THE MAKING OF THE ARCETRI OBSERVATORY IN FLORENCE

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Abstract: The first idea of establishing a public astronomical observatory in Florence, Capital of the Grand Duchy of Tuscany, dates to the mid of the 18th century. Initially, the use of a low building on a high ground was proposed, and the hill of Arcetri suggested as a proper location. At the end of the century, the Florence Observatory - or Specola - was built instead on a tower at the same level as the city's centre. As soon as astronomers started to use this observatory, they recognized all its flaws and struggled to search for a better location.

Giovanni Battista Donati, director of the Specola of Florence from the eve of the Italian Unification in 1859, finally succeeded in making a new observatory: first, he obtained funds from the Parliament of the Kingdom of Italy to build an equatorial mount for the Amici 28-cm refractor, which could not be installed conveniently in the tower of the Specola; then, he went through the process of selecting a proper site, seeking funds and finally building the Arcetri Observatory. Although Donati was a pioneer of spectroscopy and astrophysics, his intent was to establish a modern observatory for classical astronomy, as the Italian peninsula did not have any, similar to the national observatories located in many foreign capitals – Florence being the capital of the Kingdom of Italy from 1865 to 1871. To promote the project, he made use of writings by one of the most authoritative European astronomers, Otto Wilhelm Struve.

The paper describes all these steps, eventually leading to the final inauguration of the Arcetri Observatory in 1872, almost 150 years ago.

Keywords: Arcetri Observatory, Giovanni Battista Donati, Otto Wilhelm Struve, Italian astronomy, nineteenth century astronomy.

1 ESTABLISHING AN ASTRONOMICAL OBSERVATORY IN FLORENCE

Public astronomical observatories were established in the Italian peninsula, still fractioned into several independent states, only in the 18th century. The first observatory was that of the Institute of Science of Bologna, in the Papal States, whose observing tower was completed in 1725 (Zanini, 2009). The second Italian state to have a public observatory was the Grand Duchy of Tuscany, ruled by Gian Gastone (1671-1737) of the House of Medici. The observatory (or specola as these institutions were originally called in Italian) was built in Pisa between 1735 and 1746; it belonged to the local University (Di Bono 1990).

1.1 Florence vs Pisa

After the death of Gian Gastone, the Medici line extinguished and Francis Stephen (1708-1765) of the House of Lorraine became Grand Duke as Francis II. He lived in Vienna, where he had married Maria Theresa of Habsburg; in 1745 he became Holy Roman Emperor, in co-regency with his wife. During his reign, Francis II left the administration of Tuscany in the hands of a Regency Council, sitting in the Capital of the Grand Duchy, Florence. The Council asked the opinion of Tommaso Perelli (1704-1783), professor of astronomy in Pisa and director of the Observatory from 1739, about establishing a new astronomical observatory in Florence, in the upper floor of the building hosting the church of Orsanmichele (Figure 1 and 2). Perelli complied with a report dated 20 February 1751. The astronomer judged the stability and space inside the building sufficient, even though its position in the city centre limited the sky view, because of high towers such as that of Palazzo Vecchio and of the domes of the cathedral of St. Maria del Fiore and of the church of St. Lorenzo (Figure 1 and 2). Instead, Perelli suggested:

... let us use one of the very pleasant suburban hillocks of which Florence is surrounded, following in this the example of the English who established their Observatory on a hill named Greenwich a mile away from London ... The multitude of villas of which the Florentine countryside is scattered throughout makes the purchase of a proportionate and conveniently located building very easy and of little expenditure ... every mediocre building is sufficient, the same ground rooms, and any terrace, even a little high from the ground, being able to serve to install astronomical instruments ... if the choice was left to me, I would be inclined to
the Arcetri hill, a place ennobled by the observations and the many years of stay of the great Galileo ... (Corsini 1924:264)\(^1\).

\[\text{Figure 1: Aerial view of Florence from the city centre in the North to the Arcetri area in the South (Google Earth).}\]
The name Arcetri refers to a small area just south of Florence’s St. Giorgio hill gate. Two churches are called “in Arcetri”, those of St. Leonardo and of St. Matteo. The latter was part of the convent in which the two daughters of Galileo Galilei were secluded; it is close to the villa Il Gioiello (Figure 1), where the astronomer lived from 1631, was confined by the Inquisition from the end of 1633, and eventually died in 1642 (Godoli et al. 2017). Thus, Arcetri was suitable for astronomy not only because of the unimpeded view of the horizon from a hilltop; it was also an inspirational location.

Perelli concluded his report discussing the advantages of practicing astronomy in Florence rather than in Pisa. Beside the air quality, often foggy in Pisa, the Capital had the advantage of a larger population: not only more skilled artisans could be found in Florence, for the maintenance and repair of instruments; but also, more persons interested in astronomy and in conducting observations. Instead, Pisa was a small city where the large number of students attending the University only resided during the lesson terms, over which they were too burdened by their studies to have time for astronomy. Furthermore, most of the professors were either old or not learned in the subject; the few that were, did not collaborate because of academic jealousy. Perelli finally suggested to follow the example of the “most learned Nations”, who had established Observatories in their main cities and capitals, such as London, Paris, Vienna, Copenhagen, Saint-Petersburg and Beijing, or, without going too far, Bologna, the largest city in the Papal States besides Rome.

The disaffection of Perelli towards his own Observatory and the academic environment in Pisa is evident in his comments. Perelli was reputed a learned man in many fields, but negligent towards his observing duties and academic obligations (Di Bono 1990). In fact, it has been argued that he suggested himself the idea of a new observatory in Florence, upon which he was asked to report (Corsini 1924). He continued to entertain this project in the following years. Around the spring of 1760, he proposed the Regency Council to use as a specola a villa close to the gate of St. Giorgio, called Manadora (now Villa Bardini; Figure 1), which had been temporarily confiscated by the government. He offered to pay for an annual rent and provide a few “excellent astronomical instruments” he had bought from England with his own money, which would better be used in Florence to educate to astronomy the “noble Tuscan youth” than in the insalubrious and foggy air surrounding the Pisa Observatory (Corsini 1924:260-261; Perelli 1760).

About a decade later, Perelli repeated his arguments in favour of a Florentine Observatory in what one would deem a very inappropriate place, a text intended as a preface to the first volume of observations from Pisa (Perelli 1769); not unsurprisingly, the volume was printed with a preface written by Giuseppe Antonio Slop (1740-1808), assistant of Perelli (Di Bono 1990). In his text, Perelli said that it would have been better to build an observatory on an old tower on the hill close to the church of St. Miniato in Florence. This description suits to a medieval building named Torre del Gallo, standing on the highest point of the Arcetri hill (Figure 1; St. Miniato is out of the figure, about 400 m from the mid of its East border and 1000 m NNE of the Torre del Gallo). An historical account of the Grand Duchy under the House of Lorraine says that Perelli “wanted, since the times of the Regency, to erect a similar observatory on the tower of Or-San-Michele, or on that named del Gallo” (Zobi 1850:331).
In 1765 Peter Leopold (1747-1792) became Grand Duke of Tuscany, a post held until 1790 when he was crowned Holy Roman Emperor. In contrast to his father, he directly ruled the country from Florence, promoting several state reforms. In 1766 he appointed the physicist Felice Fontana (1730-1805) with the role of gathering all the scientific instruments and specimens scattered in the royal collections. This activity led to the establishment of the Imperial and Royal Museum of Physics and Natural Sciences, of which Fontana became director. The Museum opened to the public in 1775, in a building next to the monarch residence, Palazzo Pitti (Figure 1).

The Museum included laboratories and an astronomical observatory (Figure 3), for which a new octagonal tower was erected between 1780 and 1789 (Schiff 1928). The naturalist Giovanni Fabbroni (1752-1822), vice-director of the Museum, had suggested to install the observatory on a low building in a higher ground, the Cavaliere, a rectangular garden sitting on top of a bastion of the city walls. The Cavaliere is located on the higher part of the Boboli Gardens, which lie on a slope rising from Palazzo Pitti and the Museum up to the Fort Belvedere (Figure 1). However, Fontana preferred the tower solution, because of the contiguity with the Museum (Miniati 1984). In fact, there is no mention in the Museum projects of Perelli’s suggestions for a higher ground. As a result, the sky view from the new Specola was limited: “its horizon [is] dominated, with the exception of one side, by buildings and nearby hills” (De’ Vecchi 1808: 7); “The Fort Belvedere, the decoration and the trees of the Boboli Gardens hide a portion, if not considerable, at least important, of this part of the sky [the East]” (De’ Vecchi 1810: 29).

Since the Italian peninsula lacked at the time skilled manufacturers of scientific instruments, Fontana and Fabbroni spent the years between 1775 and 1780 to travel abroad and acquire the equipment for the Museum (Schiff 1928). Most of the astronomical instruments were bought in London, where the two Italians arrived at the beginning of 1778. Among the main instruments, the Museum got from London: a transit instrument and a zenith sector by Jeremiah Sisson (1720-1783), both of about 10-cm aperture (4”); an 8-cm (3”) achromatic telescope by Peter Dollond (1731-1820); a 15-cm (6”) reflecting telescope by William Herschel (1738-1822); a pendulum by Larcum Kendall (1719-1790) (De’ Vecchi 1810; Miniati 1984). In London Fontana also met Jesse Ramsden (1735-1800) and discussed about the instruments which could make the new observatory a world leader. Among them we find an astronomical circle of 3.6-m (12-feet) diameter, a giant instrument that Ramsden had never made (and would never do; McConnel 2007). Back in Tuscany, Fontana dreamt of constructing the circle by himself, in order to have “the first, the greatest, the most useful instrument made in Europe, and perhaps the only one for a few centuries” (Miniati 1984: 213). A wooden model of the instruments was made in 1796, following the design of the Ramsden circle of the Palermo Observatory. However, the instrument was never realized, due to the lack of technical skill, financial problems and last, but not least, personal rivalries between Fontana and Fabbroni (Miniati 1984).

Another problem of the Florentine Observatory was the lack of a resident astronomer. No astronomer supervised the planning and construction of the building, with the exception of Johann III Bernoulli (1744-1807), royal astronomer in Berlin, who proposed a few modifications to the original project when visiting Florence in 1775. Slop, that had become director of the Pisa Observatory, gave his assistance in 1783-1784 for the installation of the Sisson instruments and the tracing of a meridian line (De’ Vecchi 1810). However, for a long time thereafter the instruments were not used and maintained.

The first director of Florence Observatory and professor of astronomy, Domenico De’ Vecchi (1768-1852), was appointed only in 1807, when Maria Luisa of Spain (1782-1824), regent of the Napoleonic Kingdom of Etruria, opened the Museum to teaching. De’ Vecchi could not but note the limits of the observatory for what concerned the visibility of the sky, the stability of the building and its odd layout. After verifying the state of the
instrumentation, he started the first program of observations: the geographical coordinates of the Observatory were measured and a preliminary stellar catalog was begun. Yet, De’ Vecchi’s activity did not last long. In 1814 the Grand Duchy was restored; in a frenzy to undo all the acts of the French administration, the teaching in the Museum was ended and all its professors dismissed (Schiff 1929). Afterwards, the Specola was entrusted to the astronomers of a private observatory in Florence, that established by Leonardo Ximenes S. J. (1716-1786) in 1756 and bequeathed to the Piarist school (Bravieri 1985). Those astronomers seldom used the Specola. Nevertheless, new instruments were bought in this period: a refractor with a 11-cm (4”) Fraunhofer doublet and a repeating circle by Reichenbach (Funaro 2001; Inghirami 1819).

Hopes for a change arrived when Leopold II (1797-1870) ascended to the throne of Tuscany in 1824. Leopold II had a genuine interest for science, reflecting that of his grandfather Peter Leopold (Funaro 2001). A year later he appointed as director of the Specola Jean Louis Pons (1761-1831). Pons has started his career as a comet hunter in Marseille; in 1819 he was called by Maria Luisa of Spain to direct the new Observatory of Marlia in the Duchy of Lucca (Arrighi 1956), the new state the Restoration had assigned to her. After the death of Maria Luisa, the Marlia Observatory was closed and Pons moved to Florence, where he found seven more comets, totaling 37 discoveries throughout his life (Kronk 2003). Pons’ feats finally called the attention of the astronomical community to Florence, that became the “quartier général des comètes” (von Zach 1825: 187).

The fate of the ephemeral Observatory of Marlia was soon followed by that of Pisa, which was dismantled in 1831 (the last observations having been carried out in 1807; Di Bon 1990). The Specola of Florence remained the only extant public observatory in the Grand Duchy (the Duchy of Lucca was united to the rest of Tuscany in 1847); by that time, the Italian peninsula counted almost a dozen such institutes (Pigatto 2012).

2 DREAMING ABOUT A NEW OBSERVATORY

While Pons’ work in astronomy did not need special requirements, the Museum authorities had nevertheless the desire to ameliorate the conditions of the Observatory. This is evident in the actions of the physicist Vincenzo Antinori (1792-1865), director of the Museum from 1829 (Figure 4).

2.1 A first project for the Belvedere

In September 1830, Antinori visited Fort Belvedere together with Giovanni Battista Amici (1789-1863; Meschiari 2005). Amici (Figure 5) was the only instrument maker in the Italian peninsula which could rival foreign production. He was well known in Europe for his microscopes and telescopes; in particular, his Newtonian reflectors had been praised for their quality by John Herschel (1792-1871). In 1827 he furnished the Observatory of his hometown, Modena, with a complete set of astronomical instruments (Meschiari & Bianchi 2013). During the visit to Florence, Amici had promised to send Antinori “the description and plants necessary for the good construction of a modern astronomical observatory” (Antinori 1830); Amici complied by sending:

... the description of the Fraunhofer telescope published by Struve from which you can recognize the layout of the rotating roof that cover the room of that magnificent instrument.

Dealing with a new observatory, it will not be necessary to be slavish imitators of the constructions of the others, but it is good to examine what has been made by others to choose the best (Amici 1831a).

The ambition was clearly that of establishing a modern observatory as that of Dorpat (presently Tartu, Estonia) where Wilhelm Struve (1793-1864) had installed a 24-cm (9”) refractor by Fraunhofer on an equatorial mount, the best such instrument made until then (Struve 1825), and possibly to make it without recurring to foreign workshops. Soon Antinori replied by saying that the Grand Duke seemed to be in favor of such a project, and had already ordered to probe the ground of Fort Belvedere to find solid rock under the soil. Antinori continued providing a preliminary sketch of a rectangular building, with two domes on each end, to be built on the bastions of the Fort (Antinori 1831a).

More details on the project for Fort Belvedere can be found in a proposal sent by Antinori to the Grand Duke on 15 February 1832, soon after Amici had succeeded Pons to the direction of the Specola at the end of 1831. Antinori remembered to Leopold II all the defects of the building of the Specola, from the limited view to the unstable meridian hall, to the limited space and the lack of a house for the astronomer. Only some of these defects could be mitigated, but at the cost of significant modifications to the tower. He suggested instead to abandon the Specola and install a new observatory on the 16th-century central building of the Fort (no more on the ground). On the roof of that building, solidly built and well oriented across the meridian line, there could
be space for two domes, one for an equatorial instrument (which the Specola did not have yet, unless Antinori considered a portable, 5-cm (2") aperture, instrument by Dollond; De Vecchi 1810) and one for the repeating circle, while in between one could build a gallery to host meridian and other instruments. The floor below the observation deck could be used for the library, study and workshop of the observatory; another for the astronomer’s house. Antinori concluded the letter alluring the monarch:

… the new observatory could be one of the most magnificent in Italy for the location, the vastness of the horizon, the solidity of the building, the excellence of the instruments, the benefits with which it could be furnished, and His Highness will then have the glory of raising a monument in the homeland of the great Galileo worthy of the restorer of modern astronomy, and of turning to the education of his subjects a building [the Fort] that was by the Medici with quite another intention raised (Antinori 1832).

2.2 An instrument-maker as Director

When Amici moved to Florence at the end of 1831, he moved also his private workshop that he installed in his house in the city (Meschiari 2005). He also used the Observatory as a showcase for the instruments he produced: the director of Vienna Observatory, Karl Ludwig von Littrow (1811-1877), during his visit to the Specola found many instruments on display, several of which were private property of Amici (Bianchi 2010). Amici practiced astronomy mainly as a way to test the products of his workshop; in Florence he did not attend to a systematic program of observations. This draw the criticism of some contemporaries: “he attended little his post, never taught science, seldom came to the Museum; more than anything else, he attended to the workshop he had in his house …” (Parlatore 1992: 270); “although he was a very respectable man, Amici did not have the intention of being an astronomer” (Donati 1863b).
However, it had been clear from the beginning that Amici was not called to Florence as an astronomer, but as an instrument maker, and that he could continue his own private enterprise. This was evident in the letter with which Antinori announced that Leopold II called Amici to the post of director. The offer gave ample freedom to Amici: he could move his instrument workshop to Florence and continue to attend to it; given his poor health condition, he could for the moment “supervise the construction of the building of the new observatory, which should soon begin, and build the instruments that will be needed for the equipment of the new Specola”, leaving perhaps observations to one of his sons (Antinori 1831b). Amici accepted, without cheating on his expertise: “I indeed delighted myself in some branches of Astronomy, but I’m no astronomer” (Amici 1831b). In the project for the observatory in the Fort, Antinori asked space “for his [Amici’s] optical and mathematical workshop, as it will be too uncomfortable for him to descend to the city to supervise and direct the works” (Antinori 1832).

The project for Fort Belvedere did not proceed. In a report on the status of the observatory and its activity (or better, inactivity) sent by Antinori to the Grand Duke a decade later, there is no mention of a new location (Antinori 1840). The instrumentation had improved little: there was now an equatorial instrument, obtained by mounting together pieces of old instruments with a 10-cm telescope by Amici (Bianchi 2010) – which still was to be installed; a meridian circle was asked for, which could be installed within the building to make measurements in a quicker way than with the repeating circle. A suitable research program was defined (comet search, observations of lunar occultations, sunspots, shooting stars, double stars, stellar proper motions and – possibly – parallaxes), which could be done by young men educated in mathematics and willing to learn celestial mechanics – “with profit and without expenses”. Perhaps Antinori referred to students in their last years of academic studies — the Museum had opened again to lectures in 1833.

### 2.1 The Amici telescope

The only major request described in Antinori’s (1840) report is that of a movable roof which could be built over part of the greenhouse of the botanical garden; this would have served to host a big telescope, for whose achromatic objective the Grand Duke had just provided funds. The 28-cm (11”) doublet objective, made out from crown and flint blanks from the Guinand factory in Paris, was polished in the workshop of the Museum under the supervision of Amici (Meschiari 2006, Righini 1969). A first version was presented at the 3rd Meeting of the Italian Scientists, held in Florence in 1841; as the crown glass was defective, a new lens was polished later; the telescope, mounted on a mahogany tube, was ready by 1845 (Antinori 1849). The telescope was initially mounted with a tripod at the eyepiece side and a wooden pillar at the objective side; with its large dimension – the objective has a focal length of 5.3 meters – it was difficult to use from the observation room in the tower of the Specola (Figure 6) and it was moved to the adjoining terrace by sliding a tin sheet placed under its supports (Bianchi 2010). Despite its limits, the Amici telescope was the largest refractor available in Italy, and it would remain such for almost 40 years.

A continuous program of astronomical observations started at the Specola only in August 1852, when the young Giovanni Battista Donati (1826-1873) was appointed apprentice astronomer (Figure 7). Donati started using the Amici telescope for comet and asteroid observations in 1854 – the first documented use of the instrument (Meschiari & Bianchi 2013). However, using the telescope was not easy: when describing observations of comet 5D/Brorsen in 1857, Donati stated that the telescope “would be very precious for astronomical observations if one should not fight with the difficulty of moving it properly, because of its yet provisional mount” (Donati 1857: 357). One might wonder if the publishing of such a comment on a scientific journal was meant to promote the needs of the Observatory. In fact, at the end of 1858 Antinori proposed to build a rotating dome on top of a new Museum annex that was being built to host a recently acquired botanical collection (the necessity of the dome was also stated in Antinori 1849). Without the dome, which could not fit easily to the top of the tower of the Specola, it was not possible to have an equatorial mount with clockwork movements for the Amici telescope, “one of the best and most powerful ever known; but which … does not give to science the service it should and remains mostly wasted” (Antinori 1858).

### 3 PLANNING THE NEW OBSERVATORY

On 27 April 1859 Leopold II left Florence, having refused to support Italian independentists and to join the 2nd Italian War of Independence on the side of Piedmont against Austria. A series of provisional governments then ruled Tuscany through the 1860 plebiscite for the annexation to Piedmont and other Italian provinces, and the 1861 proclamation of the Kingdom of Italy under Victor Emmanuel II (1820-1878) of the House of Savoy.

In December 1859, the Tuscan government founded in Florence an advanced university school, the Institute of Superior Studies. The Museum became the section of Natural sciences of the Institute. The Minister
of Public Instruction of the Tuscan government was the agronomist Cosimo Ridolfi (1794-1865), an ancient student of the Museum (Figure 8). A few months later, Ridolfi succeeded to Antinori, who left the Museum direction, probably as a sign of loyalty to Leopold II. At the start of the Institute, Amici also was removed from his post and Donati promoted professor of astronomy and director of the Observatory.

Figure 6: Vertical section of the Tower of the Specola in Florence (Giuseppe Martelli 1792-1876. Gabinetto Disegni e Stampe Uffizi, Firenze, inv. 5750A). A note on the drawing refers to the Lunar eclipse of 31 May 1844. Over the drawing of the upper observing room is a sketch of a large refractor, likely the Amici telescope (or its project).
Donati had been adjunct astronomer since 1858, when he became worldwide famous for the discovery of C/1858 L1, one of the most beautiful comets of the century (Gasperini et al. 2011). His first interests had been the search for comets - he discovered five - and the calculations of their orbits (Galli et al. 2013). At the turn of the decade, he observed the spectra of stars of different colours and became a precursor of astrophysics, providing the first, rough, classification of stellar spectra (Bianchi et al. 2016; Donati 1862; Donati 1863a). Donati and Ridolfi soon started to collaborate to carry on the projects that Amici and Antinori did not achieve.

3.1 The conditions of Italian observatories

Beside the limited sky visibility, the lack of space and the poor stability of the tower of the Specola, its position within the city made it suffer from the results of human activities such as smokes, vibrations due to vehicles and light pollution (Cipolletti 1872; Donati 1866a). The same problems where shared by almost all the other observatories in the Peninsula which, with the only exception of the Capodimonte Observatory in Naples, where located on high buildings within city centres. After the Unification, the Kingdom of Italy thus found itself with many unsuitable observatories (for the state of the art of Italian astronomy in those years see Bònoli et al. 2005). The problem was not limited to astronomy, but extended to the plethora of institutes (such as libraries and universities) inherited from the many pre-unitarian states. Donati was soon involved in the discussions on how to rationalise the expenses devoted to astronomy (Bianchi & Galli 2014). He was in favour of establishing a single National Observatory (possibly, the new observatory for Florence he was planning to build). Yet, localisms and jealousy among the astronomers made a simple dismissal of the other observatories unfeasible (Pigatto 2012).
In 1862, Donati took part in a meeting in the capital of the Kingdom, Turin, organised by the Minister of Public Instruction, the physicist Carlo Matteucci (1811-1868), who had been his professor at Pisa University. Matteucci invited also, among others, the directors of the Observatory of Padua, Giovanni Santini (1787-1877), and of the Collegio Romano in Rome, Angelo Secchi S. J. (1818-1878), that were not subjects of the Kingdom yet. The participants agreed that the ideal solution of a single, new, observatory would have been too costly for the poor finances of the new state (Bianchi & Galli 2014). A more practical solution would have been to concentrate most of the investments on four observatories, evenly distributed in the peninsula. This is how Donati summarised the conclusions of the meeting:

In 1862 ... it was established that in Italy the Observatories that should be maintained and expanded were only those of Milan, Florence, Naples and Palermo. ... No country has more Observatories than Italy and nevertheless no country is more unfortunate than ours because none of the current Italian Observatories is equipped with instruments and located in such a way as to be able to be on par with the Observatories of other Nations. We should do to our Observatories what we have done to our past governments, tear them all down to rebuild one truly National, corresponding to the needs of the times that have changed both for politics and for science. Perhaps, however, a single Observatory across Italy would be too little, given the favorable conditions of our geographical position and of our climate; but keeping four of them is already more than enough to cultivate the very important Astronomical science with real profit (Donati 1864a).

The idea of restricting the number of first-class observatories to four was proposed again a decade later, but the reformation project never proceed (Poppi et al. 2005). Italy maintained the peculiarity of having many independent observatories until the foundation of the National Institute for Astrophysics in 1999 (Chinnici 2015; Pigatto 2012).

3.2 The scope of the new Observatory

The astronomers that met in Turin in 1862 also highlighted the need for a meridian circle installed in a stable, ground-level building, which was not yet available in Italy. The need for modern instrumentation for high-precision measurements of stellar positions also emerged from the geodetic works that the Italian astronomers were to carry within the program of the Mitteleuropäische Gradmessung enterprise. At the first general conference of the association, held in Berlin in October 1864, hope was expressed that observatories in Italy and Switzerland could extend fundamental measurements to stars at southern declinations ( Förster 1865). Yet the members of the Italian commission, among whom Donati and Giovanni Virginio Schiaparelli (1835-1910), director of the Brera Observatory in Milan, had to confess that they could not fulfill that wish, because of the lack of proper instrumentation and buildings (Ricci 1869).

When promoting the need of a new observatory in Florence, Donati made sure that this handicap was known (Donati 1866a, 1866b). Despite he was among the pioneers of astrophysics, he planned to have an observatory dedicated principally to classical astronomy:

The main purpose of Astronomy is not the investigation of the nature and essence of the heavenly bodies; these investigations are without doubts very important, but belongs to the astronomical science almost indirectly ... from them the astronomer is not moved much more than any other investigator of natural phenomena. But the precise purpose of Astronomy is the exact description of the movements of the stars, as those movements appear to us from Earth (Donati 1866b: 501).

While for the moment no meridian circle was available in Florence, Donati wished to prepare the conditions for the use of such an instrument: "High Observatories, like in Italy, do not conform to the times... It is necessary to have Observatories at high location ... but in building as low as we can (Donati 1866b: 502)."

3.3 The equatorial mount for the Amici telescope

Donati was a strong supporter of the production of scientific instruments in Italy. There could be no real development in physics and astronomy in the country, he maintained, if there were no mechanical workshops: "Mechanical instruments are the scientists' weapons. Woe to the nation that for them must rely on foreigners!" (Donati 1868a: 353). Until the death of Amici in 1863, Donati could rely on the quality and inventiveness of his instruments. However, the small scale and domestic nature of Amici's workshop would have prevented the constructions of large devices, such as the equatorial mount needed for the 28-cm telescope of the Specola. This is why Amici and Donati promoted the project of Ignazio Porro (1801-1875) for establishing in Florence the "Società Tecnomatica Italiana ... a large plant for the construction of Precision Instruments for Astronomy, Geodesy, the Navy, Industry, Commerce, Sciences, Arts ..." (Meschiani 2005: 23). The Società provided the
cost estimates for the construction and installation of the mount for the Amici telescope, 44000 liras (Ridolfi 1863a). This is equivalent to about 223000 € today².

Using this estimate, in November 1863 the Minister for Public Instruction Michele Amari (1806-1889) presented a bill to the Parliament to finance the construction of an equatorial mount, with graduated circles, clockwork movement, and a dome. The bill passed and converted into a law in February 1864 (Bianchi et al. 2012). In the meanwhile, the project of the Società Tecnomatica Italiana had failed to materialize and was dismissed; Donati, instead, started a collaboration with the mechanic Giuseppe Poggiali (1820-1892) and established a small workshop for the production of spectroscopes and other instruments. Though an estimate of the costs was asked also to the workshop of G. and A. Merz in Münich (Merz 1864) - probably as a reference - Donati obtained from the Minister the authorization to build the instrument under his own responsibility (Amari 1864). The mount thus became the first large commitment of the workshop of Poggiali, later named Officina Galileo (Meschiari 2005). Donati was also authorised to visit Paris and London to study the latest improvements in the construction of equatorial mounts, which he did as a tail to his trip to Berlin to attend the geodetic conference of 1864. In Germany, he took the opportunity to visit several observatories, which he found much better built than the Italian ones (Bianchi & Galli 2014).

By the beginning of 1866, the equatorial mount was ready: together with the telescope tube, it was stored in a ground-level room of the Museum, waiting for its installation in a suitable location (Meschiari 2005).

4 SEARCHING FOR THE SITE

Initially, Donati and Ridolfi revived the old project for Fort Belvedere. In 1861, Ridolfi contacted the Minister for Public Instruction Francesco De Sanctis (1817-1883) and the general secretary of the Ministry, Quintino Sella (1827-1884), who liked the idea and asked for a preliminary project (Ridolfi 1861a). Of this project, prepared by Donati and the architect Mariano Falcini (1804-1885), we only have an indirect description by Ridolfi: a low building with three domes (most likely one for the Amici telescope and the others for auxiliary instruments) built on the place of a higher building which had to be dismantled - most likely the central building of the Fort that Antinori wanted to use. Ridolfi recommended a few solutions to reduce the costs, such as using two small domes of the Specola, the rubble of the old building as construction material, and avoiding the "poetry" of Falcini, who had suggested to build also a Pantheon of Italian glories and a winding carriage road to access it. Concerning the Pantheon, "... we already have it in the church of Santa Croce"³, concluded Ridolfi; "the Italian Pantheon will be half-made already" by building an observatory - thus remembering Galileo Galilei - on a Fort that reminds the name of Michelangelo Buonarroti - responsible for the city defences of the Florence Republic in 1529 (Ridolfi 1861b). At the beginning of 1863 Ridolfi asked again to reserve the Fort for the astronomical observatory, and also for a magnetic and meteorological observatory which Donati had been asked to study at the 1862 Turin meeting (Bianchi & Galli 2014; Ridolfi 1863b). However, the Ministry of War replied that the Fort was needed by the military administration and could not be ceded (Minister of Public Instruction 1863).

At the end of the year, Donati and Ridolfi reconsidered the use of the Cavaliere, which could host, if not the whole observatory, at least the dome for the Amici telescope, whose bill was being discussed in the Parliament (Donati 1863). A project was committed to the architect Fabio Nuti (Figure 9). It consisted of a circular building of diameter 15 metres with four rectangular extensions: a North entrance, and three East, West and South rooms of equal size. The whole building would have a maximum extent of 30 metres along the E-W direction and occupy half of the garden. A dome of diameter about 7 meters would stand on top of the central body; it could be accessed through a spiral staircase. The telescope with its basement would be installed on a pillar raising from the ground and occupying a large part of the volume below the dome. Smaller pillars would be present under the wings in correspondence of vertical slits for observations along great circles: the East and West rooms could accommodate up to four meridian instruments, the South one two instruments for the prime vertical (an alternative drawing with just one slit in each room exists; Barbagli et al. 2017: 73). The space on the first floor would be divided into several small rooms; they were probably intended to store portable instruments, to be used on the roofs of the wings and on a balcony running all around the building. Ridolfi reached a preliminary agreement about using the Cavaliere with Luigi Guglielmo de Cambray Digny (1820-1906), intendant of the royal house in Florence. However, in September 1864 it was decided to move the Capital of the Kingdom to Florence: as part of the garden of the royal residence, Palazzo Pitti, the Cavaliere became unavailable (Donati 1866a).

Both the Belvedere and the Cavaliere are within the boundaries of the city walls (still existing nowadays on this side of their circuit, Figure 1). The city walls also delimited the extent of the Florence municipality, while the territory beyond them belonged to other administrations (in Figure 1, for example, the Torre del Gallo belonged to the municipality of Bagno a Ripoli, while the current site of the Arcetri Observatory belonged to
those limits had long felt too small for the city, in particular after the move of the Capital; they were finally enlarged at the end of July 1865 (Chiavistelli 2017). The area of Arcetri thus became part of Florence.

Figure 9: Project of the Observatory at the Cavaliere in the Boboli Gardens. (Fabio Nuti. Gabinetto Disegni e Stampe Uffizi, Firenze; inv. 5603A, 5604A).
It is possible that the enlargement of Florence territory had a role in the final choice for the Observatory’s site. After the dismissal of the Cavaliere’s project, Donati and Ridolfi thought about addressing the Municipality for a proper site and a financial contribution to its building. However, Ridolfi died in the meanwhile and Donati had to wait for the Museum’s new director, Carlo Matteucci (Figure 10). Matteucci had the intention of moving the entire Museum to a larger building, in order to establish an advanced institute for scientific research and teaching, a normal high-school. Even before arriving in Florence, he had asked Donati to search for a “Villa of the Government or of the King which we could exchange for the Museum” (Matteucci 1865a). Eventually, a project was presented for the Villa of Poggio Imperiale (Matteucci 1866a; Figure 1). It is thus unsurprising that Donati visited, sometime before October 1865, the hill between the Villa and the Torre del Gallo: together with the Museum’s professor of Geology, Iginio Cocchi (1827-1913), and the architect Falcini, he found the location suitable because of the rock underneath the soil (Donati 1866). Lastly, Donati was possibly aware of the ideas of Perelli, that had been published, though incompletely, in the “Civil History of Tuscany” by Zobi (1850). In fact, the words of Zobi were cited in a pamphlet supporting the project of the new observatory, written by an acquaintance of Donati (Andreucci 1868; Bianchi & Galli 2015).

5 CLIMBING THE ARCETRI HILL

Once the site was selected, the project for the observatory did not proceed too smoothly. With the new state incurring in many expenses to complete the unification, including those for the 3rd War of Italian Independence in 1866, the Ministry of Public Instruction could not provide the entire costs of the new institute. Fundamental was the help of Matteucci who, until his death in 1868, was very active in seeking the cooperation of local institutions; and of de Cambray Digny (Figure 11), in his roles as Mayor of Florence, councillor of the Province, and Minister of the Finances of the Kingdom (Bianchi et al. 2013).

Figure 10: Carlo Matteucci (ca. 1860; Museo Galileo, Florence; Raccolta fotografica Cartes-de-visite raffiguranti medici e scienziati).

Figure 11: Luigi Guglielmo de Cambray Digny (ca. 1860; Courtesy: A. Ciabani, myarchiviostoricofotografico.com)
5.1 Seeking funds

The first requests were addressed to the Municipality in autumn 1865. Projects and cost estimates were soon exchanged with the Mayor and the Ministry of Public Instruction, in an attempt to stimulate the contribution of both. Donati and Matteucci tried to scare the municipal authorities with the fear of a closure of the Observatory, if the current situation persisted. While at the same time renouncing to the ambitious plan of moving the Museum to the Villa of Poggio Imperiale (occupied by a school), Matteucci urged de Cambray Digny on the eve of the vote by the Municipal Council:

The important thing is to have an observatory and believe that if a new observatory is not made, the government will feel the need to abandon that of the Museum because it is absolutely useless and such that it cannot even receive the instruments we have. Thus, Florence will remain without observatory... The council ... of one thing must be concerned, that is, if Florence must have the first astronomical observatory of Italy, yes or no: if the council gives a subsidy to the government, Florence will have this first observatory ... (Matteucci 1866b).

On 9 June 1866 the Municipal Council voted for a subsidy of 30000 liras, provided both the Province and the Government gave their contribution (Atti del Consiglio Comunale di Firenze, 1872:559-562).

In the meanwhile, Matteucci asked Donati to promote the project to a larger audience. In November 1866, the astronomer gave the inaugural lecture of the Institute, stressing the inadequacies of the existing Italian observatories and presenting his proposal “of erecting in Florence a new Observatory that could serve the modern needs of astronomy” (Gazzetta Ufficiale del Regno d’Italia 1866; passage from Donati 1868b). Donati had presented his arguments earlier in March in the first issue of the Nuova Antologia, a new monthly review of “Letters, Sciences and Arts” (Donati 1866b); in autumn 1866, he also published the memoirs he had presented to the Municipality in 1865 (Donati 1866a). Donati (1866a) also includes a memoir sent to the Council of the Province in September 1866. The Council approved the co-financing of the new observatory at the assembly of 27 November 1866, where de Cambray Digny ensured that the Province would contribute with the same amount as the Municipality (Atti del Consiglio Provinciale di Firenze 1867:235-239).

A final contribution came from the Royal House. When Victor Emmanuel II transferred to Palazzo Pitti, he chose as private apartments a part of the palace named Palazzina della Meridiana (Rensi 2015), very close to the Specola (Figure 1). From the observing room, it was possible to look into the apartments and, apparently, into the King’s bedroom (Maison 2003). In order to remove this annoyance, funds were promised in exchange of the property of the upper part of the tower (Matteucci 1866b). While the observatory was still to be transferred, the observing room of the Specola became thus part to the Civil List (Gazzetta Ufficiale 1868); later the Royal House offered a contribution of 15000 liras for the new observatory (Relazione 1869).

5.2 The project

A new project for the Observatory was presented by the architect Falcini in November 1865 (Falcini 1865). The Observatory was to sit on a hilltop belonging to two private owners and have a North access through a short winding road connected to the street. Soon after, however, it was realised that some of the expropriation expenses could be saved by using a nearby land owned by the State (the Podere della Cappella, Chapel’s farm; Bianchi 2017). In August 1866, a modified project was presented with a longer access road from the South passing through the Podere della Cappella (Minister of Public Instruction 1867).

The cost of the project was estimated in about 115000 liras, more than half covered by the contribution from the Municipality and the Province (that of the Royal House was yet to come). Matteucci (1867a) appealed to the Nation’s pride to encourage his superiors:

... despite the financial straits of our budget, it will not be difficult for the King's government to obtain from the Parliament a sum which is very small and that is destined to preserve illustrious traditions and to keep astronomical studies in Italy not so far from the highest destinations to which they have already ascended and continue to rise among the other civilized nations of Europe. And the most recent example of the national observatory built in Switzerland with an even greater expense than that foreseen by us will have to comfort the King's government and the Italian Parliament not to always remain below much smaller states in promoting scientific studies and the good and rigorous observation methods.

Most likely, Matteucci referred to the Swiss Federal Observatory built in Zurich between 1862 and 1864 (Friedli & Keller 1993).
None of the drawings of this first project has been found and the original setup of the building has to be guessed from the written descriptions and from a sketch on a cadastral map (Figure 12). The building had an entrance gallery from the North; an East wing with the apartments for the astronomer, with a few extra rooms protruding to the South; a West wing for the meridian instruments. Two small domes were positioned on the E and W ends, while the larger dome for the Amici telescope sat over a building extension to the South. The Superior Council for Public Works recommended a few changes in August 1867. Among them, they required a major building symmetry: only the North entrance should be forepart to the East and West wings; the larger dome should have been positioned over the centre of the building; the few extra rooms should be removed (Ferrucci 1867).

The final, corrected, project was ready by the end of 1867 (Matteucci 1867b). To this project belongs a single surviving drawing showing the façade of the building and the E-W section of its central part (Figure 13). The section shows the mechanisms for a revolving, cylindrical, dome and the telescope basement, put over a pillar raising from the building’s foundations. Curiously, it does not show the slits for the meridian instruments yet.

5.3 The law for the observatory

In 1868, hot topics in Italian Politics were the concession of the tobacco monopoly to a private society and the introduction of a tax on milling, two measures presented by de Cambray Digny as Minister of Finances and intended to consolidate the state budget. At the autumn start of Parliament works, Donati urged de Cambray Digny to present a long-waited bill for the Observatory:

Excuse me for pity’s sake if I dare to disturb ... the most natural course of your occupations, coming to talk to you not about Tobaccos, or Milling, but Astronomy! (Donati 1868c)
... Astronomy persecuted you first at the Town Hall, then at the Province, and now at the Ministry! ... You, for having already done so much, will certainly not refuse to do now, what is missing for the completion of the work! (Donati 1868d)

The bill was presented to the House of Deputies by de Cambray Digny on 21 January 1869. The Parliamentary committee for the bill's evaluation promoted it using the same arguments developed previously with the Municipality and Province (Berti 1869). After finally managing to obtain the contribution of the Royal House, the committee recommended the building of the Observatory for its low cost: out of a final estimate of about 106820 liras (slightly reduced after the changes to the project; equivalent today to about 520000 €), 75000 had been promised by the Municipality, Province and Royal House and about 27500 had been allocated already in the budget by the Ministry of Public Instruction in 1868; the members of the House were thus required to allow a further expense of just a little over 4000 liras. The bill was also modified to include the whole Podere della Cappella into the Observatory's terrain. The House of Deputies approved the bill on 25 May 1869 and passed it to the Senate. However, in June the Senate was closed by the King and all bills under discussion were cancelled (Bianchi et al. 2013).

Figure 13: The only surviving drawing of the project of the Observatory, ca. 1867 (Archivio Storico INAF-Osservatorio Astrofisico di Arcetri).

To avoid delays, the bill was converted into a Royal Decree, issued on 23 September (Relazione 1869). However, the Parliamentary approval of the Decree did not proceed, because of political and historical events, among which the conquest of Rome and the final transfer of the Capital and of the Parliament. The Ministry of Public Instruction later decided to put a further sum of 30000 liras in its budget for 1871 (Cipolletti 1872; Donati 1873a).

6 THE BUILDING OF THE OBSERVATORY

The building on the Arcetri hill started just when the bill was being presented to the Parliament, early in 1869. The construction proceeded in two steps, balancing at a time the desire of Donati to speed up the process,
and the delays due to bureaucracy, to projects’ modifications, and to parliamentary works. First, the Amici telescope was given in Arcetri a provisional installation, using in part the leftovers of the funds for its mount; then the main building and the final installation of the telescope were made. Because of this, the Observatory has the peculiarity of having been inaugurated twice (Bianchi et al. 2013).

6.1 The provisional installation of the Amici telescope

After the mount for the Amici telescope was ready, Donati searched for societies which could build the dome. Cost estimates for an iron cylindrical dome with a spherical cap were asked in June 1866 (Donati 1866c). Later it was decided to build a wooden dome with iron frame and movements, and a copper roof (Matteucci 1867c). The dome, about 9.5-m across, had a polygonal section with twelve sides, one occupied by a slit and six by glass windows. All parts of the dome were made in Florence and completed at the beginning of 1868 (Falcini 1868).

At the same time, permission was asked to build a pavilion on the Podere della Cappella (Matteucci 1867d). The pavilion was intended to host instruments for the measurement of the terrestrial magnetic field. However, its circular walls would be used first as a base for the provisional installation of the dome and the telescope, while waiting for the construction of the Observatory – on land which still had to be expropriated (Bianchi et al. 2012; 2013). The works for the pavilion were authorized at the end of summer 1868. A road was built to access the higher part of the Podere della Cappella, the closest place to the top of the hill. The dome with the telescope inside was ready by June 1869 (Donati 1869a).

It is likely that Donati sped up the building in order to have it ready by the end of September 1869, when the Permanent commission of the Europäische Gradmessung, together with several Italian astronomers, met in Florence. On Sunday 26 September, geodesists and astronomers convened in Arcetri with other professors of the Institute and authorities (Figure 14). The Italian Government was represented at the highest degree, by the prime minister Luigi Federico Menabrea (1809-1896), the minister of Public Instruction Angelo Bargoni (1829-1901) and the minister for the Royal House Filippo Gualterio (1819-1874). The meeting was solemn, as it should have been for the inauguration of a National Observatory in the Capital of the Kingdom. That was the day, according to Donati, that should be “rightly considered as the first from which it must be intended that the history of the New Florentine Observatory begins” (Donati 1869b).

6.2 The main building

The construction of the main building had to wait for the expropriation contracts, which were signed in spring 1870. The road was then prosecuted from the provisional location of the dome up to the hilltop. Just before starting the works for the new building another curious hindrance emerged: some inhabitants of nearby villas expressed concerns about the loss of privacy of ladies in their rooms. Donati had to explain that “however similar to celestial bodies the ladies might be, such telescopes as used at the observatory could not be used towards objects so removed from the heavens in distance!” (Baldelli 1870).

In September 1870 the building works were assigned to the contractor, Carlo Berti, who had already made the road and the masonry of the pavilion. A few problems emerged between Donati and the architect Falcini. The astronomer, aducing scientific motivations, required a few changes to the project: the building was moved to the south side of the hilltop; the meridian direction was recalculated and corrected, requiring a modification to the foundation walls after they had already been laid (Boccini et al. 1881; Falcini 1873; 1879). In February 1871, Donati reported: “All the foundations are already completed and now the building starts to emerge from the ground, and I hope it will be finished soon” (Donati 1871a). At this time, other project modifications had probably been decided: the move of the entrance to the South façade; a long, additional, external stairway on that side; an increase of the height of the building; the removal of the central pillar for the telescope, whose weight had to be sustained by the dome vault of the central room on the ground floor. All these changes made the final costs of the building rise (Falcini 1873).

By the end of summer 1871, the Municipality and Province gave, at least in part, the financial contribution they had promised. Donati also asked the local authorities to express their satisfaction with the works, in order to justify the new extra expensed that had not been foreseen. After a visit of two councillors (one of them being the ubiquitous de Cambray Digny), the city council stated that “this Institute will be the only one in Italy reaching the degree of perfection that is now deemed necessary” and recommended the Minister of Public Instruction, Cesare Correnti (1815-1888) to increase the budget to ensure the completion of the works (Resolution 1871).
Figure 14: The first inauguration of the Arcetri Observatory, on 26 September 1869 (F.lli Alinari, Firenze. Archivio Storico INAF-Osservatorio Astronomico di Padova). The bottom key includes the names of the astronomers and geodesists attending the ceremony, some of whom have been identified in the picture. For more details, see Bianchi et al. (2013).
In autumn that year Donati felt discouraged. The astronomer had already handed over the main room of the old observatory to the Royal House, while the new one was in the domain of masons; just a few of them, since “the contractor lost confidence knowing that he cannot finish the building with the allocated funds and fears with reason that he will have to wait indefinitely before being paid” (Donati 1871b). Also, the Ministry was deaf to his requests, having left Florence for the new Capital, Rome, before settling the problems of the funding. Indeed, the move of the Capital took some momentum away from the Arcetri Observatory. In a discussion in the Senate on 20 December 1871, the general Nino Bixio (1821-1873), friend of Giuseppe Garibaldi and one of the organizers of 1860 Expedition of the Thousand, asked the Minister of Public Instruction if something was in program to transform the Roman observatory into an observatory worthy of a Capital. He meant the Observatory of the Collegio Romano run by Secchi and dedicated mainly to the “novelty” of astrophysics, while he judged of more utility the works related to ephemeris calculation and geographical determinations, as “those of the Observatories of Greenwich, Paris, Washington, Madrid and others.” The Minister Correnti replied:

The standard Observatory in this moment is the Florentine Observatory, for which, as the Senate knows, a considerable expense was made with the help of the civil list, of the Province and of the city of Florence. The Observatory of Florence located on the hill of Arcetri, in an excellent position, is the only one in Italy that could compete with the principal observatories of the great nations (Rendiconti 1872:56).

However, Correnti concluded that in the nearby future it might have been useful to have an Observatory in the Capital. Apparently, the Minister was unaware that a public Observatory existed already in Rome, that of Campidoglio belonging to the University.

Despite all odds, the works proceeded. The Amici telescope and its dome were removed from the pavilion and put over the main building, which by the summer of 1872 was almost complete (Figure 15). Donati scheduled a new ceremony for October: if the first event of 1869 was to be considered as the laying of the “first stone”, this second inauguration had to celebrate the “placement of the last stone of the Observatory of Arcetri” (Donati 1872a). The astronomer wished to have the same attendance as for the first inauguration. Several invitations to Italian astronomers and physicists were made. Also, the Museum director, the botanist Filippo Parlatore (1816-1877), invited the attendee of the conference of the International Metre Commission in Paris: the invitation was read at the meeting on October 4 (Commission Internationale du metre 1872: 60). The ceremony took place on Sunday 27 October (Figure 16). Though the attendance was large, only a few international guests were present, probably because of problems on train lines due to poor weather (the event itself had been postponed by a week): among them, Camille Flammarion (1842-1925). Donati himself was missing, since he badly broke his leg the day before. Other notable absentees were the Minister of Public Instruction Antonio Scialoja (1817-1877) and any other major Government representative: definitely Arcetri had lost the appeal of a National Observatory (Bianchi et al. 2013).

6.2 Early science from Arcetri

Donati must have tried to use the Amici telescope as soon as it was installed in Arcetri in its provisional position. He also had a wooden cabin built next to the telescope, in order to ease its nightly use and follow the construction works (Bianchi et al. 2013). However, the first documented observations in Arcetri were not done with the refractor, but with a Repsold transit instrument belonging to the Italian Geodetic Committee. Stellar transits were observed in October and November 1869, both in Arcetri and in the Adriatic port of Ancona, in order to measure the difference in longitude between the two locations. The observations, that involved the use of a telegraphic line brought to Arcetri for that purpose, were part of the Europäische Gradmessung operations (Donati 1871c).

The first (and only) documented use of the Amici telescope in the pavilion is dated June to August 1871. The astronomer (and likely his assistant for astronomy Domenico Cipolletti, 1840-1874) observed comet
C/1871 L1, discovered by Wilhelm Tempel (1821-1889) from the Brera Observatory in Milan (Donati 1871d). The same August, the astronomers also counted meteors of the Perseid shower (Donati 1871e).

The Amici telescope must have certainly been used in other circumstances when Donati stayed in Arcetri by night. On the night of 24 October 1870, Donati observed a magnificent aurora “from the heights of the new observatory of Arcetri, and not disturbed therefore by the light in the streets of the city, which is always injurious to any celestial observation.” (Donati 1870). Another one was observed on 18 April 1871, when the astronomer was preparing to search comet C/1871 G1 (thus, likely, from Arcetri; Donati 1871f). A third bright aurora, that of 4 February 1872, caught Donati in the city (Donati 1872b); in these phenomena and their connection to terrestrial magnetism and solar activity, Donati saw the effects of a Cosmic Meteorology, one of the first definitions of Space Weather (Cade & Chan-Park 2015).

After the Amici telescope was dismantled, in order to place its basement upon the Observatory, Donati installed in Arcetri the Fraunhofer telescope (Donati 1871g). The old refractor had been equipped with a new equatorial mount and a spectroscope, made by the Officina Galileo and used during the observation of the solar eclipse of 22 December 1870 from Sicily. The telescope was placed in a small dome, coming from the old Specola, on the SW terrace in front of the Observatory. The only instrument available for use in Arcetri, in February 1872 it was used to monitor the solar activity and observe the photospheric spectrum, on the days before and after the auroral display (Donati 1872b). A new high-dispersion 25-prisms spectroscope attached to the Fraunhofer telescope allowed to observe in April the inversion of the Hα line on sunspots (Donati 1872c); in June, the chromosphere in the D3 Fraunhofer line, later known to be due to Helium (Bianchi et al. 2016; Donati 1872d).

7 STRUVE, PULKOVO AND ARCETRI

In October 1871 the Arcetri building yard was visited by Otto Wilhelm Struve (1819-1905; Figure 17). The German-Russian astronomer was one of the most authoritative figures in 19th century astronomy. In 1862 he became director of the Pulkovo Observatory near St. Petersburg, one of the best built and equipped astronomical observatories of the time, founded by his father Wilhelm in 1839 (Batten 1988). Here is how Donati remembered Struve’s visit in the speech for the 1872 inauguration:

![Figure 16. The second inauguration of the Arcetri Observatory, on 27 October 1872 (F.lli Alinari, Firenze. Archivio Storico, INAF-Osservatorio Astronomico di Monte Porzio, Roma).](image-url)
Here came, among others, Struve, the illustrious Russian astronomer who, in the several reports his Government asked him on the state of practical astronomy in the numerous countries he visited, never ceased to deplore the miserable conditions of Italian observatories, and whose authoritative voice, having been heard by our own Government, certainly had not a small influence on the conception and realization of this Observatory. Struve wisely directs the large observatory of Pulkova, which is a truly and splendid scientific royal palace of which he is the prince (Donati 1872e: 5).

Donati indeed believed that Struve gave a big thrust to the project. The Italian astronomer hoped that his colleague could be present at the 1872 ceremony, when Struve would have been a guest of honour and bestowed with a high decoration. However, Struve could not be present (Bianchi & Galli 2015).

Among Struve's "several reports", one describes a tour of almost all Italian Observatories - including the Specola of Florence - that had taken place a decade before, in Autumn 1863. Struve found all the Observatories poorly manned, equipped and badly built; no one, he found, followed "those rules ... which already for more than half a century have been recognized by the scientific world as essential for the success and exactness of observations" (Bianchi & Galli 2015: 217). At the end of the visit, Struve met the Minister of Public Instruction of the Kingdom of Italy and expressed his recommendations about Italian Observatories:

... instead of the large number of these establishments spread over the Kingdom and almost none of which were provided with sufficient means to the current requirements of science, it would be useful to have only a small number of well-organized and suitably-equipped ...

(Bianchi & Galli 2015: 226).

Back home, Struve reported to his own Minister and his relation was published in Russian in 1864, apparently unnoticed to Italian astronomers.

In Autumn 1867 Donati and Struve met in Berlin at the conference of the Europäische Gradmessung. It was probably on that occasion that Donati learned of the report. Afterwards, Struve sent him a copy in French. Donati immediately started to use Struve's report to support the building of the new Observatory in Florence (Donati 1868b). References to the report are also present in the Parliament discussions on the bill for the Observatory and on the budget of the Ministry for Public Instruction (Bianchi & Galli 2014; 2015). After his 1871 visit to Arcetri, Struve sent Donati a letter expressing his satisfaction for the new Observatory, exhorting the authorities to complete it and provide the necessary means. This document also was used by Donati, who passed it to the Ministry (Bianchi & Galli 2015).

Under the direction of Struve father and son, Pulkovo became a model for the building of several observatories worldwide (Wolfschmidt 2009). It became a source of inspiration for the Arcetri project as well. The E-W layout of the Florentine building reminds that of the Russian Observatory, even though the design was not unique to Pulkovo (Castro Tirado & Castro-Tirado 2019) - in Italy it characterises the Capodimonte Observatory in Naples built from 1812 (Pigatto 2012). Donati and Falcini must have used the Description de l'observatoire astronomique central de Poulkova (Struve 1845) as a sort of handbook, where to search for ideas and technical solutions, as much as Amici and Antinori did with Dorpat's observatory (Struve 1825). Indeed, Donati (1864b) asked Struve about details of the clockwork movements of the Merz refractor as read on page 185 of the Description. In Falcini's project, the roof of the meridian hall was supported by pillars and arches on each side of the three vertical slits, as "in the drawings of the Pulkovo Observatory in Russia which is reputed to be one of the best built" (Comparini 1878). There were
plans to install a transit instrument on the prime vertical, as Wilhelm Struve did in Pulkovo (Cipolletti 1872; Donati 1869b). There is also the suggestion of a further link: in 1866 a wood-seller from Paris, Alphonse Thibaut, was paid for preliminary drawings of the dome for the Amici telescope (Conto del R. Museo 1866). Was him related to that "M. Thibaut, former stage technician", that built the domes for Pulkovo (Struve 1845: 36)?

8 COMPLETING THE OBSERVATORY

Despite the 1872 inauguration, the Observatory was still incomplete, both in the building and in its instrumentations. Donati, still recovering from his broken leg, felt discouraged: "If I had an enemy", he confessed to Schiaparelli, "I would wish him to be an astronomer, and that it would come to his head, as it came to me, the idea of making a New Observatory" (Donati 1872f). Nevertheless, he kept on going. At the end of the year, he proposed the Municipality to build another, pedestrian, access from the North, connecting the Observatory to the new Viale dei Colli (Figure 1), an avenue made by the architect Giuseppe Poggi (1811-1901) and part of a plan of modernization started when Florence was Capital (Poggi 1882). Perhaps, by connecting it to the Viale, already a popular promenade, Donati hoped to gain visibility (and support) for the Observatory. The project was not implemented and still nowadays the North access is limited to a narrow passageway to the nearest street.

In the end the building had成本 much more than what foreseen, 197000 liras - almost twice what projected (Donati 1873a;b). The rise must have been due also to inflation between 1869 and 1873, since the cost is only 1.5 times more than the original, when converted to current values (about 770000 €). Most of the extra expenses had been sustained by the contractor Berti, who demanded to be paid. Donati thought about solving the issue by proposing an increase of the funding from the Ministry, to be sustained by a refurbishment of the law that had never been approved (Donati 1873a). The cost of the missing instruments, instead, were to be covered by the Municipality and Province, that in June 1872 had signed an agreement with the Minister of Public Education to sustain the needs of the Institute of Superior Studies, to which the Observatory belonged. For the Observatory, 87000 liras of extraordinary expenses had been allocated (Riordinamento 1872). Donati tried to convince the authorities that the total cost, including the building and the instruments, would have been nevertheless small, when compared to those of foreign observatories. Pulkovo - the unreachable reference at the top of the scale - had costed "about 8 and a half million of current liras", though Donati recognised that it was "the richest of all that exists, and truly its example dismays". Just mentioning the more recent ones, the new Leiden Observatory costed "3 millions of francs"; the Dudley Observatory in Albany, NY, half a million liras; and the Observatory of Leipzig, 200000 liras - a cost comparable to what needed by Arcetri, though the German was "more modest than the Florentine Observatory" and financed by "the small Kingdom of Saxony" (Donati 1873c). The Kingdom of Italy, Donati implied, could certainly spend more for the sake of Science.

When asking for new instruments, Donati maintained his original ideas mentioned above, that the Observatory had to be dedicated to classical astronomy:

The New Observatory, for its position and construction, must be especially directed to the astronomical observations so called fundamental, that is the determination of the positions of celestial bodies.

This purpose, although less universally understood, and, I will say, less seductive than those other studies that target the physical constitution of the stars, is still the most important of Astronomy (Donati 1873b).

Indeed strange words in the mouth of a pioneer of astrophysics! Nevertheless, the largest expense that Donati asked was that for a great meridian circle "that the Observatory of Florence has never had", with a circle diameter of at least 1 metre and possibly made by the Repsold firm in Hamburg - clearly, that instrument was deemed too complex for the Officina Galileo of Florence. For the rest, he suggested modifications to the old Sisson transit instrument and required just a spectroscope for the Amici refractor on its equatorial mount, which was considered complete (omitting that it did not have yet graduated circles and clockwork movements). He also asked for the small domes on the East and West ends (in Figure 16 they are covered by provisional roofs); a few small buildings for laboratories, workshops, the gatekeeper and assistants; and the completion of the pavilion to install the self-recording magnetic instruments he had bought earlier in London - which could be used for research on "Cosmic Meteorology" (Bianchi et al. 2011; Cipolletti 1872; Figure 18).

Other problems were already lurking. Donati had asked the builder to follow his own design for the support of the meridian slits, not Falcini's original projects. Already in September 1872, the roof proved unable to shelter the meridian hall from heavy rains; a modification was needed (Falcini 1879). Donati was certainly
ready to face this and other difficulties. Unfortunately, he suddenly died on 20 September 1873, on his return from a meteorology conference in Vienna, victim of the 19th-century fourth cholera pandemic (1863-1875).

9 EPILOGUE

With the death of Donati, the first phase of the life of the Arcetri Astronomical Observatory can be considered as concluded. At the end of 1873 the authorities of the Institute were almost succeeding to have an eminent astronomer as Schiaparelli as director, but in January 1874 he declined the offer because of family reason. It was then decided to leave the directorship vacant, in order to save money and use it to complete the instrumentation: though this was intended as a temporary solution, the Observatory remained without a director for 20 years. In the meanwhile, the only astronomer at work in Arcetri was Tempel, coming from the Brera Observatory and employed at the end of 1874 at the suggestion of Schiaparelli (Bianchi et al. 2011).

Tempel had to work with incomplete instrumentation and in a building that was rapidly deteriorating. The rainwater infiltrations became more and more important; the roof of the meridian hall had to be reinforced by posts and the West terrace covered with tiles. Other damages followed in the East wing. Most of the problems were due to lack of maintenance, stopped by a legal quarrel between the contractor Berti and the architect Falcini, who wanted to be paid, and the Ministry, who imputed to them all the faults of the construction. After the solution of the dispute, and further delays, a major refurbishment of the Observatory started in 1889 and a new Director, Antonio Abetti (1846-1928), was appointed at the end of 1893.

Figure 18. The Arcetri Observatory and surrounds in 1880 (Archivio Storico INAF-Osservatorio Astrofisico di Arcetri). The circular wall of the 1869 pavilion still existed, but was never put into use for the magnetic instruments (Bianchi et al. 2011).
Abetti modified the mechanisms of the mount of the Amici telescope, that finally had a clockwork movement, graduated circles, and a metal tube, and substituted the wooden cylindrical dome with one covered by metal. He obtained a Bamberg transit instrument and dreamed of buying the large meridian circle that Florence never had. However, in 1921 Arcetri became an “Astrophysical Observatory” under the directorship of his son Giorgio (1882-1982); the funds saved for the circle were used for the construction of the Solar Tower, inaugurated in 1925 (Bianchi et al. 2011). The same year, the Amici telescope was equipped with a new 36-cm (14”) Zeiss objective. The 1840s Amici doublet is now part of the historic collection of the Observatory, while the original mahogany tube is on display at the Museum Galileo in Florence. The telescope is still in use today for public observations in a dome detached from the main building (Figure 19).

A standard bearer of astrophysics in Italy, Arcetri was dedicated for most of the 20th century to solar physics, while in the last four decades opened itself to several other research and technological fields. With over a hundred people working every day on the hill (including researchers, technicians, postdocs, students and administrative staff), the Arcetri Astrophysical Observatory still thrives nowadays, waiting to celebrate the 150th anniversary of its second inauguration in 2022.

10 NOTES

1. All translations into English were made by the author.
2. The current monetary values were estimated using the conversion tables provided by the Italian Istituto Nazionale di Statistica (https://www.istat.it/it/archivio/243273).
3. The 14th century Franciscan Basilica of Santa Croce (Holy Cross) in Florence had been the burial place of distinguished citizens: among them Niccolò Machiavelli (1469-1527), Michelangelo Buonarroti (1475-1574) and Galileo Galilei (1574-1642). Starting with the remains of Piedmontese poet, but Florence resident, Vittorio Alfieri (1749-1803), from the beginning of the 19th century the church received monumental burials and cenotaphs of several others notable Italians; it became known as the “temple of Italian glories” (in the words of the poet Ugo Foscolo [1878-1827], whose remains are also in Santa Croce). When contemplating the tombs in 1817, the French author Marie-Henri Beyle (1783-1842) was overcome with awe and experienced the condition which is now known, after his pseudonym, as Stendhal’s syndrome (Berti 1993).

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12 REFERENCES

Amari, M., 1864. Letter to the Director of the Museum, dated May 31. Museo Galileo, Firenze (Fondo ARMU, Affari 75, n. 53).

Amici, G. B., 1831a. Draft of a letter to V. Antinori, dated January 11. Biblioteca Estense, Modena (Fondo Amici, folder 1125, sheet 8400).

Amici, G. B., 1831b. Draft of a letter to V. Antinori, dated October 22. Biblioteca Estense, Modena (Fondo Amici, folder 1125, sheet 8402).

Andreucci, O., 1868. Del cosi detto Istituto Ximeniano, del nuovo Osservatorio fiorentino e del loro avvenire. Osservazioni storiche e voto. Firenze, Eredi Botta. Annali del Museo Imperiale di Fisica e Storia naturale di Firenze, 2, Firenze, Guglielmo Piatti (1810).

Antinori, V., 1830. Letter to G. B. Amici, dated December 23. Biblioteca Estense, Modena (Fondo Amici, folder 40, sheet 197).

Antinori, V., 1831a. Letter to G. B. Amici, dated January 25. Biblioteca Estense, Modena (Fondo Amici, folder 40, sheets 200-201).

Antinori, V., 1831b. Letter to G. B. Amici, dated October 17. Biblioteca Estense, Modena (Fondo Amici, folder 40, sheets 205-206).

Antinori, V., 1832. Copy of a letter to Leopold II, dated February 15. Museo Galileo, Firenze (Fondo ARMU, Copialettere 13, p. 11-17).

Antinori, V., 1840. Copy of a letter to Leopold II, dated November 24. Museo Galileo, Firenze (Fondo ARMU, Copialettere 21, p. 85-99).

Antinori, V. 1849. Copy of a project sent to the Superintendent of the Imperial and Royal House and Court, dated November 21. Museo Galileo, Firenze (Fondo ARMU, Copialettere 28, p. 63-90).

Antinori, V., 1858. Copy of a letter to the director of the public works of the State, dated November 2. Museo Galileo, Firenze (Fondo ARMU, Copialettere 36, p. 102-107).

Arrighi, G., 1959. Il Reale Osservatorio astronomico di Marlia, Lucca. Physis, 1(3), 165-195.

Atti del Consiglio Comunale di Firenze dell’anno 1865-66. Firenze, Cellini (1872)

Atti del Consiglio Provinciale di Firenze. Sessioni ordinarie del 1866 e straordinaria del 1866-67. Firenze, Pier Capponi (1867).

Baldelli, G. 1870. Objection to the Neighbourhood of an Observatory. Astronomical Register, 8, 183.

Barbagli, F., Bianchi, S., Casalbuoni, R., Dominici, D., Mazzoni, M., et al. (eds.), 2017. Astronomia e Fisica a Firenze dalla Speola ad Arcetri. Firenze, Firenze University Press.

Batten, A. H., 1988. Resolute and Undertaking Characters: The Lives of Wilhelm and Otto Struve. Boston: D. Reidel Pub. Co.

Berti, D., 1869. Relazione della commissione generale del bilancio sul progetto di legge presentato dal ministro delle finanze nella tornata del 21 gennaio 1866. In Raccolta dei documenti stampati per ordine della Camera, Legislatura X – Sessione 1867-68 dal 22 marzo 1867 al 20 agosto 1869, 8. Firenze, Eredi Botta. Doc. 254A.

Berti, L. (ed.), 1993. Il Pantheon di Santa Croce. Firenze, Cassa di Risparmio di Firenze.

Bianchi, S., 2010. Gli strumenti di Giovan Battista Amici dalla vecchia Specola di Firenze al nuovo Osservatorio di Arcetri. Nuncius, 25(2), 357-382.

Bianchi, S., Galli, D., Gasperini, A., 2011. Giovanni Virginio Schiaparelli e l'Osservatorio di Arcetri. Firenze, Fondazione Giorgio Ronchi.

Bianchi, S., Galli, D., Gasperini, A., 2012. “The first Astronomical Observatory of Italy”. The birth of the Arcetri Observatory (1861-1873). Il Colle Di Galileo, 1 (1-2), 55-70.

Bianchi, S., Galli., D., Gasperini, A., 2013. Le due inaugurazioni dell’Osservatorio di Arcetri. Giornale di Astronomia, 39(3), 19-30.

Bianchi, S., Galli, D., 2014. Il riordino degli Osservatori astronomici all’indomani dell’unità d’Italia. Giornale di Astronomia, 40(4), 35-44.

Bianchi, S., Galli, D., 2015. Les Observatoires astronomiques en Italie: an 1863 report by Otto Wilhelm Struve. Nuncius, 30(1), 195-227.

Bianchi, S., Galli, D., Gasperini, A., 2016. The origins of Astrophysics in Florence. In Chinnici, I. (ed.). Starlight. The origins of Astrophysics in Italy. Napoli, Arte'm. Pp. 14-33.

Bianchi, S., 2017. The Electrical Institute at the Podere della Cappella. Il Colle Di Galileo, 6(2), 15-31.

Bocci, G., Bellesi, P., Stoppa, G., Becucci, A., Berti, C., 1881. Transcripts of witnesses’ statements to the Court of Appeal of Florence, dated June 17. Archivio Storico Università, Firenze (Fondo Carteggio della Soprintendenza, 1881/53).
Bonacci F., Fodera Serio G., Poppi F., 2005. La ricerca astronomica in Italia al momento dell’Unità: uomini e strutture. In _Cento anni di astronomia in Italia 1860-1960. Atti dei Convegni Lincei n. 217_. Roma, Bardi Editore. Pp. 29-72.

Bravieri, D., 1985. _L'Osservatorio Ximeniano di Firenze_. Firenze, Baccini & Chiappi.

Cade, W. B., III, Chan-Park, C., 2015. The Origin of “Space Weather”. _Space Weather_, 13, 99–103.

Castro Tirado, M. A., Castro-Tirado, A. J., 2019. The evolution of astronomical observatory design. _Journal of the Korean Astronomical Society_, 52: 99-108.

Chiavistelli, A., 2017. «Una potenza accanto alle potenze». Firenze Capitale d’Italia (1865-1870). _Annali Di Storia Di Firenze_, 11, 11-43.

Chinnici, I., 2015. Per una storia istituzionale degli Osservatori Astronomici in Italia. _Giornale di Astronomia_, 41(1), 11-21.

Cipolletti, D., 1872. Il nuovo osservatorio astronomico di Firenze. _La Nazione_, October 27.

Commission Internationale du metre, 1872. _Réunions générales de 1872. Procès-verbaux_. Paris, Imprimerie nationale.

Comparini, P., 1878. Osservatorio astronomico di Arcetri. Relazione Peritica. Archivio Storico Università, Firenze (Fondo Carteggio della Soprintendenza, 1878/41).

_Conto di R. Museo con Alfonso Thibaut_, 1866. Payment made on April 30. Museo Galileo, Firenze (Fondo ARMU, Affari 77, n. 50).

Corsini, A., 1924. Le origini dell’Osservatorio di Arcetri. _L’Universo_, 5(4), 255-266.

De’ Vecchi, D., 1908. Rapporto del professore d’astronomia. _Annali del Museo Imperiale di Fisica e Storia naturale di Firenze_, 1, 1–13.

De’ Vecchi, D., 1810. Descrizione dell’Osservatorio Imperiale di Firenze. _Annali del Museo Imperiale di Fisica e Storia naturale di Firenze_, 2, 5-113.

Di Bono, M., 1990. Un secolo di astronomia a Pisa nelle vicende della Specola (1735-1833). _Bollettino Storico Pisano_, 59, 49-89.

Donati, G. B., 1857. Intorno alle due prime comete del 1857. _Nuovo cimento_, 5, 345-359.

Donati, G. B., 1862. Intorno alle stelle stellari. _Nuovo Cimento_, 15, 292-304, 366-376.

Donati, G. B., 1863a. Memorie astronomiche [...] (Abstract by S. M. Drach, Esq.). _Monthly Notices of the Royal Astronomical Society_, 23, 100-107.

Donati, G. B., 1863b. Draft of a letter to C. Ridolfi, dated December 16. INAF-Osservatorio Astronomico di Monte Porzio, Roma (Archivio Storico del Museo Astronomico e Copernicano, Fondo Donati, Corrispondenza, folder 82).

Donati, G. B., 1864a. Draft of a letter to an unknown person, dated December 26. Biblioteca Nazionale Centrale, Firenze (Carteggi Vari, 325, 82).

Donati, G. B., 1864b. Draft of a letter to O. W. Struve, dated June 6. Biblioteca Nazionale Centrale, Firenze (Carteggi Vari, 325, 83).

Donati, G. B., 1866a. _Intorno ad un nuovo osservatorio astronomico da erigersi in Firenze_. Firenze, Cellini.

Donati, G. B., 1866b. Studi astronomici. Intorno a ciò che la Luna ci fa conoscere della terra; e intorno alla riforma degli osservatori astronomici in Italia. _Nuova Antologia_, 1, 495-502.

Donati, G. B., 1866c. Draft of a letter to an unknown person, dated July 10. INAF-Osservatorio Astronomico di Monte Porzio, Roma (Archivio Storico del Museo Astronomico e Copernicano, Fondo Donati, Corrispondenza, folder 82).

Donati, G. B., 1868a. II Sole. I. Dei metodi per determinarne la distanza dalla Terra. _Nuova Antologia_, 8, 334-353.

Donati, G. B., 1868b. Della prossima eclisse solare e delle condizioni presenti dell’astronomia pratica in Italia. _La Nazione_, June 26.

Donati, G. B., 1868c. Letter to L. G. de Cambray Digny, dated October 27. Biblioteca Nazionale Centrale, Firenze (Carteggi, Cambray Digny 23, 55).

Donati, G. B., 1868d. Letter to L. G. de Cambray Digny, dated November 21. Biblioteca Nazionale Centrale, Firenze (Carteggi, Cambray Digny App. 19, 83).

Donati, G. B., 1869a. Letter to the Superintendent of the Institute of Superior Studies, dated June 9. Archivio Storico Università, Firenze (Fondo Carteggio della Soprintendenza, 1869/87).

Donati, G. B., 1869b. Parole pronunziate dal Prof. G.-B. Donati il 26 settembre 1869 in occasione che gli astronomi di varie parti d’Europa riuniti in Firenze per conferire intorno alla misura di un grado europeo visitarono i lavori incominciati per la costruzione di un nuovo osservatorio sulla collina di Arcetri. Firenze, Le Monnier.

Donati, G. B., 1870. _The aurora borealis_. _Astronomical Register_, 8, 269-270.

Donati, G. B., 1871a. Letter to A. Vegni, dated February 20. _Archivio Storico della Provincia_, Firenze (Carteggi, 320, 111).

Donati, G. B., 1871b. Draft of a letter to G. Cantoni, dated November 8. INAF-Osservatorio Astronomico di Monte Porzio, Roma (Archivio Storico del Museo Astronomico e Copernicano, Fondo Donati, Corrispondenza, folder 82).
Donati, G. B., 1871c. Osservazioni astronomiche eseguite in Italia. In General-Bericht über die Europäische Gradmessung für das Jahr 1870. Berlin, Druck und Verlag von George Reimer. Pp. 25-27.

Donati, G. B., 1871d. Beobachtungen des Cometen II. 1871., *Astronomische Nachrichten*, 78, 59-60 & 173-174.

Donati, G. B., 1871e. The falling stars. *Astronomical Register*, 9, 227-230.

Donati, G. B., 1871f. Aurora boreale osservata a Firenze la sera del 18 aprile 1871. *La Nazione*, April 20.

Donati, G. B., 1871g. Letter to G. V. Schiaparelli, dated October 18. INAF-Osservatorio Astronomico di Brera, Milan (Archivio Storico, Corrispondenza Scientifica Serie III)

Donati, G. B., 1872a. Letter to G. Santini, dated October 5. INAF-Osservatorio Astronomico di Padova (Archivio Storico, Fondo Santini, Corrispondenza, lettere sciolte, Busta 1, fasc. 26).

Donati, G. B., 1872b. La grande aurora boreale del 4 febbraio 1872. *La Nazione*, February 6.

Donati, G. B., 1872c. Osservazioni spettroscopiche di macchie solari fatte a Firenze. *Memorie della Società degli Spettroscopisti Italiani*, 1, 52-56.

Donati, G. B., 1872d. Sulle righe spettiali. *Bollettino meteorologico dell’Osservatorio del Collegio Romano*, 10(5), 43-44.

Donati, G. B., 1872e. Parole pronunziate dal Prof. G.-B. Donati per la solenne inaugurazione del nuovo osservatorio di Firenze ad Arcetri il 27 ottobre 1872. Firenze: Le Monnier.

Donati, G. B., 1872f. Letter to G. V. Schiaparelli, dated December 2. INAF-Osservatorio Astronomico di Brera, Milan (Archivio Storico, Corrispondenza Scientifica Serie III).

Donati, G. B., 1873a. Liquidazione dei lavori del Nuovo Osservatorio, dated February 7. Archivio Storico Università, Florence (Fondo Carteggio della Soprintendenza, 1873/52).

Donati, G. B., 1873b. Relazione intorno ad alcuni importanti provvedimenti per il Nuovo Osservatorio, dated February 22. Archivio Storico Università, Florence (Fondo Carteggio della Soprintendenza, 1873/52).

Donati, G. B., 1873c. Letter to L. Ridolfi, dated February 24. Archivio Storico Università, Florence (Fondo Carteggio della Soprintendenza, 1873/52).

Falcini, M., 1865. Letter to the Director of the Museum, dated November 6. Archivio Storico della Provincia, Firenze (Carteggi, 118, 92.5).

Falcini, M., 1866. Copy of a letter to G. B. Donati, dated January 21. Museo Galileio, Firenze (Fondo ARMU, Affari 76, n. 50).

Falcini, M., 1873. Letter to G. B. Donati, dated January 4. Archivio Storico Università, Florence (Fondo Carteggio della Soprintendenza, 1873/52).

Falcini, M., 1879. Letter to U. Peruzzi, dated October 6. Archivio Storico Università, Florence (Fondo Carteggio della Soprintendenza, 1879/82).

Ferrucci, A., 1867. Copia di voto emesso dal Consiglio Superiore dei Lavori Pubblici, dated August 3. Museo Galileio, Firenze (Fondo ARMU, Affari 77, n. 10).

Förster, W. (ed), 1865. *Verhandlungen der ersten allgemeinen Conferenz der Bevollmächtigten zur Mittel-Europäischen Gradmessung*. Berlin, Königlichen Geheimen Ober-Hofbuchdruckerei (R.v. Decker).

Friedli, T. K., Keller, H. U., 1993. Rudolf Wolf als Pionier der Sonnenfleckenforschung. *Vierteljahrsschrift der Naturforschenden Gesellschaft in Zürich*, 138(4), 267-281.

Funaro, L. E., 2001. Il criterio e la mano: viaggi e donativi sovrani all’Imperiale e regio museo fiorentino. *Nuncius*, 16(1), 153-189.

Galli, D., Gasperini, A., Bianchi, S. 2013. Dalla meccanica celeste alla spettroscopia stellare. Corrispondenza tra Giovanni Battista Donati e Ottaviano Fabrizio Mossotti. *Atti della Fondazione Giorgio Ronchi*, 68(1), 15-84.

Gasperini, A., Galli, D., Bianchi, S., 2011. La cometa del Risorgimento. *Giornale di Astronomia*, 37(3), 9-14.

Gazzetta Ufficiale del Regno d’Italia, November 16, page 2 (1866).

Gazzetta Ufficiale del Regno d’Italia, September 3, page 1 (1868).

Godoli, A., Palla, F., Righini, A., 2017. *La villa di Galileo in Arcetri / Galileo’s villa at Arcetri*. Firenze, Firenze University Press.

Inghirami, G., 1819. Letter VII. *Correspondance astronomique, géographique, hydrographique et statistique*, 3, 135-163.

Kronk, G., 2003. *Cometography, a catalogue of comets*, Vol. II, 1800-1899. Cambridge, Cambridge University Press.

Maison, L., 2003. Les observatoires italiens en 1875 un example pour le renouveau de l’astronomie française? *Nuncius*, 18(2), p. 577-602.

Matteucci, C., [1865a]. Letter to Donati, undated. INAF-Osservatorio astroonomico di Monte Porzio, Roma (Archivio Storico del Museo Astronomico e Copernicano, Fondo Donati, Corrispondenza, folder 140).

Matteucci, C., [1865b]. Letter to Donati, dated October 14. INAF-Osservatorio astroonomico di Monte Porzio, Roma (Archivio Storico del Museo Astronomico e Copernicano, Fondo Donati, Corrispondenza, folder 140).

Matteucci, C., 1866a. *Sull’indirizzo degli studi e sul riordinamento dei locali del museo di Fisica e Storia Naturale di Firenze*. Firenze, M. Cellini & C.
Struve, W., 1845. *Description de l'observatoire astronomique central de Poulkova*. St. Petersbourg: Académie Impériale des Sciences.

von Zach, F. X., 1825. Les quatre comètes de l’an 1825. *Correspondance astronomique, géographique, hydrographique et statistique*, 13, 182-195.

Wolfschmidt, G. (ed.), 2009. *Cultural Heritage of Observatories and Instruments – From Classical Astronomy to Modern Astrophysics*. Proceedings of the International ICOMOS Symposium in Hamburg, October 14–17, 2008. Berlin: hendrik Bäßler-Verlag.

Zanini, V., 2009. I primi Osservatori Istituzionali Italiani. In Chinnici, I. (ed.). *Astrom 2009. Astronomia e Strumenti. Il patrimonio storico italiano quattrocento anni dopo Galileo*. Città del Vaticano, Edizioni Musei Vaticani; Livorno, Sillabe. Pp. 46-53.

Zobi, A., 1850. *Storia civile della Toscana dal 1737 al 1848 (Vol. II)*. Firenze, Luigi Molini.