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AMONG the instruments from the Museum included in Epact is a large and finely engraved quadrant bearing the name of an illustrious Italian astronomer. The quadrant is undated but can be placed in the late sixteenth century. It has a radius of 297 mm and a suspension ring at the apex, probably used only for storage. Printed close to the apex on each side is a rule with scales instead of an alidade with sights, which, added to the considerable weight of the instrument, suggests that it was used primarily for calculations rather than observation. Both sides of the quadrant carry elaborate engravings demonstrating the highest skill on the part of the maker. On one face (illustrated right) is a version of the thirteenth-century design known as the 'new' quadrant of Petrus Judaeus. In addition to the usual lines for the equator, the tropics, and the zodiacal band, the projection is generalized by the provision of horizon lines for every three degrees of latitude. In the centre is engraved a coat-of-arms representing an obelisk between two stars, which has yet to be identified.

The other side of the instrument (illustrated far right) carries the universal projection of the sphere associated with Gemma Frisius, folded twice to the shape of the quadrant. The universal planisphere of Gemma is a projection of the celestial sphere from the first point of Aries onto the plane of the substital colures. Lines of equal right ascension are arcs of circles passing through both poles, and lines of equal declination are circular arcs, concave upwards in the northern hemisphere, downwards in the southern. The ecliptic becomes a straight line passing through the centre of the projection and inclined 23½ degrees to the equator. Gemma's projection is based on the Sphaera Aratcholis and is not uncommon, especially on French astrolabes.

This side of the instrument is engraved along one of its straight edges with the words 'QVADRANS PLANISPHAERII GENERALIS IO. ANTONII MAGINI' - 'Quadrant of the General Planisphere of Giovanni Antonio Magini'.

Giovanni Antonio Magini may not today be the most well known figure from the history of sixteenth-century science, but in his own time he had a substantial and international reputation as a mathematical astronomer and astrologer. What can be inferred from the appearance of his name on this quadrant? Are we to believe that he had the skill to be the maker of such a fine and elaborate instrument? If not, was he the designer, or just the original owner of the quadrant?

An engaging debate in the history of science is whether, in the sixteenth century in particular, learned men and academics actually engraved or made instruments they designed, or simply commissioned them from skilled artisans. Some scholars maintain that instrument making, although a well-respected activity, was a practical art and therefore was not considered appropriate to men of letters. Hence, they argue, if an instrument is inscribed with the name of a person of high social standing, he is more likely to be the designer or the owner than the maker.

Other scholars would disagree with this conclusion, as the article on the sundials of Miniato Pitti in the last issue of Sphaera testifies: Pitti was a learned man, a member of the Florentine nobility and Abbot of the monastery of San Miniato al Monte near Florence, yet he clearly is shown to have made instruments with his own hands. The question of whether Magini was the maker, designer or owner of this quadrant, in light of the ambiguity of the inscription, would therefore seem to be capable of being answered in a number of different ways.



Magini was born in Padua in 1555, and obtained his degree in philosophy from the University of Bologna in 1579. He was appointed to the Professorship of Mathematics at the same place in 1587 following the death of Egnatio Danti. Magini was a very productive writer, with interests not only in mathematical sciences such as trigonometry and surveying but also in 'miracula medica', 'mysteria chimica', and 'metempsychosis' (the art of predicting someone's personality from the patterns of lines on their forehead). He wrote a treatise on the latter, published by a certain G. B. Spontoni under the name of his father Ciro, which some mistakenly took to be a pseudonym of Magini himself.

As an astronomer Magini did not accept the existing planetary theories, but devised his own, consisting of eleven rotating spheres, which he explained in the *Novae caelestium orbium theoricæ congruentium cum observationibus N. Copernici* (Venice, 1589). Magini's international stature is indicated by the appearance of an English description of his system in Thomas Blundeville's *Theoricque of the Seuen Planets* (London, 1602). His astronomical work was not only mathematical however: he was also a strong defender of astrology. His *De astrologica ratione*, for example, published in Venice in 1607, concerns the use of astrology in medicine.

Magini's interest in trigonometry, surveying and geography resulted in a commentary on Ptolemy's *Geographia* published in Cologne in 1596, as well as a treatise which dealt with the use of quadrants in surveying and astronomy, including details of calculations and measurements they could perform (the *Planis Triangula*, Venice, 1597).

Magini's main work was Italia, which was planned as an historical atlas and collection of maps of all regions of the Italian peninsula. The production of Italia, started around 1594, proved to be very expensive and led Magini to take on various commissions besides his teaching post at Bologna. One such commission took him to Mantua and the court of the Duke Vincenzo Gonzaga. The Mantuan court was one of the most brilliant of its time in Italy and Gonzaga acted as a major patron of the arts and sciences: he was the employer of Monteverdi and Rubens as well as of Magini, who became tutor to Gonzaga's sons Francesco and Ferdinand.

Magini corresponded with many of the leading astronomers of his time, including Tycho Brahe, Kepler, and Galileo, the last of whom Magini had successfully competed against for the Bologna chair. Magini's correspondence, edited in 1886 by Antonio Favaro, constitutes the major source of biographical information about him. To return to the question of the relationship between Magini and the 'quadrans planisphaerii generalis' with which his name is associated on the Oxford quadrant, in Magini's published works and in his letters there are references to a quadrant of the general planisphere suggesting that it was a printed book or a manuscript. While this remains a possibility, the Oxford quadrant shows that it was an actual instrument. It is still possible that the term refers to a book as well, since in the dedication of the *De Planis Triangula* Magini refers in the same sentence to commissioning an instrument (not necessarily the general quadrant) and writing a book: 'si cum libro instrumentum quoque ipse usum conferent, fabricandum ex auriscalco cursorem' - 'if I had also made the instrument to use together with the book, I would have had it made in brass'.

In considering Magini's role in the Oxford quadrant it is also useful to consider three other quadrants that can be associated with him. The first dated quadrant linked to Magini belonged to Pietro Riccardi, Professor of Practical Geometry in Bologna, until his death in the 1880s when his library was sold on the antiquarian market, probably together with the quadrant itself. The instrument then changed hands a number of times, and the last available information is that it was sold by Christie's in 1960.

This quadrant has a radius of about 350 mm and a ring and shackle for suspension. Two detachable sights are fixed on one of the edges, but it is possible that they are later additions, along with the alidades on both faces of the instrument.

On one side the quadrant is engraved with a stitcal quadrant and a transversal scale on the limb. The space between the quadrant and the limb is filled with two cartouches. One has a coat-of-arms, now scratched and difficult to recognize, showing a unicorn and engraved with the name 'Bartolomeus Montalbani' (although the arms are not his). The other cartouche has the inscription 'Io. Antonii Magini Patris, Opus Bon. Elaboratum anno 1597' - 'Giovanni Antonio Magini of Padua designed (this) in Bologna [in the year] 1597'. Bartolomeo Montalbani of Bologna, who died in 1651, belonged to the *Fudri* Minori Conventuali and was a chapel musician. His brother Ottavio was a friend of Cassini and Professor of Astronomy at Bologna.

A very similar quadrant to Christie's instrument is in the Observatory Museum of Stockholm. It is again engraved with two cartouches. One encloses the inscription 'Io. Antonius Maginus in Bon. Gymnasio Mathematicarum Professor fieri curavit' ('Giovanni Antonio Magini Professor of Mathematics in the University of Bologna had [this] made'), 'I v R', and 'Per Arnoldus Scherpenzelem Anno 1595 Bononae'. It is possible that 'I v R' is a later engraving, referring to an owner. The other cartouche encloses a coat-of-arms with an obelisk, the same as on the Oxford quadrant.

Who exactly was this Arnoldus Scherpenzelem who signed himself as the maker of the Stockholm quadrant? In the *preface* of his *Primum Mobile* of 1609, which dealt with problems of spherical geometry in geography, astronomy and dialling, Magini explained that he employed many artists for the publication of Italia, due to the difficulty of finding good engravers. To begin with, he reported, he engaged a certain Arnoldus de Arnoldis from Flanders, who engraved many of the maps. Arnoldus then went to Siena where he was offered better pay, and left the job to his brother Jacopo. From 1607 Magini used Benjamin Wuyt from London, who was then working for Cardinal Goussage.

Magini also says that Arnoldus not only engraved many maps for Italia but made mathematical instruments for him. As far as it has been possible to ascertain, Arnoldus worked for Magini from 1595 to 1600 (a world map engraved by Arnoldus was published in Siena in 1601).

There can be little doubt that Arnoldus Scherpenzelem, engraver of the Stockholm quadrant, and Arnoldus de Arnoldis employed by Magini on Italia are the same person. A town named Scherpenzeel exists in the Netherlands, and it is likely that Arnoldus emigrated from there to Bologna at a time when engraving and painting were flourishing under the influence of the internationally renowned Carracci brothers.

The Oxford quadrant is undated and bears Magini's name alone, the Christie's quadrant is dated 1592 and bears the names of Magini and Bartolomeo Montalbani, and the Stockholm quadrant is dated 1595 and has the names of Magini and Arnoldus. A fourth quadrant survives, in the Museum für Kunst und Gewerbe in Hamburg, signed only with the name of Arnoldus. It thus lays to rest the idea that Arnoldus made instruments only in association with Magini.

The Hamburg quadrant is undated. It has a radius of 390 mm and on one face is engraved a *quadratum nauticum* in both Italian and Dutch. The space between the *quadratum nauticum* and the limb is filled on one side with lengthy instructions on the use of the instrument and on the other with the arms of Cardinal Montalbo. Below the coat-of-arms is a further inscription and the signature 'Arnoldus de Arnoldis' - 'Arnoldus de Arnoldis florenter'. The other side is engraved with a stitcal quadrant. Felice Peretti was Cardinal Montalbo from 1570 to 1585, in which year he was elected Pope under the name Sixtus V. This dates the Hamburg quadrant to between 1570 and 1585. Although a number of unanswered questions remain about the relationship between Magini and Arnoldus, some preliminary conclusions can be drawn about their respective roles in the quadrants bearing their names.

Magini and Arnoldus exemplify a collaboration between a designer and an engraver of instruments, the extent and characteristics of which are not completely clear. The Hamburg quadrant illustrates Arnoldus as a prior and independent maker. The fact that the Stockholm instrument carries both names suggests that the two were given the same importance of the genesis of that instrument. It might have been thought that Arnoldus, although already a skilled engraver, gained useful experience from making instruments during his period of employment by Magini and then started working on his own and signing instruments only with his name. But in fact it seems instead that Arnoldus was already making instruments before their collaboration.

An interesting question then arises about the two quadrants - the Oxford and the Christie's instruments - which have the name of Magini but not of Arnoldus. Were they engraved by Arnoldus, although not signed, or were they engraved by somebody else? Although the Christie's quadrant is dated, it does not offer us immediate help in dating the Oxford example more precisely.

A more detailed analysis of letter and numeral forms, and a comparison with maps in Italia should provide further information. But this line of thought opens yet another question. If the 'QVADRANS PLANISPHAERII GENERALIS IO. ANTONII MAGINI' inscription on the Oxford quadrant means that it was designed and not made by Magini, it is not clear what authorship he was claiming. Did it amount to something more than the simple folding of a projection that was quite clearly associated at the time with Gemma Frisius?

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