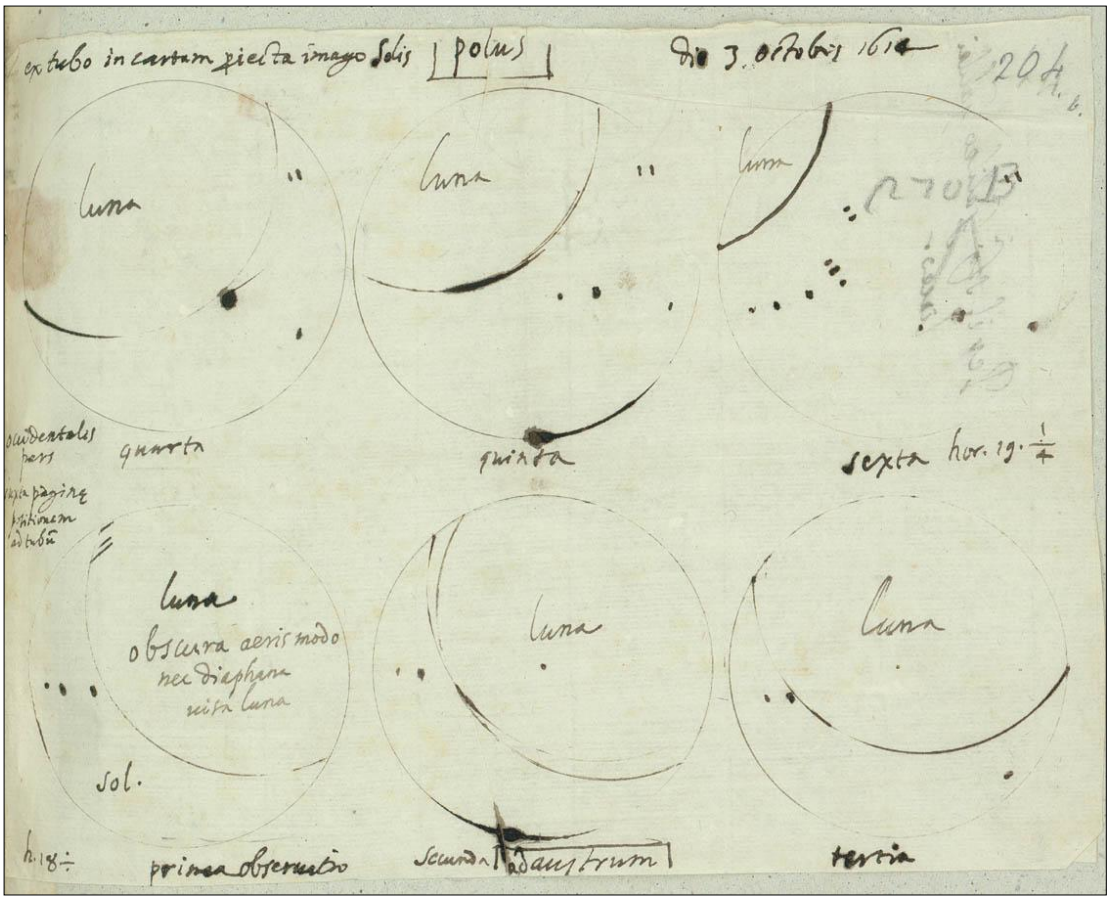

Figure 8: Sketches of solar eclipse phases observed by Colonna on 3 October 1614 (after Colonna, 1614b).

Porta fell ill again, and on 4 February he passed away.

Colonna (1617) was left without an experienced mentor, and he quickly lost his original enthusiasm for astronomy: "… here they is no one with whom I can discuss cosmic concerns, because there is no one who really knows, just our Stelliola." In August 1615 Colonna told Galilei he had observed Jupiter and its satellites for two months, just for fun, thereby confirming his unscientific approach to astronomical observations. Meanwhile, a sudden gust of wind caused the lens, which he has received through Galilei's "… particular courtesy …" to shatter and prompt "… a great pain." (ibid.). Colonna then told Galilei that he had good intentions of producing a new plano-convex lens, but he ran into many technical difficulties to find good-quality glass, to make a uniformly circular copper cup, and to obtain a proper lathe. All these hindrances did not allow him to make perfect lenses, as he would have liked (Colonna, 1615). Consequently, in Naples there were few remaining accomplishments from the incentive of the two Lincean's activities, only the diligent research by Stelliola.

Fourteen years then passed before Colonna again praised Fontana's telescopes and observations, telling Cesi about the

> … eight-palms telescope which, although giving a reverse image, shows closely the Moon, the stars, and everything with much greater magnification than the usual telescopes of the same length, and it makes the objects clearer than usual. (Colonna, 1629).

It is likely that the meeting between the two Neapolitans took place around the end of 1625, when Colonna followed Cesi's studies of nature, as published in his *Apiarum*.

5 FRANCESCO FONTANA AND THE INVENTION OF THE MICROSCOPE

In 1621 Jakob Kuffler (1600–1622) arrived in Rome and presented a new instrument designed to magnify miniature objects. He demonstrated how this instrument could recognize the compound eyes of insects, including that of fleas. He was the brother of Johannes Sibertus (1595–1677), Aegidius (1596–1658), Abraham (1598–1657), and Isaak (1605–1632), and the son of Jakob, a Dutch merchant residing in Cologne. Johannes and Aegidius became sons-in-law and business partners of Cornelis Jacobszoon Drebbel (1572–1633), the supposed inventor of the microscope that used two convex lenses (De Waard, 1912). The Dutch engineer and inventor lived in England from 1605 to 1610, then three years at the court of Rudolf II (1552–1612) in Prague before returning to England in 1613, where he made microscopes with two convex lenses. In May 1622 Jakob was in Paris to present the new instrument to Queen Maria de' Medici (1575–1642). The French astronomer and savant Nicolas-Claude Fabri de Peiresc (1580–1637) participated in the demonstration. De Peiresc wrote to Girolamo Aleandro (1574–1629), who was the Secretary of Cardinals Bandini and Barberini, informing him about the instrument and asking him to introduce Jakob Kuffler to Scipione Cobelluzzi (1564–1626), the Cardinal-Priest of Santa Susanna, and Maffeo Vincenzo Barberini (1568–1644), the Cardinal-Priest of Sant'Onofrio and from 1623 Pope Urban VIII. Unfortunately, due to the plague, Jakob died in Rome in November 1622, before he could explain to the Cardinals how the microscope worked. Galilei, who was in Rome at the time, saw the microscope and taught Cobelluzzi how to use it. However, Galilei remarked that he had created such an instrument some years earlier, using a lens configuration similar to his telescope (Freedberg, 2003: 151–154). In 1625, after Jakob's death, Aegidius and Johannes Kuffler arrived in Italy to present and sell some new inventions, "… a clock moving for a year without regulation … [and] four extra-ordinarily good telescopes …", as Aegidius wrote in letters to Johannes Faber (Kuffler, 1625).

In June 1625, one of the Kuffler brothers was in Naples at the Dominican monastery of Santa Caterina a Formiello to present a telescope to Friar Donato d'Eremita[11] and his confreres. However, Colonna was there to admire the microscope and understand its working principles:

> Since Your Lordship wrote to me that he has seen such an instrument, I wanted to see what it was like, although its operations were not known, I knew the characteristics of the lenses of different shapes, I tried and today I made it with the same proportion without disassembling the instrument because of haste, the lenses do not possess the clarity they must have, but as soon as I have some free time I will do it. I call it an enghiscopio, which means eye-wear up close. I believe that the Fathers would have become inventors if they had succeeded immediately, as they are used to engaging in such successful activities, but I believe they will labor for a long time if they do not know how to use them, since lenses cannot be produced in an ordinary way. (Colonna, 1625).

The microscope and the study of bees then became Colonna's new scientific goal. He was not satisfied with his microscope and, as usual, he set out to manufacture a new one. In July 1626 he was making

> … the foot and the tube, like a screw, that will be no more than four fingers for an eyepiece; using it you can observe a whole day without straining your eyes, it gives an upright image; it is an invention of a friend that I'm helping to publish; by intending to create

> one similar to that of the Cologne people, but he did not know how, and studied to find a better way. (Colonna, 1626a).

Who was this friend? Colonna's letters do not disclose this. Then one month later Colonna regretted the delay in producing the bee sketches, due to his friend's shock at recently having lost a daughter. In September "… the bee's friend was a little unwell, since he suffers a bloody cough." Nevertheless, the friend was completing a new microscope commissioned by Cesi, and

> Although it does not enlarge as much, it multiplies sufficiently so that we can see the follicles of the bee's hairs close up, without the eye suffering any glare like that of the Cologne craftsman. This friend has also crafted another small one inch eye-piece, which shows in reverse but magnifies the object significantly. (Colonna, 1626b).

By the end of 1626, this anonymous friend had sent Cesi a drawing of the bees, observed with great detail, to be engraved by Matthäus Greuter (ca.1564–1638). Only when Francesco Stelluti published his *Persio* in 1630 was the name of Francesco Fontana revealed as the anonymous 'friend'. He was identified by Stelluti as the person who recorded the observations of bees with Fabio Colonna:

> After Mr. Francesco Fontana observed and carefully drew everything, I had three bees engraved on copper, here in Rome, representing the arms of Our Lord the Pope Urban VIII. They are great in that form as displayed by the microscope lenses; and I had them engraved in three different positions. (Stelluti, 1630: 47).

Comparing the table of *Melissografia* published in 1625 with the bee observations of Stelluti and that of Fontana in the *Persio*, the Neapolitan images show remarkable detail, both in the paws and in the eyes of the bees.

In his *Novæ Cœlestium Terrestriumque Observationes*, Fontana wrote that his invention of the microscope in Naples occurred in 1618. He claimed that the microscope was never invented before that year. Because the microscope used an optical configuration like the telescope —he continued—it was possible that other scientists could have make it. Once again the Jesuit Father Sersale testified to having also seen and used the microscope at Fontana's house in 1625. This comment is similar to his other one about the invention of the telescope. As Fontana's statement concerning the telescope was confirmed by witnesses or via observations only a few years later, likewise his observations with the microscope were only known eight years later. Fontana also described his microscopic observations of dust, fleas, ants, flies, spiders, and even sand, but there was nothing about his observations of bees.

The protagonists of this scientific adventure disappeared within a few years but the secret of the Neapolitan eyepiece, which was the result of a very insightful enterprise, atones for Manzini's fear that "… men die and with them the technology, which is so necessary for humanity, is also buried." (Manzini, 1660: 2).

6 NOTES

1. Unless indicated otherwise, all translations into English were made by the author.
2. The diplomatic mission of King Ekathotsarot (?–1610) of Siam comprised sixteen people who arrived in Holland at the beginning of September 1608 on board the *Orange*, which was skippered by the Admiral Cornelis Matelief de Jonge (1570–1632) (De Renneville, 1725: 243).
3. The recommendation letter of the Zeeland authorities to the States General of the Netherlands to issue a patent for Lippershey's invention is dated 25 September 1608 (Zuidervaart, 2010: 11).
4. The first edition of *Magiae Naturalis*, published in 1558 when Della Porta was only fifteen, was indexed by the Spanish Inquisition. The revised and augmented edition of 1589 provides a comprehensive representation of the experimental activities of the Neapolitan scientist (Valente, 1999).
5. In his *Almagestu*m Riccioli (1651: 484) is skeptical about these observations, considering them optical illusions produced by Fontana's telescope, but Molaro (2017) shows a really good overlap between Fontana's drawings and a modern simulation of the sky as observed by the Neapolitan astronomers.
6. The portrait caption reads: "The Neapolitan Francesco Fontana inventor of the new astronomical optical tube in the year 1608, *Ætatis Suæ* 61 …", but this number could also be read as 19. Excluding that in 1608 Fontana was 61 years old, then if the age refers to the year 1608, Fontana was 19 and must have been born in 1589. If, instead, the date refers to the year of publication of the book (1646), we must accept that Fontana was 61 and was born in 1585.

   Although the book was published in only one edition, there are at least two versons of the volume, with the scientist's portraits prepared by two different engravers, and an additional item in the list of errata. The text appears to be printed and bound hurriedly: in addition to the variations described above, there are different collations of both the index, inserted after c. A4v, or after c. B4v, or even after c. T4v, and the portrait. Other copies report a double c. B3 with different headings. In the second version of the portrait the date of the invention of the tele-

scope is shown in Arabic numerals (Olostro Cirella, 2016: 146–147). Also, in this latter case, the second number [19 or 61] is not evident. However, the portraits do not seem to represent a young man, let alone an adult gentleman. Crasso (1666: 298) refers to the "... unclear Fate of a famous man."

7. The cited persons are: Fernando Enriquez d'Afán de Ribera (1583–1637), the Duke of Alcalá and Viceroy of Naples from 1629 to 1631; Francesco III Boncompagni (1592–1641), the Metropolitan Archbishop of Naples from 1623 to 1641; and Niccolò Enriquez de Herrera, the Apostolic Nuncio to Naples from 1630 to 1639.
8. In the spring of 1604 Della Porta contacted the Lincei members and had a close friendship and scientific correspondence with Cesi. The 'Lincean Prince' stayed in Naples for some days that year meeting Della Porta and Imperato, "… very good friends of Lincei and miracles of nature …", as he wrote to Stelluti, and he described the city as "… the paradise of delights … dwelling of the very fertile Ceres, the most abundant Neptune, and the very courteous and pleasant Venus." So much so, that Della Porta can be considered a member of the Academy from that time. In 1610 Della Porta wrote his name in his own hand in the Academic register (Galluzzi, 2017).
9. Three different buildings were proposed: the first was in the working area of Montesanto near Porta Medina, usually called *Porta Pertuso* by Neapolitans; the second palace, suggested by Colonna and visited by Stelluti in 1613, was near the Porta di Chiaia, the most elegant and popular street of Naples for princes and knights, but this elegant palace was already inhabited by a minister; the last one was suggested by Stelliola, a place owned by the D'Anna family near Porta Regale (now Piazza Dante) where astronomical observations could be made and scholars at the nearby new University building (now the archaeological museum) could be received. However, due to lack of sufficient funds the project did not proceed (Colonna, [1612]; Stelliola, 1615).
10. With the death of Della Porta in 1615 the manuscript remained unpublished and its traces were lost, along with other scientific and literary works of the Neapolitan scientist. The original text of *De Telescopio* was found in the Archives of the Accademia dei Lincei in 1940 by Giuseppe Gabrieli and was published by Olschki in 1962 and edited by Maria Amalia Naldoni and Vasco Ronchi.
11. Fra Donato d'Eremita was born in Rocca d'Evandro, in the Campania region, at the end of the sixteenth century. He was among the greatest connoisseurs of descriptive and taxonomic botany in the first decades of the seventeenth century. In Florence he was a chemist of Cosimo II de' Medici. After his return to Naples, in 1611 he was a pharmacy apothecary of the Dominican convent of Santa Caterina in Formiello, where he used alchemical knowledge to produce spagyric medicines based on minerals and metals. He was also a peripheral figure in the Accademia dei Lincei, as he counted among his friends Della Porta, Imperato and Stelliola. In 1624 Fra Donato published *Dell'elixir Vitae*, a treatise on distillation, alchemical equipment and experiments, including a description of his pursuit of the 'elixir vitae', thought to grant eternal youth and immortality. He died in Naples around 1629, as evidenced by a letter from Colonna to Stelluti (Genticore, 1998: 41–42; 78–79).

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