

Making Instruments Count



MAKING INSTRUMENTS COUNT
Essays on Historical Scientific Instruments
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RAPHAEL'S 'ASTRONOMIA': BETWEEN ART AND SCIENCE

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Compared with the study of scientific instruments, the history of art is a relatively well-established discipline. Even though consensus regarding the ultimate aims or even the achievements of art history may be lacking, scholars working in the field do share the benefit of certain 'methodological tools' which help to date and identify the artistic provenance of a painting, illuminated manuscript or sculptural work. Furthermore, the present generation of art historians also enjoys the advantage of a large and generally reliable corpus of secondary literature. As a result, many of the sorts of problems which still vex the historian of scientific instruments—such as uncatalogued collections, lack of detailed technical studies of the objects and countless numbers of artisans whose careers and oeuvres remain unknown or unstudied—exist, but only at a much reduced level for the art historian.

On the other hand, the historian of scientific instruments knows that, in most cases, the combination of a certain degree of mechanical intuition and a dash of common sense will unlock the essential secret of how an instrument works or for what purpose it was intended. The analogous task for the art historian is much more difficult. Apart from those pieces whose function is purely decorative or functional, the significance of many works of art is often somewhat difficult to retrieve. One reason for this is that much of what we can appreciate or deduce from a work of art is inextricably linked with the process of its making—not only in the practical problems of how a group of figures is arranged, the palette determined or the composition balanced, but also in that indefinable interchange that takes place between the imagination of the artist and his particular ability to convey what are often essentially non-pictorial concepts.

The task for the art historian interested in the iconography of paintings or sculpture is three-fold: to decipher the commonplace visual and pictorial conventions used by the artist, to isolate what is unusual or peculiar in the work, and to try to determine how and to what end these two strains have been brought together.

For many works of art, such as religious or mythological paintings which rely on a given set of authoritative texts, minimal effort is required to understand the subject. For others—especially for those works whose stories are derived from little-known contemporary literary sources or from that indefinable font often referred to as 'common knowledge'—the mystery of the artist's intent often remains unsolved. In most cases, the inability of a twentieth-century viewer to understand a work of art is caused by a gap between our cultural and 'intellec-

tual' assumptions and those of the artist and his contemporaries. It is extremely rare for an artist to occlude purposefully the meaning of his own work. Such an act would be, virtually by definition, perverse. Our misunderstandings and confusions are, for the most part, due to the fact that the overwhelming majority of twentieth-century viewers is no longer trained in the grammar that would have allowed it to interpret the language of a lost age.

For example, in the pantheon of twentieth-century learning, science holds a particularly esteemed place. In the minds of many, science and 'scientific method' have become slightly confused with 'Truth'. One may advocate the philosophy of 'conjectures and refutations', but more often proof is marginalized to being defined as conclusive.¹ Our modern bias about the function of science makes it extremely difficult for us to entertain the possibility that intellectual assumptions underlying the thinking and research of the medieval or Renaissance 'scientist' may have been completely different from our own. And, in consequence, it hinders our ability to understand works of art whose iconography appears to be motivated by 'scientific' concerns; or, more precisely, those paintings which deal with the wider questions embodied in the discipline of natural philosophy.

One example will suffice to illustrate the different layers of problems involved in deciphering the content of a painting whose subject matter touches upon the concerns of science. As part of his decoration of the papal apartments of Pope Julius II [della Rovere], Raphael painted a female figure, in the vaulting of the Stanza della Segnatura, who stands above and behind a semi-transparent globe [Fig. 1]. The vaguely classical garb worn by the figure, as well as the presence of two winged *putti* at her sides, strongly suggests that she is intended as an allegorical figure. Her attribute of the celestial globe, covered with golden stars and the familiar outlines of the constellations, has prompted authors throughout the ages to name the figure as either Urania, i.e. the Muse of Astronomy, or, rather more often, as a personification of the most exalted of the seven Liberal Arts, Astronomia.²

¹ Enquiry into the problematic status of scientific proof has sadly remained in the realm of philosophy. The phrase 'conjectures and refutations' is borrowed from K. P. Popper, *Conjectures and Refutations: The Growth of Scientific Knowledge*, London, 1963.

² The identification of this female figure still remains the subject of debate even though it seems clear that the subject of the panel is certainly 'Astronomy' regardless of whether we call the figure Urania or Astronomia. For a resumé of the arguments, see the forthcoming article by R. J. M. Olson on 'Raphael's Image of Astronomia in the Stanza della Segnatura: New Insights and Implications', citing (among others) Vasari and Bellori. See G. Vasari, *Le vite de' piu eccellenti pittori, scultori e architettori*, ed. G. Milanesi, 1879, IV, p. 334.: '... e in quella dove è l'Astrologia, vi è ella medesima che pone le stelle fisse e l'erranti a'luoghi loro'; and G. P. Bellori, *Descrizione delle immagini dipinte da Raffaello d'Urbino nel Palazzo Vaticano e nella Farnesina alla Lungara*, Rome, 1751, p. 11: 'Nell'altro quadro della Filosofia vedesi una donna, che riquarda sotto di se un globo grande stellante, nel cui mezzo è collocato il centro della terra. Ella soprastando avanti, vi posa sopra una mano,

Turning to the constellations, several of the figures can be easily identified [Fig. 2]. At the top of the globe, among the northern constellations, we can see (reading from right to left) a large, beaked fish—a fairly typical representation of Delphinus—the front half of a winged horse (Pegasus), and, above Pegasus's up-turned belly, the long curving tail of Draco. A bit of Cygnus's wing also seems visible on the upper-left edge of the globe, adjacent to the back of Delphinus. Running through the middle of the globe, one sees three constellations placed along a curving line. These three zodiacal constellations, Capricorn, Aquarius and the southern fish of Pisces, help to define the curving line of the ecliptic.³ In the southern celestial hemisphere, *Piscis meridionalis* catches the end of Aquarius's stream. A mysterious second fish—mysterious because there were no constellations in this section of the Renaissance sky—rides vertically along what must be the equinoctial colure and the tail of Cetus can be seen disappearing over the right-hand edge of the globe. There is a slight problem in identifying the male figure, wearing a hat and holding his arms outstretched, placed in the upper right section of the globe. Purely from its position relative to the other constellations, this figure should be Andromeda, whose head touches the belly of Pegasus. But the figure's proximity to the tail of Draco, its placement directly above the southern fish of Pisces and its masculine hat and short, *cioppa*-like dress suggests that the figure might be Cepheus.⁴

edinnalza l'altra per meraviglia della grand'opera del Fabbro eterno; e questa è la speculazione delle cose naturali, la quale contempla il mondo, e la natura, investigando le cagioni e gl'influssi loro'. I thank Professor Olson for allowing me to read her article prior to publication. I think one must assume that Vasari is mistaken in his claim that the image contains depictions of 'le stelle ... erranti', or the planets. There is no indication of how these images might have fitted into Raphael's schema; nor is there any trace of later, *a secco* additions to the surface of the fresco. See also J. Pope-Hennessy, *Raphael*, London, 1970, pp. 148–51; L. Dussler, *Raphael*, London, 1971, pp. 70–71 and R. Jones and N. Penny, *Raphael*, New Haven and London, 1983, pp. 52–5.

³ The term 'notius' for the southern fish of Pisces appears in Hyginus, *Astronomicon*, III, 29. Hyginus also uses 'inferior' (*ibid.*), while Firmicus Maternus calls it 'australis' (*Matheseos*, VIII, 4, 12; 30, 12 and 31, 10) and Columella describes it as 'austrinus' (XI, ii, 62). See A. LeBoeuffe, *Les Noms latins d'astres et des constellations*, Paris, 1977, p. 182. This fish can be identified as the southern Pisces by its placement relative to the ecliptic and its inverted position, lying with its belly northwards. The northern fish of Pisces is usually shown situated well above the ecliptic and placed perpendicular to the celestial equator, its nose touching the small of Andromeda's back.

⁴ Rash-Fabbri offered the following identifications for the constellations: Lacerta (the lizard), Pegasus, the wing of Cygnus, Delphinus, 'a figure with arms outstretched like Andromeda', Capricorn, Aquarius, Pisces, Cetus, Eridanus and *Piscis meridionalis*. See N. Rash-Fabbri, 'A Note on the Stanza della Segnatura', *Gazette des beaux-arts*, CXXI^e année (vol. XCIV), 1979, pp. 97–104, esp. p. 98 and p. 104, n. 20. Olson has rightly suggested Aquarius's stream for Rash-Fabbri's Eridanus, but mistakenly retains the anachronistic Lacerta. She also misidentifies the two fish surrounding Cetus's tail as the northern and southern Pisces. The second fish in the southern hemisphere of Raphael's globe seems to be the artist's invention. There is no constellation recorded in this location in any of the early printed stellar maps (see, for example, Dürer's 1515 *Imagines coeli meridionalis* and Apian's *Imagines syderum coelestium* of 1536). In fact, the space seems to have remained blank until Pieter

The two major anomalies in Raphael's constellations—the peculiarly hybrid Andromeda/Cepheus and the addition of a second fish to the southern sky—alert one to other, more serious, problems with the overall arrangement of the constellations themselves and, in turn, with the structure of the globe. In lining up the zodiacal constellations, Raphael has interposed an unusually large space of blank sky between the zodiacal constellations of Aquarius and Pisces. The reason behind this alteration is difficult to uncover; but it may lie in Raphael's desire to provide an unobscured view of the Earth, a central component to any understanding of the structure of the Ptolemaic universe. In moving the constellations, Raphael created an empty hole in the fabric of the constellations. He solved this problem by filling the space with a series of undulating lines representing the stream that pours from the mouth of the urn held by the water-bearer, Aquarius. Raphael's solution is visually successful, but the original displacement of the zodiacal constellations causes overcrowding in the right-hand side of the globe. For example, traditionally, the *Piscis notius* of Pisces should almost touch Aquarius's ewer. It should also be placed directly below Pegasus, with its back riding along the upper boundary of the ecliptical path. In Raphael's globe, the southern fish is shown with its back placed on the celestial equator. Essentially, in expanding the zodiac, Raphael has had to move the *Piscis notius* too far to the right; and, in moving the fish, he has thereby destroyed the coordinates for all of its northern neighbors, Cepheus, Cassiopeia, and Andromeda. Cepheus should be directly north of Pegasus, Cassiopeia vertically parallel with the horse's belly, and, as mentioned, Andromeda's head shares a star with Pegasus's stomach. Given the lack of space, Raphael decided to conflate two of the constellations into one figure. The position of the figure, certain elements of its posture and its relatively large scale are all reminiscent of Andromeda. The gender, garb and direction in which the constellation faces, however, all follow the traditional iconography of Cepheus. Perhaps the most telling detail of the composition is the inclusion of the hat, an attribute specific to Cepheus, recording the Ptolemaic designation of the star, ϵ Cep, as 'the tiara' of Cepheus, King of Ethiopia.⁵

The expansion of the zodiacal signs has also caused problems regarding the celestial coordinates of the equator, ecliptic and colures. The crossed ecliptic and celestial equator should imply the vernal equinox. Canonically, the vernal equinox occurs when the Sun passes through the zodiacal sign of Aries. Astronomically, due to the precession of the equinoxes, the vernal equinox in 1500 would have

Dirksz Keyser and Frederick de Houtman placed 'the Phoenix' in this position in 1595–97. See D. J. Warner, *The Sky Explored: Celestial Cartography 1500–1800*, New York, 1979, p. xii.

⁵ See G. Toomer, *Ptolemy's Almagest*, London, 1984, p. 346, and K. Lippincott, 'The Astrological Vault of the *Camera di Griselda* from Roccabianca', *The Journal of the Warburg and Courtauld Institutes*, XLVIII, 1985, pp. 42–70, esp. pp. 47–8. It is worth noting that the placement of the stars in the southern hemisphere is less problematic primarily because there are fewer Ptolemaic ceiling constellations in this part of the sky.

been well into Pisces. Neither of these points coincide with Raphael's placement. Furthermore, the equinoctial colure, as its name attests, should also pass through the equinoctial intersection. Raphael's colure is drawn substantially to the right of the equinox.

The sum effect of all these minor errors should have some bearing on our reading of Raphael's globe. Most modern interpretations of the globe have argued that the image records a date that is, in some way, significant to the concerns of the room's patron, Pope Julius II [della Rovere]. Rash-Fabbri has argued that the orientation of Raphael's globe records a very specific time and date: three hours after sunset on 31 October 1503, the moment Julius II was elected to the papacy.⁶ This conclusion is unlikely for three reasons. First, Raphael's rendering of the constellations is sufficiently distorted to suggest that it could not possibly record any celestial configuration. Raphael's vastly exploded ecliptic depicts less than one-quarter of the heavens spread across a 180° hemisphere. One might compare, for example, the 'gore' of the Farnese Atlas in the Codex Pighianus, which essentially reproduces this span of the ecliptic [Fig. 3].⁷ Astronomically, the zodiacal constellations of Capricorn, Aquarius and the first fish of Pisces takes little more than 60° of the ecliptic. Second, there are no planets included in the image. Astrological time is measured by the relative placement of the planets against the ecliptic. Without planets, neither time nor date can be established. Third, there is no evidence to suggest that the globe represents a night sky. The time of night or day has not been specified. Whereas it is true that the constellation of Pegasus is an unforgettable feature of the autumnal night sky, it does not necessarily follow that this impression served as the starting point for Raphael's depiction. Without the inclusion of the Sun, it is impossible to be certain about any proposed time of day or year. One could suggest that the Sun is actually hidden behind the Earth, located on the far side of the globe in the sign of Virgo or Libra, but arguing from this sort of negative evidence seems ill-advised.

Instead, one might reconsider the artistic premise of Raphael's celestial globe. Scholars have suggested that the sketch of Urania in the Albertina indicates that

⁶ Rash-Fabbri, 'A Note on the Segnatura', n. 4 above, p. 100 and 104, nn. 22–24, citing A. Giustiniani, *Dispacci dal 1502–1505*, ed. P. Villari, Florence, 1876, II, pp. 274 and 295. See also the relevant passages S. Y. Edgerton, Jr., *The Heritage of Giotto's Geometry: Art and Science on the Eve of the Scientific Revolution*, Ithaca NY and London, 1991, esp. pp. 196–207. I thank Professor Edgerton for allowing me to read this material prior to publication.

⁷ Berlin, Staatsbibliothek Preussischer Kulturbesitz, Lib. Pict. A.61, fol. 228^r. The Codex Pighianus is named after the Netherlandish antiquarian Stephanus Vinandus Pighius, who compiled a notebook of sketches after antique monuments in Rome some time between 1549 and 1557. See P. P. Bober and R. O. Rubinstein, *Renaissance Artists and Antique Sculpture: A Handbook of Sources*, London, 1986, p. 465 and *passim*. Sadly, the sketches after the Farnese Atlas are not themselves included in Bober and Rubinstein's work. Surprisingly little has been written about the Atlas. The best account remains G. Thiele, *Antike Himmelsbilder. Mit Forschungen zu Hipparchos, Aratos und seinen Fortsetzern, und Beiträge zur Kunstgeschichte des Sternhimmels*, Berlin, 1898, pp. 19–43.

Raphael's original concept was to show Urania standing behind an armillary sphere [Fig. 4] and that he abandoned this idea subsequently in favour of a semi-transparent celestial globe.⁸ One might amend this opinion by suggesting that the identity of the object rendered in the Albertina drawing is less important than the information conveyed by it. The essential feature of the 'armillary sphere' in the sketch is the fact that it represents a spherical, geocentric map of the heavens. The structure is 'transparent' in the sense that one can see the contours of Urania's leg through it. These two features remain unchanged in the final fresco. The major difference between the two, however, is the addition of a layer of constellations to the exterior surface of the sphere in the fresco. But this change does not effect the essential nature of the globe.

The major artistic achievement of Raphael's fresco is his successful solution to the problem of rendering a semi-transparent spherical object, whose surface is decorated with translucent constellations. It is a difficult feat, rarely attempted in the history of art. The conceptual consistency between sketch and final product suggests to me that it was precisely this artistic challenge which interested Raphael—his aim was to create a convincing effect, rather than merely to provide a reproduction of an astronomical map. Raphael certainly could have painted an accurate stellar map had he chosen to do so. The fact that his constellation figures of Capricorn, Aquarius and Piscis meridionalis are virtually identical to that found on Vanosino's later celestial globe of c.1565 strongly supports an argument that Raphael made a conscious choice *not* to follow the model in all its details [Fig. 5].⁹ The point is that he obviously chose not to follow the model. Instead, he

⁸ See P. Joannides, *The Drawings of Raphael with a Complete Catalogue*, Oxford, 1983, p. 195, no. 253; *Raphael in der Albertina aus Anlass des 500. Geburtstages des Künstlers*, Vienna, 1983, pp. 70–71, no. 20 and E. Knab, E. Mitsch, K. Oberhuber and S. Ferino-Pagden, *Raphael. Die Zeichnungen*, Stuttgart, 1983, pp. 587–88, no. 343. It might be noted that Joannides says that the figure of 'Astronomy' seems fully worked from a model, while the spheres have been added later. This could mean that the spheres themselves were merely a shorthand notation. The idea that Raphael's original plan was to depict Astronomia standing behind an armillary sphere could be an over-interpretation of the evidence. Both Edgerton and Olson have noted Rash-Fabbri's error in calling this object an 'orrery' (p. 98); an error repeated by Jones and Penny (*Raphael*, p. 56).

⁹ See J. Hess, 'On Some Celestial Maps of the Sixteenth Century', *The Journal of the Warburg and Courtauld Institutes*, XXX, 1967, pp. 406–9; *Manoscritti cartografici e strumenti scientifici nella Biblioteca Vaticana secoli XIV–XVII*, Vatican City, 1981, pp. 61–2, no. 75 and A[mold] N[esselrath]'s entry in *Raffaello in Vaticano*, Milan, 1984, pp. 70–72, no. 46. The assumption is that both Raphael's and Vanosino's maps were copied from a similar model. For Vanosino's globe and its relation to the Sala Bolognese or Sala dei Brevi in the Vatican and Sala del Mappamondo in Caprarola, see K. Lippincott, 'Two Astrological Ceilings Reconsidered: the Sala di Galatea in the Villa Farnesina and the Sala del Mappamondo at Caprarola', *The Journal of the Warburg and Courtauld Institutes*, LIII, 1990, pp. 185–207, esp. pp. 196–7, n. 57.

Incidentally, this 'critical reader' disagrees with Shearman's reading of 'signe planetarum et coelorum ... exornavit' as a description of the terrestrial and celestial globes that may have decorated Julius II's library. See J. Shearman, 'The Vatican Stanze: Functions and Decorations', *Proceedings of the British Academy*, LVII, 1971, pp. 369–424, esp. pp. 410, n. 84 and 413, n. 91. Shearman



Fig. 1.

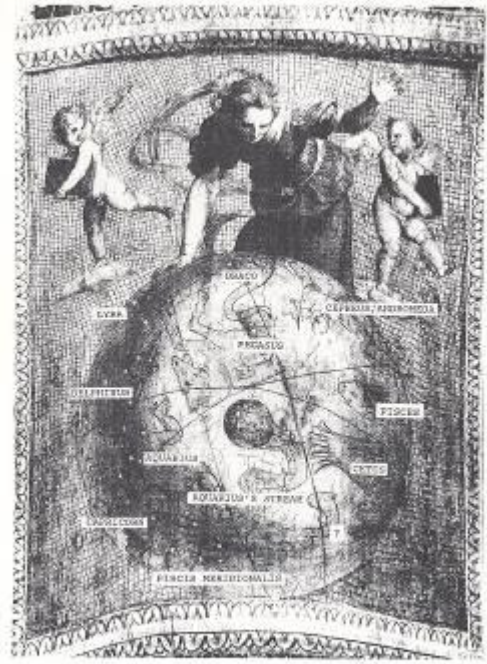


Fig. 2.



Fig. 3.



Fig. 4.



Fig. 5.

wished to create a convincing visual metaphor of the *caelum crystallinum*. He achieved this by rearranging the cartographical demarcations of the ecliptic, equator and colures—their relative coordinates shifted so that each helped to define pictorially the essential sphericity of the globe. He widened the gap between Aquarius and Pisces so that the Earth of the geocentric system would be more clearly visible. He added the ‘autumnal equinoctial colure’ in order to emphasize the sphere’s transparency and to demarcate the outer surface of the back of the globe. And he subtly rearranged the constellations of the northern hemisphere (amalgamating Andromeda and Cepheus into a single constellation) and added the mysterious second fish to the southern celestial hemisphere so that the constellations themselves formed an aesthetically pleasing pattern on the surface of his globe.

Raphael’s rearrangement of the heavens was so suavely handled that the final effect is wholly convincing. The viewer accepts the illusion of an object which is three-dimensional and semi-transparent. He also accepts the suggestion that Raphael’s fresco represents an astronomically accurate celestial globe. It is a testimony to Raphael’s consummate skill as a painter that he was able to sustain both illusions. It is, however, also a mark of the viewer’s compliance in this

follows P. Fabre, ‘La Vaticane de Sixte IV’, *Mélanges d’archéologie et d’histoire. École française de Rome*, XV^e année, 1895, pp. 455–83, esp. pp. 476–7, n. 1. The passage, taken from Francesco Albertini’s *Opusculum de mirabilibus novae et veteris urbis Romae*, Rome, 1510, fol. Zii^r, reads: ‘De Bibliotecis novae urbis ... Est praeterea biblioteca nova secreta per pulchra (ut ita dicam) Pensilis Iulia: quam tua beatitudo construxit signisque planetarum et coelorum exornavit, additis aulis et cameris ornatiss[imis] atque de ambulatoriis auro et picturis ac statu is exornatis non longe a capella syxtea’. The grammar of the phrase, the genitive plural of *planeta* and the fact that only ‘signs’ are mentioned, without any reference to globes or similar objects, leads one to suspect that Albertini indeed may be describing a room decorated with constellations and planets as Schmarsow and Pope-Hennessy have already suggested. See *Francisci Albertini opusculum de mirabilibus novae urbis Romae*, ed. A. Schmarsow, Heilbronn, 1886, pp. 34–5, n. 12, and Pope-Hennessy, *Raphael*, p. 138, n. 57. There may well have been globes in Julius’s library. The 1477 *Computa bibliothecae apostolice*, undertaken during the pontificate of Sixtus IV, records ‘Expendi pro cohopenura facta duabus sphaeris solidis, quarum in altera est ratio signorum, in altera cosmographia ...’ (E. Müntz and P. Fabre, *La Bibliothèque du Vatican au XV^e siècle d’après des documents inédits*, Paris, 1887, p. 152). Albertini also alludes to ‘strumenta geometriae et astronomiae et alia quae in liberalibus disciplinis pertinent auro et argento picturis exornata’ in the library of Sixtus IV (ed. Schmarsow, p. 34). But neither celestial nor terrestrial globes contain depictions of the planets; whereas astrologically decorated rooms often do. Remembering that Albertini’s *Opusculum* was finished by June 1509, his description of Julius II’s library could easily record its appearance prior to Raphael’s intervention. For the dating of Albertini’s manuscript, see edn. Schmarsow, pp. iv–viii. See also D. Redig de Campos, *I Palazzi Vaticani*, Bologna 1967, p. 102. As for the suitability of astrological decoration in the Vatican, one only need cite Pier Matteo d’Amelia’s drawing proposing or recording an astrological decoration for the vault of the Sistine ceiling. For an illustration of the drawing (Uffizi, Gabinetto degli stampi e dei disegni, 711 A) see J. Shearman, ‘The Chapel of Sixtus IV: The Fresco Decoration of Sixtus IV, Raphael’s Tapestries’ in *The Sistine Ceiling: Michelangelo Rediscovered*, London, 1986, pp. 22–91, esp. p. 40.

process of artistic persuasion, an almost wilful gullibility combined with a modern-day lack of knowledge about the mythological configurations underpinning the constellations of the night sky, that the astronomical impossibility of Raphael's globe has gone unnoticed.