OF the instruments in the Museum's collection made before 1600, some, such as those by Habermel and Cole, are fairly widely known and well studied. Others, although they have been on display for many years, had escaped careful attention until their turn came to be catalogued for Epact (see the front page). One instrument that had gone largely unnoticed is a rectangular wooden sundial, displayed for many years in the Top Gallery alongside the nocturnals.

The examination of this instrument has led to the recovery of a forgotten mathematician, a man of some importance in sixteenth-century Florence, and it adds to our understanding of the position of mathematics and mathematical instruments in his society.

On technical grounds alone the sundial has always merited inclusion in the Museum's displays. It offers two different ways of finding the time, one on each face of the flat instrument. One side has an altitude dial of the design associated with the astronomer Johannes Regiomontanus and published by him in 1474, while the other has a form of horary quadrant.

The Regiomontanus form of sundial was not common, and with a date of 1558 the present example ranks as an early survivor. A slightly earlier example can be found on the reverse side of a nocturnal by Caspar Vopel in the Museum's collection, dated 1557; another example recorded in Epact is in the British Museum, again by Vopel and dated 1551.
Both the Regiomontanus dial and the horary quadrant determine the time from a measurement of the altitude of the sun. The top edge of the instrument incorporates two pinhole sights for this purpose: they are aligned with the sun by allowing sunlight passing through one hole to fall, as a bright spot, on the other. The dials each require a plumb-line to establish the angle between the zenith and the sun (the complement of the altitude). Each plumb-line would have had a bead which could be set, friction-tight, at any position on the line. In this instrument both plumb-lines are missing.

Solar altitude depends on variables other than time: it will also vary with the date and with the latitude of the observer. The quadrant side of the instrument has an adjustment for the former but not the latter and so can be used in only a single latitude. An inscription gives its latitude as 43° 30′ and the date 1558: 'QVADRANS HORARVM · AD LAT GRAD · XLIII · MIN · XXX · M D L VIII'. The Regiomontanus dial however is a universal dial, serving for the whole world, and is announced as such: 'HOROLOGIVM SOLARE RECTILINEVM QVADRANGVLARE · VNIVERSO ORBI DESERVIENS'.
The quadrant indicates the time in 'Italian hours', according to which the day has twenty-four equal divisions, beginning and ending at sunset. There are lines for the hours 9 to 24, along with instructions to the left of the quadrant: 'LINEAE RVBEAE ANTE MERIDIEM', marked in red, and 'NIGRAE VERO POST', marked in black. This is an unusual example of colour-coded instructions, telling the user that the morning hours are in red, the afternoon in black. As these are Italian hours, the morning and afternoon lines are not symmetrical, and the morning hours sweep upwards across the more vertical afternoon hours.

Crossing both sets of hour divisions are lines for the daily motion of the sun through the sequence of daytime hours. These are arcs of circles that begin at zodiac or date positions corresponding to whole-hour dawn times. The lines represent the paths that the bead on the plumb-line, set for the date in question, would trace as the sights are made to follow the sun.
To the left of the daily motion lines is a straight scale with zodiac names and months from June to December; to the right is a corresponding curved scale from December to June. The right edge is also marked 'LINEA MERIDIANA', showing that it indicates the position of the bead at successive noons. Outside the projection of lines is a separate altitude scale with a pivoted brass suspension point at its apex for the missing plumb-line.
On the same side as the horary quadrant are two circular scales. One is a zodiacal calendar marked 'ROTA GRADI SOLARIS', with symbols of the zodiacal signs and the dates of the sun's entry into each sign during its yearly progress. This is enclosed in a shadow square which utilizes the same plumb-line suspension as the quadrant. The second circular scale is a scale of golden numbers ('AVR NVM', the number of the year in the lunar cycle of nineteen years) and epacts ('EPACTA', the moon's age on the first day of the year). It is marked 'HAEC ROTA COEPIT 1558′, indicating that it begins in 1558. There is also the motto 'SOLI DEO GLORIA' ('glory to God alone') and, under the colour-coded instructions to the left of the quadrant, the maker's signature: 'MINIAS PITT· FLO· FACI·'.
The lines, numbers and letters of the quadrant and its inscriptions have been engraved and stamped, filled in black or red, and the surface varnished. The two circular scales however have been painted, in black, red, white and gold, and the remainder of the surface has foliate decoration, also painted in black and gold.
The side of the instrument with the Regiomontanus dial has no painting, only engraving and stamping filled in black and red. The dial has an articulated brass arm to position the suspension point of the missing plumb-line across a triangular grid formed by the horizontal lines of a latitude scale, from 0 to 66 degrees, and the converging lines of a zodiacal scale.

To use the Regiomontanus dial, the suspension point of the plumb-line is positioned, using the articulated brass arm, at the intersection point appropriate to the observer's latitude and the date, with the bead set for the solar declination. The sights are then trained on the sun and the position of the bead among the rectilinear hour lines gives the time, in this instance in the system of common hours, where the day is divided into two periods of 12 equal hours, beginning at midnight and noon.

The single set of hour lines serves for both the morning and afternoon and is numbered from 1 to 12 and from 12 to 1, with one extremity marked 'MEDIVM NOCTIS', or 'midnight', and the other 'MERIDIANVS', or 'noon'.
The maker has chosen to give his signature a second time on the Regiomontanus side of the instrument, in the form 'PER MINI · PITTVM MON· OLI· FABREFAC· M D L III·'. The small 'v' in the date has been added as a correction. Around the rim he has also given an appropriate quotation from Ovid: 'TEMPORA LABVNTVR TACITISQVE SENESCIMVS ANNIS ET FVGIVNT FRENO NON REMORANTE DIES' – 'time slips away and we grow old with the silently passing years; there is no bridle that can curb the flying days' (Fasti, book 6, lines 771-2).
Who was this 'Minias Pitt. Flo.' or 'Mini. Pittum Mon. Oli.' who signed himself twice as the maker of the instrument? A search among the older and more obscure Italian biographical dictionaries reveals Miniato Pitti, a member of the Florentine nobility and Abbot of the monastery of San Miniato al Monte, a scholar with a reputation in his time for extensive learning, a mathematician and cosmographer who was involved in at least one of the mathematical projects of Cosimo I de' Medici, an enthusiastic connoisseur of painting, and a good friend and committed patron of Giorgio Vasari.

Several points confirm Miniato Pitti as the maker of the Museum's instrument. The church of San Miniato, a famous landmark overlooking Florence, was already in the hands of the Olivetan branch of the Benedictines in the sixteenth century and 'MON. OLI.' in Pitti's signature on the dial indicates that he belonged to the order of Monte Oliveto. The latitude chosen for the horary quadrant is appropriate for the region around Siena, and thus for the site of the Olivetan mother monastery, Monte Oliveto Maggiore.
Pitti is included among the biographies compiled by Michele Poccianti and published in Florence in 1589 as the Catalogus Scriptorum Florentinorum. Here Pitti is described as distinguished in secular knowledge as well as the study of scripture, and as particularly learned in mathematics and cosmography. His funeral in 1567 provoked a great gathering of learned men and monks mourning his passing in the church of San Miniato. More importantly, he is remembered in Poccianti's account as someone who was accustomed to making sundials, and making them with great skill, in bronze, wood or whatever other material was required.

More can be learned about Pitti from the extensive literary record of Giorgio Vasari, in particular his Lives of the Artists and his correspondence, which includes over twenty of Pitti's letters. In fact, Pitti is not unknown. Not only is he familiar within the branch of specialist art historical scholarship devoted to Vasari, but his memory is also preserved in the Olivetan order today.
Pitti was one of Vasari's earliest, most enthusiastic and most faithful supporters. When describing his struggles to establish himself as a painter, Vasari introduces Pitti as one of his first important patrons. After arranging the very first commission which the nineteen-year-old Vasari received for a fresco, Pitti continued to use his influence and authority with the Italian Olivetans to place Vasari's work in different churches, first as abbot of several monasteries, then in the influential position of 'visitor', which obliged Pitti to travel widely at a time when the Olivetans were commissioning decoration in their monasteries under his guidance. These commissions first brought Vasari work in Pisa, Siena and Arezzo. Pitti then had him engaged for the extensive decoration of the refectories at San Michele in Bosco in Bologna in 1539 and at the Olivetan monastery in Naples in 1544.

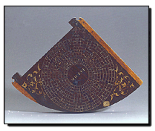
As well as the official work in the refectory at Naples, Vasari left a painting in a much less formal style in the sacristy corridor: a fresco portrait of an Olivetan monk, looking out of a window and holding his spectacles in one hand. This portrait is naturalistic and convincing and is probably of an individual Vasari had come to know well. Pitti was in Naples in 1544 as visitor to the monastery. There are only a few likely subjects for this portrait and Pitti, as Vasari's friend and sponsor for some fifteen years, is one of the most plausible candidates.

Pitti encouraged Vasari's work on the Lives and in 1548 proposed the Torrentino press in Florence for the first edition of what would become the most celebrated book in the history of art. It is clear that Pitti moved easily in the company of artists and was regarded as a connoisseur: Vasari described him as 'a man with a rare knowledge in cosmography and many other sciences, and particularly in painting.' He once owned Michelangelo's famous tondo of the Virgin and Child made for Bartolomeo Pitti. Among his artist friends were Salviati, Pontormo, Bronzino and Francesco da Sangallo, and in one letter written from Rome in 1563 he reported to Vasari a long conversation he had recently had with Michelangelo.
One of the most interesting revelations from Vasari's correspondence is the part played by Miniato Pitti in the planning and execution of the Guardaroba of the Palazzo Vecchio in Florence, where Vasari was designing the extensions undertaken by Cosimo I de' Medici. In a letter to Cosimo in September 1563, Vasari says that Pitti is dividing up the 'tavole' of Ptolemy (the maps of Ptolemy's Geographia) for the arrangement of the Guardaroba and that he will have the 'balls' (palle) made of limewood.

This implies that Pitti, who was greatly respected as a cosmographer, was responsible for the distribution of the maps by Egnatio Danti in the Sala delle Carte Geografiche. This arrangement was given prominence by Vasari in his account of the Accademia del Disegno in Florence, but it is not clear how much of Pitti's plan survived.

Pitti did keep in touch with the project, as far as his travels permitted. In October he was obliged to go to Rome, expressing his regret that this made it difficult for him to be involved effectively, and he remained there until the spring of 1564. In April, back in Florence, he wrote to the Duke assuring him that Danti would have all the help he needed, while in the same month Vasari wrote to Cosimo that Danti was working vigorously and that Pitti was helping him and teaching him many things.

Vasari's account of the Guardaroba was written while the work was in hand and not all of the plans came to fruition. He describes an arrangement of fifty-seven maps on the doors of cupboards around the room and forty-eight constellations above them. The ceiling was to have had two concealed compartments from which could be lowered two large globes, one of the earth, marked up as a key to the global disposition of the fifty-seven maps, the other of the heavens, marked with the forty-eight constellations and arranged to perform all the operations of an astrolabe. The idea had come, it seems, from Cosimo himself, as a definitive cosmography to establish a true account of the heavens and the earth and the relationship between them 'exactly and without errors'.
The Grand Duke's terrestrial and celestial spheres, descending from their hidden compartments by a concealed mechanism, may have been the 'balls' – here again Vasari uses the term palle – that Pitti was to have provided for the Guardaroba to realize the grand cosmographical design of Cosimo. From what has been recorded of Pitti's cosmographical work, it probably had a similar concern for detail and completeness. Both Poccianti in 1589 and Giulio Negri in 1722 (in his Istoria degli Scrittori Fiorentini) refer to a manuscript Libro di Geografia where Pitti links the ancient and modern names of the provinces, cities, towns, mountains, countries and nations of the whole world.
No doubt more information about Miniato Pitti will emerge through manuscripts and perhaps through other instruments. The identification of what is very probably a second instrument by Pitti has in fact already been made, with the aid of the Epact database. The instrument is among those from the Museum of the History of Science in Florence included in Epact. Although unsigned, it had previously been attributed to the Florentine maker Giovanni Battista Giusti. However, a stronger case can now be made for Pitti rather than Giusti as the maker of this Florentine instrument.



The instrument, dated 1556, is a wooden horary quadrant and perpetual calendar. It is dedicated to Cosimo before he became Grand Duke, and is projected for 43° 45′, the latitude of Florence. It is very similar to the Oxford horary quadrant. It uses the same projection of lines for Italian hours and a comparable colour-coding of the morning and afternoon lines, here in silver and gold: 'LINEAE ARGENTEAE ANTE MERID AVR POST'. The latitude is also indicated by an inscription very close in form to that on the Oxford instrument: 'QVADRANS HORARVM AD LAT· GRA· XLIII· MIN· XLV·'. The presence of the lines for the sun's daily motion is another distinctive feature. The general treatment of the two pieces is very alike, especially the combination of painting with engraving and stamping. The similarity of the foliate decoration painted in gold over black on the quadrant side of the Oxford instrument to that on the Florence quadrant is also particularly striking.

The Florence instruments in Epact also include another quadrant similar in character to the signed example by Pitti and to the unsigned quadrant. Significantly, it is by another Olivetan cosmographer and maker of wooden sundials, Stefano Buonsignori (d. 1589), best known for his painted polyhedral dials. Appropriately, it was Buonsignori who completed the cartographic project of the Guardaroba for Francesco I, after Danti lost his position on the death of Cosimo. The maps of both Danti and Buonsignori may reveal the influence of Pitti's Libro di Geografia, for its comprehensive gazetteer of ancient and modern place names would have been a valuable resource in the Guardaroba, whose maps identify place names in Latin, Italian and the language of the relevant country.
The case of Miniato Pitti provides an instructive example of the social implications of instrument making in sixteenth-century Florence. It has recently been suggested, in connection with the authorship of two instruments bearing the name or initials of Egnatio Danti (an astrolabe in Oxford and the instrumentum primi mobilis in Florence) that Danti's high social and scholarly standing makes it improbable that he himself would have made instruments.

Danti's father and grandfather were goldsmiths and architects, and his brother Vincenzo worked as a goldsmith before becoming famous as a sculptor. Whatever the noble standing of the family in Perugia, Danti's immediate background did not separate him from the world of the artist or rational artisan.

It is true that in Danti's 1569 Trattato dell'Uso et della Fabbrica dell'Astrolabio he suggests that if his reader wants to make ('fabbricare') an astrolabe, he should look for a diligent artificer and choose a large diameter. But this must not be taken out of context. The section of the work where this is written is actually providing the reader with practical and manual instruction. Indeed, the whole work was, as its title announces, concerned not only with the astrolabe's use but with its manufacture, falling within the tradition of such tracts in the 16th century.

No doubt many of Danti's readers would have needed help with metal working, even if they could be involved with other aspects of an instrument's construction. The notion of fabbricare can cover different individual capabilities and working relationships with craftsmen. But Danti justifies his extensive treatment of making the astrolabe with the explicit advice that those who want to understand it well should try their best to make one with their own hands: 'fabbricarlo di propria mano'.
To take a contemporary example, Tycho Brahe describes in his Mechanica of 1598 how he had several large round brass plates made with great care in Nuremberg. These were to be used in the future construction of a universal astrolabe of his own design. Tycho probably never accomplished this task, and there is no necessary implication that he would have worked on the final instrument. But this is at least an instance of a craftsman being engaged to provide not a finished piece but an item that would have been otherwise difficult to obtain. As such, it falls within the sense of Danti's advice.

If we want to tune ourselves to the sensibilities of the sixteenth century, the case of Miniato Pitti is very helpful. As a member of one of the noble families of Florence, holding one of the most senior positions in the Olivetans, he was significantly more elevated in social rank than Danti. Yet he was perfectly willing to acknowledge that an instrument was of his own making: on the Museum's sundial, not only does he explicitly append 'FACI[ebat]' to his signature on one side, but on the other, with even more emphasis on the material aspect of making, he adds 'FABREFAC[iebat]'.
This leaves little doubt that Pitti actually made the piece. In case any scepticism remains, it should be noted that as early as 1589 Poccianti had recorded that Pitti constructed his sundials 'manibus proprijs', that is, with his own hands. Although Negri's account is not so close to the period, it is worth noting that he repeats this understanding, saying Pitti had a singular dexterity in making sundials of different materials, with his own hands: 'nel fabbricate con le sue Mani'.

Negri is not troubled by this: far from being beneath Pitti's status, instrument making represented 'gentili e virtuosi trattenimenti', or polite and virtuous entertainments. The earlier, Renaissance sensibility may not be quite the same, but the instruments themselves invoke a virtue that is not confined to simply telling the time. On the Museum's instrument, for example, Pitti associates his mathematics with a humanistic appreciation of the poetry of Ovid. This instrument itself carries other clues to its cultural context. In what seems a self-conscious manner, its two dials celebrate their own ingenuity, and the self-regarding inscriptions indicate their technical and intellectual virtues. Pitti is pleased to match the words of instruction with the colours of the lines described, and points out that while one dial works only in the latitude of Siena, the other will serve throughout the world.

The Oxford instrument tells us something about the intellectual recreations of Miniato Pitti and his circle of friends in sixteenth-century Florence. It also teaches us that their enjoyment of the ingenious and the artful was enhanced, not compromised, when the mathematician was, so far as might be possible, a skilled maker. That integrity may now be lost, but it lies at the centre of the mathematical and material culture of the Renaissance.

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