



Digital reconstruction of the room in the painting of *Las Meninas* with the help of a mirror like the one used at the Isle of Pheasants; the canvas is seen at the left, then the mirror, etc. (© Luis Ramón-Laca)

A Virtual Three-Dimensional Model of *Las Meninas*

Paradox or Mirror Image?

LUIS RAMÓN-LACA

ABSTRACT

A virtual three-dimensional model of *Las Meninas* is discussed. The model suggests that Diego Velázquez used a large mirror to create his masterpiece.

In his influential essay on Diego Velázquez's *Las Meninas* (1656) (The Prado Museum, Madrid, accession number P01174, 318 cm × 276 cm), originally published in 1965, the French philosopher Michel Foucault considered Velázquez's masterpiece to be "the representation, as it were, of classical representation" [1–3]. According to Svetlana Alpers, the scene represented in *Las Meninas* has eluded full and satisfactory discussion by art historians, the major study in this respect being Foucault's essay [4]. Gabriel Shapiro recently argued that "a number of recent essays on *Las Meninas* refer critically to Foucault's essay and take it as a relatively immediate account of the painting" [5]. These essays include that by John R. Searle, who considered the painting paradoxical [6], and the famous answer thereto by Joel Snyder [7]. Jonathan Brown saw *Las Meninas* as Velázquez's plea for the art of painting to be endowed with nobility [8].

In 1715, Antonio Palomino identified nearly all the characters in *Las Meninas* [9]. As summed up by Alpers,

in the foreground, the little princess (the Infanta Margarita) turns to us from her entourage, as does one of her maids, and a dwarf, and of course Velázquez himself who has stepped back from his canvas for this very purpose. . . . The king and queen [are] marked by their reflection in the mirror at the center of the far wall, and the large picture seen from the back on its stretcher [10].

However, no convincing understanding of the painting as a whole has been reached [11]. "Why after over three centuries, does *Las Meninas* continue to bother us?" asks Searle [12]. According to Alpers, "the frame appears to intersect a room whose ceiling, floor, and window bays extend, so it is

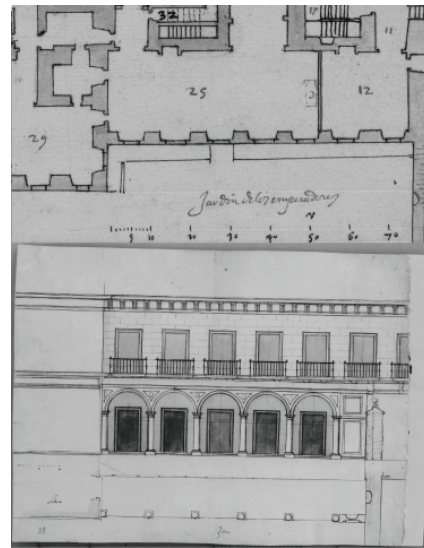


Fig. 1. (top) "Numbers 25 and 12" in Gómez de Mora's floorplan (Biblioteca Apostolica Vaticana, Mss. Barb. Lat. 4372 © BIBLIOTECA APOSTOLICA VATICANA); (bottom) Gómez de Mora's elevation of the windows belonging to those numbers (Real Biblioteca, Madrid, IX-M-242, fasc. 2, 10 © PATRIMONIO NACIONAL).

suggested, to include the viewer" [13]. The question arises as to how Velázquez achieved this. Using a virtual 3D model of the room depicted in the painting, the present work shows that *Las Meninas* was probably painted with the aid of a large mirror, explaining why *Las Meninas* leaves us with something contrary to expectation but not quite a paradox. The canvas, the doors at the back of the scene, and of course Velázquez and his companions, must therefore appear left-right reversed.

THE ROOM OF LAS MENINAS

Palomino identified the room in the scene as the "galería del cuarto bajo del Príncipe" (the Prince's low rooms gallery, referred to below as the Prince's gallery) in the Alcázar de Madrid, which was destroyed by a fire in 1734 [14]. The Prince's gallery was later identified as being represented by "numbers 25 and 12" in the floorplan (Biblioteca Apostolica Vaticana, Mss. Barb. Lat. 4372) prepared by Juan Gómez de Mora in 1626 [15] (Fig. 1). The Prince's gallery was a long

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room in the south wing of the palace. It has long been assumed that the only difference between what we see in *Las Meninas* and Gómez de Mora's floorplan is a partition wall that may have been torn down some time after the latter was drawn (we will return to this partition wall below). A platform (or canopy) for the Infanta María (the sister of Philip IV and later Empress of Germany) is shown against the partition wall in Gómez de Mora's floorplan [16].

The 1686 inventory of the Alcázar details the paintings hanging in the Prince's gallery, among which was one depicting the myth of Minerva and Arachne, and another of *The Contest of Pan and Apollo* [17]. Both are visible on the rear wall in *Las Meninas*. Sadly, neither this inventory nor any other records the wall on which these paintings hung, which would help us understand in which direction the subjects in *Las Meninas* were facing. Nonetheless, if the windows in the Prince's gallery faced toward the south, then all would appear to be looking toward the west. However, the fact that *Las Meninas* includes Velázquez's self-portrait suggests that he must in fact have been looking toward the east, using a mirror to allow him to capture his image—and perhaps those of all his companions (certainly, the portrait of the Infanta Margarita in the Kunsthistorisches Museum, Vienna, accession number GG 3691, 105 cm × 88 cm, shows her to have her hair parted on the other side).

In his catalogue of the Prado Museum, Pedro de Madrazo indicates that Velázquez “was working on the portraits of Philip IV and his second wife Mariana of Austria; their figures appear reflected in a mirror hanging on the back wall of the room being used by the artist as his studio” [18]. Where exactly, however, would the royal couple have been seated? And was it really them in person? In 1985, Georges Kubler indicated that the mirror hanging on the back wall did not correspond to any actual presence of the royal couple but was likely a reflection of what was on Velázquez's canvas [19]. Indeed, there seems to be some consensus among experts, who, using various methods, have shown that the mirror reflects a supposed double portrait of Philip IV and Mariana of Austria [20].

As suggested by Martin Kemp, Velázquez may sometimes have painted his works using a number of viewpoints [21]. Different reconstructions have shown, for example, that the mirror in *The Toilet of Venus* (The National Gallery, London, accession number NG2057, 122 cm × 177 cm) would in reality have reflected Venus's pelvis rather than her head [22]. Of course, it is unlikely that the viewer would suspect any manipulation of perspective on the part of the artist, even though the painting clearly contravenes Euclid's first statement of his *Especularia*: For a plane mirror, if the eye is positioned where the perpendicular from an object falls towards the mirror, the object cannot be seen [23].

Finally, the procedure of combining different elements in space and time in *Las Meninas* was well expressed by Kubler: “[Velázquez's] eye and mind hold the maids of honor and the royal couple and ourselves in different spaces and times, while conveying them all into paint as in a single instant” [24]. Did he achieve that, perhaps, by using a mirror?

THE SCENE OF LAS MENINAS: A DIRECT VIEW OR A MIRROR IMAGE?

In an interesting scene cut from the film *El Sol del Membrillo*, directed by Víctor Erice in 1992, which was included in the 2004 DVD edition of the film, the famous painter Antonio López affirms his belief in Velázquez's use of a mirror in the production of *Las Meninas*. There are two schools of thought among those who study this painting, one defending the idea that it is a direct view of the scene, the other defending the idea that Velázquez used a large mirror [25]. The first of these schools is the larger. Its main exponent is John F. Moffit, who produced a scale-model on paper and showed that the painting could represent a true scene in the Prince's gallery. However, this hypothesis, which Kemp corroborates with few variations, has the clear problem that the viewpoint (i.e. where the artist stood) would have to be a huge 7.5 m away from the picture plane. Would it be possible to paint portraits of subjects so far away? For both Moffit and Kemp, Velázquez's viewpoint would have lain outside of the Prince's gallery in the adjoining room. Indeed, Kemp affirms that the artist must have used the door between the Prince's gallery and this adjoining room as a kind of Alberti's veil, allowing him to make a preliminary sketch of *Las Meninas*. The virtual 3D construction of the scene discussed in this work, however, proposes that *Las Meninas* was not painted in this way at all, but rather was produced with the aid of a mirror. This would have allowed the distance to the painted subjects to have been reduced. Velázquez would then simply have painted the reflection he saw.

Interestingly, King Charles II's probate list of assets makes mention of a huge mirror (3.5 × 2 *varas*, i.e. 2.9 × 1.7 m) hanging in the King's bedchamber at the time of his death [26]. In the royal painters' studio, there were also “seven mirrors all measuring two and one quarter *varas* in height and five feet in width” (i.e. 1.9 × 1.4 m) [27]. In 1656, the Count of Castrillo brought from Italy “among other things, . . . six glass mirrors measuring two *varas* [1.7 m] in height and one and one half [1.3 m] in width” [28]. When the belongings of Philip IV were inventoried, seven large mirrors measuring five *quartas* (1 m) in height and over three (0.6 m) in width were valued at 52,800 *reales* (*Las Meninas* itself was valued at only 16,500 *reales*) [29]. If the dimensions of Charles II's bedchamber mirror are compared to those of *Las Meninas*, it is clear that it would have been capable of reflecting the main part of the scene depicted in the painting. The virtual 3D model described below demonstrates that this is the case.

A VIRTUAL 3D MODEL OF LAS MENINAS

The present virtual 3D model was constructed using conventional computer drawing software, reconstructing the perspective of *Las Meninas* (Color Plate C). In 1953, Rudolf Wittkower undertook something similar with respect to *The Flagellation* by Piero della Francesca, although without the help of a computer [30].

By first comparing the floorplan of the Alcázar de Madrid drawn by Gómez de Mora with a partial elevation of the Alcázar held in the Royal Palace (in Madrid), I determined

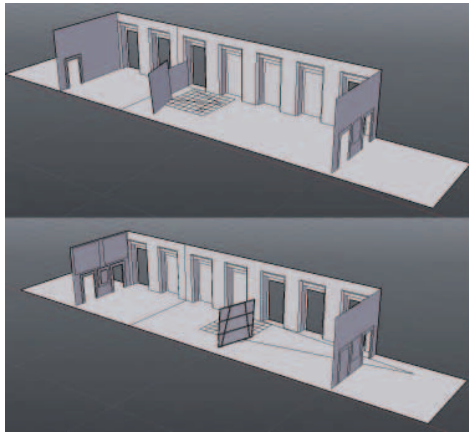


Fig. 2. Virtual 3D model contemplating the use of a large mirror in gray (above, Velázquez and his companions are facing east; the angle of Velázquez's vision as the painter and the position in which he appears in the actual painting are marked on the floor) and the same model without such a mirror (below, they are facing west; the supposed angle of Velázquez's vision as the painter is marked on the floor). (© Luis Ramón-Laca)

the dimensions of the windows and spaces between them (Fig. 1). The distance between the bottom left-hand corner of the first window in the painting and the rear wall was thus established at 12.95 m. The actual size of one of the paintings hanging at the rear wall, a copy by Juan Bautista Martínez del Mazo of *Apollo as Victor over Pan* by Jacob Jordaens (The Prado Museum, accession number P01172, 181 cm × 225 cm), is also known. A theoretical grid with sides of 0.5 m was constructed, over which I positioned the different elements in the painting (the canvas and the subjects, etc.). Using two computer drawing programs (AutoCAD and Rhinoceros), a 3D model of the scene was then constructed (Fig. 2). Textures similar to those seen in *Las Meninas* (lime, mirror glass, fiber matting, canvas and wood [pine and ebony]) were then applied. A virtual mirror (see Fig. 2, above) of the dimensions of that which hung in Charles II's bedchamber was then installed in the model and moved until a position was found in which the reflection in that mirror reliably depicted the scene in *Las Meninas*. That mirror would have occupied the self-same position as the partition wall, suggesting that it might have been hung on it.

The characteristics of the light on 21 December at 12:30 were then chosen to illuminate the model; these match well those actually seen in *Las Meninas* (Fig. 3). The exact day and time cannot be fixed, but entering the room as it does, and given the south-facing orientation of the windows, the light would appear to correspond to the end of autumn/beginning of winter. Some may doubt whether it is really possible to fix a day and hour for the painting [31]. However, the idea that the light is that of a late autumn/early winter's day at around noon is corroborated by the painting's shadows. For example, that of the Infanta's farthingale, and those of the dog's legs, all subtend an angle of approximately 30°. Any solar chart for Madrid's geographical coordinates will show that this angle corresponds perfectly to the height of the sun at midday at the stated time of year. If we did not know the orientation of the Prince's gallery it would be impossible to determine any date or time—there would be an infinite number of possible combinations of azimuth and solar elevation. However, its

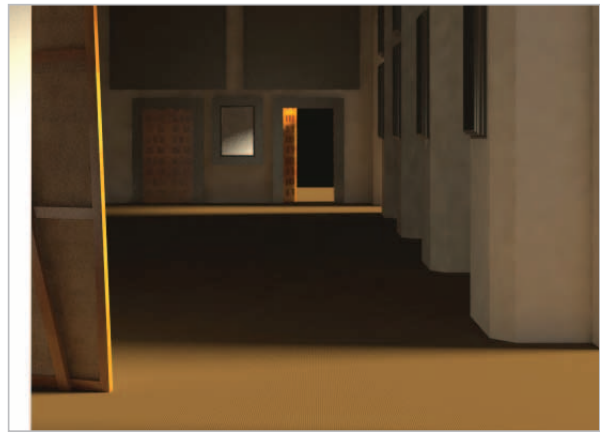


Fig. 3. View of the virtual 3D model with the help of a large mirror.



Fig. 4. View of the virtual 3D model without the help of a large mirror (direct view, through the door between "number 25" and the adjoining room). (© Luis Ramón-Laca)

orientation is known, and the azimuth has to be 180° (the position of the sun at midday), since the light is perpendicular to the window-bearing wall. Thus, the date can be estimated from the sun's elevation.

ANALYSIS OF LAS MENINAS USING THE VIRTUAL 3D MODEL

Figure 3 shows the virtual 3D model of *Las Meninas* contemplating the use of a large mirror (Fig. 2, above) and Figs 4 and 5 the same model without such a mirror (Fig. 2, below). Apparently, both solutions are possible, but in the former scenario Velázquez would have been able to stand much closer to his subjects than in the latter. In photographic terms, Fig. 3 would appear to represent that which would be seen through a 35 mm lens, while Fig. 5 would appear to be that seen through a 70 mm lens. 35 mm is a focal distance quite like that of human vision, while a focal distance of 70 mm is that of a telephoto lens. This type of lens shortens distances, making objects in the background of a scene appear proportionally larger than they really are. No such enlargements are seen in *Las Meninas*: Compare, for example, the proportions of the canvas in front of Velázquez and the doors in

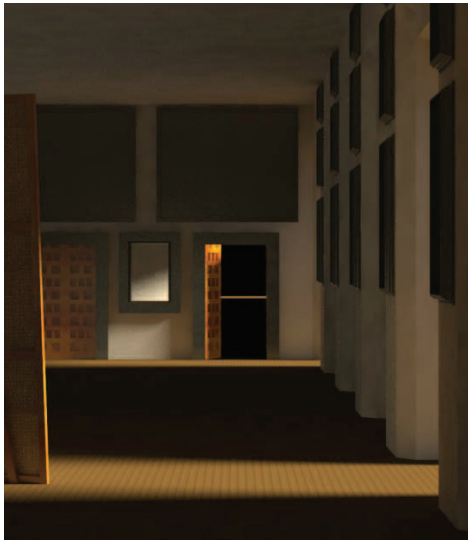


Fig. 5. View of the virtual 3D model without the help of a large mirror (direct view, detail). (© Luis Ramón-Laca)

the rear wall. In Fig. 5, however, which illustrates Moffit and Kemp's reconstructed perspective, the doors appear much larger than they really are in *Las Meninas* (as would be seen through a 70 mm lens). This would seem to confirm that Velázquez used a large mirror to help him paint this work.

The 3D model also reveals the angle of Velázquez's vision as the painter, as well as the position in which he appears in the actual painting (Fig. 2, above). If these positions were one and the same, he (and therefore we) would not have been able to see the illuminated door in the rear wall where Don José Nieto appears. Since the model suggests that a mirror was used in the painting of the scene, could this doorway be that which existed between the Prince's gallery and the adjoining room (i.e. that which Kemp describes as providing the frame of an Alberti's veil)?

DISCUSSION AND CONCLUSIONS

The present work shows that *Las Meninas* could have been painted with the aid of a large mirror conveniently positioned in the Prince's gallery. This would have set Velázquez at an adequate distance from the subjects he wished to paint and would have provided him with the perspective shown in the painting. The model suggests that the mirror used was perhaps hung on the wall that separated "numbers 25 and 12" in Gómez de Mora's floorplan, indicating that this wall may, in fact, never have been torn down. Following the idea that *Las Meninas* was produced with the help of a large mirror, Velázquez could have simply placed, at the appropriate height in front of the canopy seen in Gómez de Mora's floorplan, portraits of the King and Queen instead of any reflection in a supposed small mirror. He would then simply have painted what he saw of them in his large mirror.

Since the perspective of *Las Meninas* is frontal, and since we know the size of the two large paintings hanging on the rear wall, the proposed 3D model can be invested with true scale. Some authors, including Fernando Mariás and Kemp, assume that Velázquez would have wanted to faithfully reproduce the Prince's gallery in his painting. Indeed, why

should this be questioned? Certainly, in the 3D model, the measurements of the paintings on the rear wall and those of the room in Gómez de Mora's floorplan are completely coherent. The stature of the persons in the painting, as derived from the model, are also plausible.

It has been suggested by Jonathan Brown, however, that human vision and perspective are not subject to the same rules, which would apply to *Las Meninas* [32]. Brown was probably referring to Erwin Panofsky's idea that the concept of conical perspective is symbolic and not a representation of how a scene is actually perceived by a real person [33]. Certainly, in *Las Meninas* we can see how what must be a straight line forming the intersection between the rear wall and the ceiling appears as a slight curve, and this is truly how we would see this line. Indeed, in the nineteenth century, Hermann von Helmholtz had already demonstrated that a straight line in our peripheral vision is perceived as a curve since it falls on the plane that cuts the "celestial sphere" (a term he used to refer to the imaginary sphere around us) upon which what we see appears to lie [34]. However, Helmholtz's theories do not rule out human vision meeting the mathematical requirements of conical perspective. The reconstruction of the perspective of *Las Meninas* is therefore perfectly possible [35]—in fact Brown, in the 1990s, accepted the reconstruction produced by Kemp [36]. The present 3D model confirms that the perspective of *Las Meninas* can be perfectly reconstructed.

The use of a large mirror in the painting of *Las Meninas* need not surprise us. Charles II had a mirror of adequate size in his bedchamber, and there was an enormous mirror at the center of the room in which Philip IV of Spain and Louis XIV of France met on the Isle of Pheasants (as shown in Lebrun's painting). It remains unknown whether it was a Spanish or French possession [37], but it clearly shows that mirrors of the size required to paint *Las Meninas* were available in Velázquez's time (see Article Frontispiece). In the writings of Baltasar Gracián, a Jesuit philosopher of Velázquez's time who greatly admired his art [38], the quality of being reversed is associated with a clear vision and genuine understanding [39] (consider how the sky and clouds are sometimes understood better in their reflection on the still water of a lake). The apparent straightforwardness of the "everyday life of the Alcázar" scene painted in *Las Meninas* would seem to hide an intricate network of meanings (the main subject of Foucault's analysis) that highlights the complexity of royal life and politics. Indeed, mirrors were associated with royalty, as the engraving *Emblem XXVIII* by Juan de Solórzano reveals [40]. This engraving shows a mirror on which several flies try to settle, without ever managing to do so, thus establishing a metaphor of the purity required of the monarchy.

Velázquez's use of a large mirror reflects his genius: it made possible the painting of a scene that would have otherwise been impossible. Not only that, through the use of the perspective achieved, he found a way to infuse the viewer with the vivid sensation of standing within the Prince's gallery. As Théophile Gautier put it, "où est donc le tableau?" [41].

Acknowledgments

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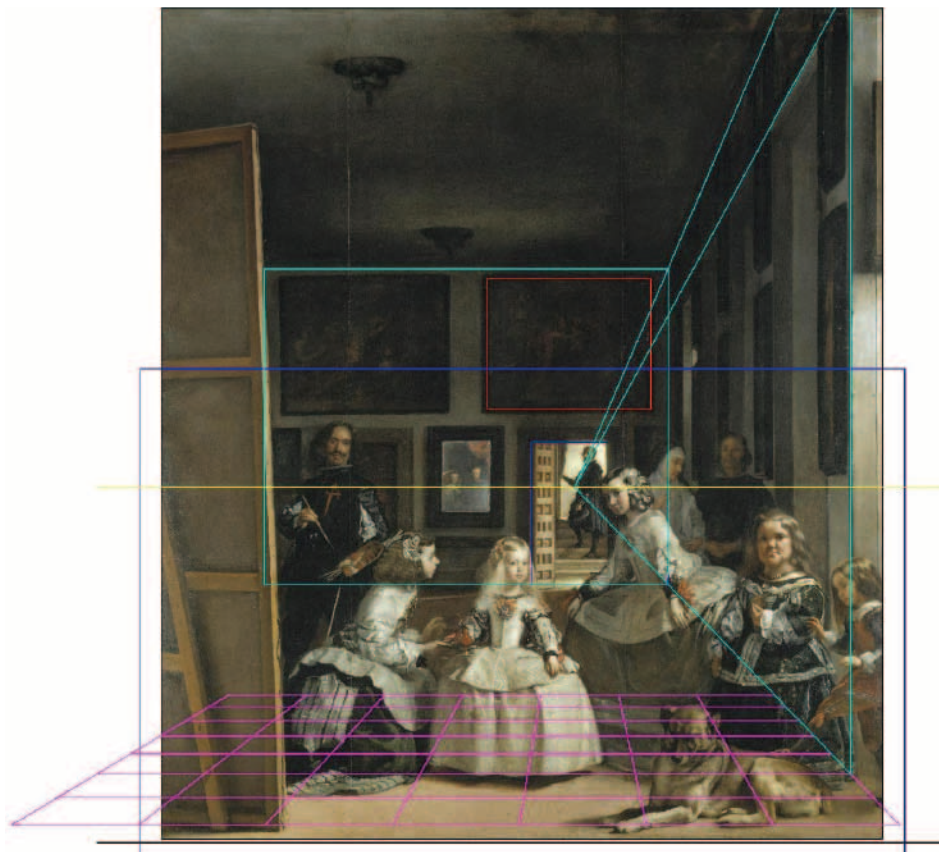
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COLOR PLATE C: **A VIRTUAL THREE-DIMENSIONAL MODEL OF LAS MENINAS: PARADOX OR MIRROR IMAGE?**



Reconstruction of the perspective of *Las Meninas*: Blue represents Charles II's large mirror; cyan, lines to vanishing point and rear wall; red, Mazo's existent copy of Jordaens; yellow, horizon line; black, earth line; pink, theoretical grid with sides of 0.5 m. (Copyright of the image: © Archivo Fotográfico Museo Nacional del Prado. Reconstruction © Luis Ramón-Laca.) (See article in this issue by Luis Ramón-Laca.)