A medical interpretation of colour in the late works of Titian

L. C. Álvaro González

Department of Neurology. Hospital Universitario Basurto, Bilbao, Spain.
Department of Neurosciences. UPV/EHU, Leioa, Bizkaia, Spain.

ABSRACT

Introduction and objectives. Titian (1490-1576) was a Renaissance painter of the Venetian school, rivalling Michelangelo and Raphael of the Roman school. He was a master of the use of colour. In his late period, his style took on a new dimension, with his works losing the vitality, contrasts, and volumes he created with colour in his early works. His late works display a reduced chromatic palette, with a tendency to use ochres and earthy and reddish tones. Blues, greens, and whites barely appear, or show a striking change in tonality. These colours correspond to short wavelengths, the part of the spectrum affected by cataracts. This is our working hypothesis.

Material and methods. The works of Titian held at the Prado (49 paintings) and Thyssen museums (4 paintings), and in general catalogues, were reviewed. Having observed the late change in style, I focused on the works from his later years, 1562-1576, and selected five that are representative of the working hypothesis: *The crowning with thorns* (1570), *Flaying of Marsyas* (ca. 1570-1576), *Pietà* (ca. 1576), *The penitent Saint Jerome* (ca. 1575), and *The burial of Christ* (1572). The following aspects of colour were analysed: brightness and luminosity; polychromy; number of colours and shades; contribution of colour to shape and volume; and atmosphere and ambient light. With the exception of *Flaying of Marsyas* and *Pietà*, the other three works are replicas of earlier pieces, enabling appreciation of the stylistic change in paintings of the same subject and general outline.

Results. All five works show a tendency to an oligochromatic palette, with predominance of earthy tones, ochres, yellows, and shades of red. The change in the whites (especially in Christ's body in the *Pietà*) is striking, with a washed-out appearance that, nonetheless, heightens the work's mystery, elevating the piece. The presence of short-wavelength colours is much reduced; paint is applied in thick brushstrokes or by hand, and the ambience is muted, gloomier, and more sinister. Skies and vegetation are simplified, as blues and greens are absent. This tendency is broken in *The burial of Christ*: compared with the earlier version, the general scene is preserved, but the colours, portraits, and anatomy are unnatural, no doubt the work of Titian's students. The late Titian, with the stylistic change in colours probably imposed by limitations in his visual perception, nonetheless achieves once again a style that is unique, sublime, steeped in mystery and questions, as we might expect of the master, whose genius enabled him to overcome the limitations imposed on him, in this case affecting his perception.

Claude Monet is the most widely studied case of an artist with cataracts, which in this case were documented. Analysis of the change in Monet's style and use of colour reveals a clear parallel with Titian. Monet's cataract was hypermature, with a tempestuous progression after three interventions; Titian's was very probably a senile capsular form that, had he not been a painter, would not have impacted his colour vision in day-to-day life. Finally, Rembrandt also shows a simplification of colour and geometric forms in the drafting of his final self-portraits, although in all likelihood this was the result of poverty and a lack of resources, an external limitation that he was able to overcome.

KEYWORDS

Titian, late Titian, colour, cataract, painting, medicine

Corresponding author: Dr Luis Carlos Álvaro González
E-mail: luiscarlosalvaro@yahoo.es

Received: 22 February 2024 / Accepted: 4 April 2024

Introduction

Painting has traditionally functioned as a mirror, reflecting different diseases, human suffering in general, and different healthcare systems at each moment in history, including their most noteworthy representatives, physicians. This trend has been addressed in numerous studies, both in monographs studying the overall relationship between art and medicine[1] and in studies analysing signs of specific diseases (including neurological diseases) in the history of painting in general[2] or in specific periods.[3] However, the other side of the mirror, painting as a reflection of potential diseases of the painter, has received less attention.

Tiziano Vecellio di Gregorio, Titian, Titianus, or simply Tiziano (1490-1576), was one of the most distinguished painters of the Renaissance period, the greatest representative of Venetian painting, which rivalled the Roman school of Michaelangelo and Raphael on its own merits. Titian, also called "da Cadore" after his hometown (Pieve di Cadore, in Veneto), lived a very long life. We lack information on his health, although the available evidence suggests that he was a vigorous man, strong and free of disease until his death at the age of 86 years due to an outbreak of plague.[4] In his biography of Italian painters, which includes Titian in the second edition, Vasari[5] notes that Titian enjoyed a robust constitution, was barely ever sick, and never with a serious disease; he conserved all his faculties, his sight and his pulse, until his death at nearly a hundred years of age. Vasari recounts that:

> when [I] was in Venice in the year 1566, [I] went to visit Tiziano, as a close friend, and [I] found him, although extremely advanced in years, with brushes in his hand painting.[5(p508)]

More recent monographs on the painter do not contradict this account.[6]

Regarding the dispute between the *colorito* of the Venetian school, the excellence of the Tuscan *disegno* of Raphael and Michelangelo, and the perfection of Michelangelo's *terribilità*, Giorgio Vasari recounts how he brought his master Michelangelo to see Titian's work *Danaë* when the latter was visiting Rome and the Pope. In Titian's presence, Michelangelo praised the work, although he later complained that despite the achievement, "it was a pity artisans in Venice did not learn to draw well from the beginning and that Venetian painters did not have a better method of study."[5(p501)] Logically, Vasari had an interest in demonstrating the superiority of the Tuscans, although at other times he underscored the intrinsic superiority of Venetian *colorito* in such aspects as the sensuality of Danaë, which revealed the limitations of the dominance of Michelangelo's draughtsmanship.[4(p62)] The critic Paolo Pino expressed himself in similar terms in 1548, commending the ideal of Michelangelo's drawing combined with Titian's colour. In turn, Lodovico Dolce wrote in his 1557 work *Dialogue on painting* that Titian was the superior of Michelangelo and Raphael. He defined the characteristics of good painting as drawing, creative capacity, and colour and tonality, considering the Venetian to be the equal of Michelangelo and Raphael in the first two, and their superior in the latter. Similarly, in his *Lettere*, Pietro Aretino sought to reconcile both cultures, rather than viewing them as opposing poles.[4(p53)] We must not overlook the influence of Titian's painting in legitimising power and creating a national discourse on the Republic of Venice.

In Titian's late period, spanning approximately the years 1562 to 1576, his style changed substantially. This change is clear in his use of form and especially of colour. Colours lose their sharpness and brightness, the previous capacity to highlight volumes or contrasts, features that were so clearly displayed in his earlier period. The colour palette shows an oligochromatic tendency, with a predominance of ochres and earthy tones, applied with broad strokes. There was much speculation about this change during Titian's lifetime and after his death. It was thought to have been the result of an age-related loss of faculties, although it was later associated with the heavy brushstrokes used by Rembrandt or by the impressionists, to the extent that the 20th-century Italian art historian Roberto Longhi described it as "magical impressionism."[7] However, we may also consider one of the reasons for this chromatic change to have been a disease of the eyes: cataracts. Opacity of the crystalline lens occurs in over half of the population at the age of the late Titian, with rates approaching 100% if we consider the different stages of the disorder. The opacity most severely distorts short-wavelength light: blues and greens, followed by whites. Clear vision of colour, or of its brightness and tones, is lost, with a tendency to reduced polychromaticity and contrast. In the early stages of Titian's cataract, we observe no changes in lines, design, or drawing; these details are characteristic of different types of mature, advanced cataracts (see Discussion). It is exactly these findings that we observe in key works from his late period,

which we shall analyse in order to assess this working hypothesis. We shall not judge or presume to question the genius of the artist, who in this phase more than any other was able to maintain an air of mystery and grandeur matching or even surpassing works from earlier periods: only a genius possesses the resources to overcome the limitations of disease.

Methods

I reviewed Titian's works displayed at the Prado museum (49 paintings),[8] the Thyssen museum (four paintings),[9] and in general catalogues,[4,6] and analysed in detail his later works, from the last 14 years of his life (from 1562 to 1576, the year of his death). From this period, I selected the works that most clearly show the change in his style, in which our analysis is most relevant:

1) The crowning with thorns (1570), Alte Pinakothek, Munich;

2) Flaying of Marsyas (ca. 1570-1576), Kromeríž Archdiocesan Museum (Czech Republic);

3) Pietà (ca. 1576), Galleria dell'Accademia, Venice;

4) The penitent Saint Jerome (ca. 1575), Museo Nacional Thyssen-Bornemisza, Madrid; and

5) The burial of Christ (1572), Museo Nacional del Prado, Madrid.

The 1570 work *The crowning with thorns* may be compared against another with the same title, painted in 1542 and held at the Musée du Louvre in Paris. In both paintings, Christ is shown surrounded by the same four figures who are torturing him, using the same canes to fence him in and place the crown on his head, in scenes showing great dynamism that becomes claustrophobic due to the closeness of the two granite walls in the background.

Saint Jerome was portrayed several times by Titian. The later work, painted around 1575, is not only the most mature, but probably also shows the greatest certainty and pious feeling, while showing the oligochromatic palette of this period. For comparison, I selected the painting *The penitent Saint Jerome*, painted around 1530 and held at the Louvre, an early work by the artist at the height of his use of colour, light, and volume.

The burial of Christ (1572), at the Prado, is a poor-quality work when compared against the 1559 masterpiece of the same name, which hangs a few metres away on the same wall. We are therefore able, once more, to directly compare the two; the later work was probably completed by Titian's students, as noted in the label beside the piece in the Prado museum.

For the other two works (*Flaying of Marsyas* and *Pietà*), no previous version of the painting is available for comparison. Where appropriate comparison with previous works is possible, I identify those which most clearly show the contrast between Titian's late and earlier periods.

The analysis will consider the following aspects of colour:

— Brightness and luminosity;
— Polychromy, number of colours and shades;
— Contribution of colour to form, volumes, profiles and spatial limits (ie, imitation of sculpture or grisaille); and
— Atmosphere and ambient light.

Having described the paintings, we shall conduct a clinical analysis of the findings from the perspective of our working hypothesis that the artist had a cataract, which caused the change in his painting style. The discussion will also include a comparison against bibliographic findings on later painters.

Results

1) The crowning with thorns (1570), Alte Pinakothek, Munich

This work shows a clear reduction in the brightness, saturation, and luminosity of colours compared to the 1542 work at the Musée du Louvre (Figure 1). The colours used in this work are sumptuous, vivid, and give differentiated form to the figures' anatomy; this is particularly the case in the torso of the soldier on the left, which is modelled on the classical Belvedere torso sculpture, found shortly before, as well as the lateral and posterior muscles of the neck in the bald man to the right, the anterior neck muscles of the figure in the background with the blue military jacket, and in the feet of Christ, which are retracted and contracted in response to pain. The veins and tendons of the feet are shown in subtle profile. The 1570 painting shows thick brushstrokes, and the same anatomical features are harder to identify. The flesh loses its brightness and the anatomy is indistinct, particularly in the legs of Christ. The same occurs with the clothing, which in the Munich piece is made with just a few suggestive brushstrokes. If we observe the figure to the left in the Louvre piece, the observation of the Belvedere torso,

Figure 1. *The crowning with thorns*: 1570 (left, © Alte Pinakothek, Munich) and 1542 (right, © Musée du Louvre, Paris).

the clothing covering the lower half of the body floats with movement; Titian draws folds and creates very well profiled volumes and edges between different fabrics and colours, using solid textures. If we follow this soldier's clothing from the base of the right axilla to the feet, five colours are observed: white, yellow, blue, another yellow, light green, and another white. In the Munich piece, on the other hand, only two or perhaps three poorly differentiated colours are observed: a white band high on the left leg, the only one visible, and a crimson sash whose lower part becomes blurred and loses vividness, shifting towards an earthy olive green. No edges or clear folds are observed; a noteworthy feature is the addition of a black dagger, hanging from the figure's belt, in the 1570 piece. Titian's tendency to use red as the dominant colour in the clothing is observed in the figure to the left (described above), as well as the third figure from the left, depicted wearing a hat, and in the bald man above and to the right of him. Christ's tunic is made up of a single colour, white, with the exception of the bloodstains at the front, on his chest, and back, to the left. With the exception of the figure with the blue hat, in which Titian recreates this highly characteristic combination of reds and blues, the

Figure 2. *Flaying of Marsyas*, ca. 1570-1576. © Kroměříž Archdiocesan Museum (Czech Republic).

rest of the painting is clearly oligochromatic, with earthy reds and the previously mentioned lack of grisaille or volumes, edges, and vividness of colours in the clothing and flesh, features that are so evident in the 1542 work.

The ambient light falls almost frontally in the earlier work, centred on the figure of Christ, the soldier to the left, and the bust of Emperor Tiberius above the doorway, presiding over the scene. In the 1570 work the light falls from above, this time from the right, and is artificial, emitted by a lamp that seems to flicker and flare, illuminating Christ and his immediate surroundings to create a close, murky atmosphere, a clear departure from the intense, almost blinding light of Titian's earlier painting.

2) Flaying of Marsyas (ca. 1570-1576), Kroměříž Archdiocesan Museum

This work depicts the flaying of Marsyas (Figure 2), a flute-playing satyr from Phrygia who challenged Apollo to a musical contest. Apollo is shown at the left, looking upward while playing a stringed instrument. The judge is King Midas, who proclaimed Apollo the victor. Midas is shown seated to the right, with features that resemble

Titian's. He has donkey ears, as does the satyr beside him, carrying the bucket. Midas' ears are the "prize" for his failure in another of Apollo's musical contests, this time against Pan, in which Midas preferred the latter as the winner. Strings were considered the most elevated of instruments, divine like Pythagoras' spheres. Their music had the power to elevate the soul to the kingdom of beauty and truth, hence Apollo's heavenward gaze, lost, rapt in the beautiful sound. On the other hand, the wind instruments were considered plebeian and corresponded to the non-divine, including fauns and satyrs. To challenge or betray a god, who possessed access not only to true beauty but also to strength and power, had tragic consequences, as in the case of Marsyas, seen here, or the Titans, who were also painted by the master from Cadore.

Marsyas occupies the central vertical space in the painting, and is portrayed upside-down, hanging from his satyr's legs, which spread open in a V shape with a tree trunk seen between them, whose black texture is very close to that of his legs, which are tied with two red bows. Apollo's robe and Midas' tunic, with folds in the centre, are shown in the same colour. Flesh tones are earthy and dark, generally painted with broad strokes, and Titian is able to capture the expression and sentiment of each character with an anatomy and attire that are poorly elaborated. He executes this with the dominant use of reds and earthy browns, which nonetheless draw us into this masterpiece. The reds of Marsyas' blood, which is lapped up by a small dog and mixes with the earth in the foreground, are echoed in the thick vegetation of the background, made up of fast, thick, poorly profiled brushstrokes, giving the scene a close, intimate atmosphere, which would resound with Marsyas' cries, isolated from the world by the dense, peculiar vegetation that Titian created with his brush. The only light is in the upper left part of the painting, illuminating Apollo and Marsyas. This is achieved with a series of whites that open up the vegetation, allowing light to enter. The white is reflected on the garment around the waist of the skinner wearing the hat, at the edge of Marsyas' black skin, on the upper band of the tunic on Midas' back, and on the snout and trunk of the black dog. These reflections are not observed in Apollo, perhaps due to his divine nature, which, as seen in his expression and rapture, is alien to suffering; nor are they seen on the kneeling female figure in the foreground, whose back is draped with a violet garment, a unique colour in the piece. The vivid red of this figure's left stocking is the same tone as that running down Marsyas' skin towards the ground, where it is lapped up by the small dog, the victim's blood. Therefore, reds and earthy tones dominate this piece, a scene of martyrdom that, sadly, is repeated in every historical era.

The right side of the piece is characterised by the heavy atmosphere and resonant cries of pain, echoed in these earthy and olive brushstrokes. The left half, on the other hand, is marked by an opening in the sky located, not by chance, above the head and instrument of Apollo, who is a stranger to pain, contemplating the light of beauty. Suffering does not reach the gods (left), only the underworld and its creatures (right), in whom it is reflected time and again, like an echo. Titian's genius remains as a clear presence in this final oligochromatic phase, undiminished by his apparent perceptual limitation.

3) Pietà (ca. 1576), Galleria dell'Accademia, Venice

This piece is Titian's final painting and, according to the literature, is unfinished (Figure 3). The final touches are said to have been made by Palma Giovane after the death of his master Titian,[4] although his real contribution seems to have been the angel carrying the torch, which flies above the group. The rest of the piece is purely late Titian, imbued with the magic and air of mystery created by Titian's tendency to reduced chromatic richness, with a predominance of darker and earthy tones and poor definition of profiles and volumes with colour, a characteristic of his earlier works.

Pietà was painted for the church of Santa María dei Frari, without a doubt for his own tomb. Today, it hangs in the Galleria dell'Accademia in Venice; the painting is colossal, measuring nearly 4 metres high by 3.5 metres wide. The central figure, the Virgin Mary holding the deceased Christ, immediately brings to mind Michelangelo's sculpture at the Vatican. To their right, a kneeling figure looks on anxiously. He bears a resemblance to Titian, and is styled as a mixture of Job and Saint Peter. On the other side of the *Pietà*, to the left, is a standing spectator, the sinner Mary Magdalene, ostentatiously crying in pain and gesticulating. From the head of Mary Magdalene, the highest figure, we can follow a descending diagonal through the heads of the Virgin Mary, the dead Christ, and Titian/Job/Saint Peter, to the feet of the latter. This line describes the hypotenuse of a right-angled triangle, whose base is formed by the feet of the four

Figure 3. *Pietà*, painted in 1576, the year of Titian's death. This was his final work. © Galleria dell'Accademia, Venice.

figures at the foot of the crypt, and whose vertical edge follows the external silhouette of the standing, screaming Mary Magdalene. Each side of the crypt is guarded by a sculpture: on the left, Moses and his stone tablets and on the right, the Sibyl, bearing the cross of martyrdom. They represent the Old and the New Testaments, respectively. The statues stand on lion head pedestals, a figure as Venetian as Saint Mark. Like in other late works of Titian, a characteristic air of oppression and anguish are created by the architecture in the background, an austere, elevated crypt with a concave back, with a roof resting upon two stacks of individual carved stones. Resting on the top of the crypt, a small gable roof, we observe a *memento mori*, a still life with flowers, on one side, and votive lamps of reparative, regenerative fire, on the other. The Christian symbology of resurrection continues, with the bird visible in the dome of the upper part of the crypt, a pelican with its chicks, representing a phoenix that lies on the vertical line passing between the heads of Christ and the sorrowful Virgin.

The painting is dominated by cold colours, with the dark greys of the architecture even showing a similar tone to the darkened whites of the sculptures of Moses and the Sibyl and the lion pedestals. It is a degraded white, lacking any brightness, that draws the folds of the tunic and the anatomy; despite the limited detail, it achieves

great expressiveness. The white that stands out is that of the body of Christ. It provides a semblance of life that contrasts with the remaining whites, while transmitting a sensation of decomposition, of dead tissues that degenerate and dissolve, corresponding to death. Above the deceased Christ, the phoenix, a pelican, shines almost artificially in this piece dominated by greys, the white here standing against a reddish background reminiscent of sunrise, the counterpoint to Christian resurrection which is elevated above death, depicted directly above the figure of Christ in that contrasting white of decomposition. The skin of Mary Magdalene and Titian/Job is painted in the dark, earthy tones characteristic of this stage of the painter's life, and is clearly differentiated from the white of Christ, of the sculptures, and, of course, the angel painted by Palma Giovane, an addition that, in my opinion, is excessively ostentatious and whose colour is discordant with the rest of the painting. Against the spectrum of greys and whites that dominate the work, three coloured details stand out. Firstly, Mary Magdalene's dark olive-green tunic; and secondly, Titian's characteristic combination of blues and reds, mentioned above: the former in the Virgin Mary's tunic and the latter in the tunic covering the back of Titian/Job, the two separated by the white of Christ's skin and loincloth. As with the dominant colour, the olive green, blue, and red are traced in broad strokes, which give the clothing little sense of volume, brightness, or contrast, but nonetheless do not lose expressiveness, a feat that only a genius could achieve.

Titian was clearly aware of his coming death, which obsessed and terrified him; this sense is unequivocally transmitted in the *Pietà*. It was a voyage into the unknown, reflected in the new and degraded white of Christ, with the only consolation being Christian faith and hope in resurrection, represented by the pelican reborn toward the light of the rising sun. This central, zenithal light faintly illuminates the four central figures and the statues.

4) The penitent Saint Jerome (ca. 1575), Museo Thyssen-Bornemisza, Madrid

Saint Jerome is a classical theme in art history, with artists usually portraying the landscape, anatomy, clothing, and attributes of Saint Jerome, an eremite and one of the fathers of the church. The saint's attributes or identifying marks include the crucifix, the Bible, the skull as a *memento mori*, the stone with which he beat himself in recognition of his condition as a sinner, the cardinal red habit, and the lion, from whose paw, according to tradition, he had extracted a thorn, hence the lion's docility and loyalty to the saint. Not all the attributes are always depicted, although combinations of some of them allow him more easily to be recognised.

We are fortunate to be able to compare the work at the Thyssen museum (ca. 1575) against an earlier *The penitent Saint Jerome*, this one painted around 1530, held at the Louvre (Figure 4). The latter depicts a traditional landscape with tree trunks, branches, and leaves in the foreground, extending to the background of the wooded landscape and up the high rocks, which also show lush, abundant vegetation. Blue tones are observed in the clouded sky, in a scene illuminated by crepuscular ambient light that strikes the tree trunks in the foreground and shows Jerome and his attributes in a play of well-defined light and shadow. The saint's dark flesh shows an accurate anatomy, with a dark, almost black cloth covering his lower half and one of his legs. In his right hand he holds the rock. The lion, serene, stands behind him. In the foreground, a closed Bible leans against a rock, on top of which also rests a cardinal's hat, another attribute of the saint. In the background, set into the cliff face, is a crucifix, with a white cloth around Christ's waist. Greens, blues, shades of brown, whites, and an interplay of vivid light and shade make up the colour palette of this early painting, with a plenitude of colour, contrast, light, and liveliness.

Turning our attention to the later work, painted around 1575 and displayed at the Thyssen, we observe the reduced colour palette described throughout this article. The dry vegetation is inferred, rather than seen, painted in the earthy colours that dominate the elements of the landscape, both rocks and trees. These elements are simplified, mere outlines, in a simple geometric drawing that contrasts with the detail and irregularities seen in the rocks in the earlier Louvre piece, both in the high vertical wall and in the rock in the foreground. In the Thyssen painting there is almost no differentiation between the cliff wall of the background and the rock in the foreground, covered by the head of the lion, which is depicted sleeping and painted in the same dark earthy tone as the dry vegetation. The sky, covered with grey clouds, lets through the weak, diffuse light illuminating the scene, which does not allow for the strong contrasts between light and shadow that we observe in the Louvre painting. We observe no blues or greens, nor the associated volume

Figure 4. *The penitent Saint Jerome*: ca. 1575 (left, © Museo Nacional Thyssen-Bornemisza, Madrid) and ca. 1530 (right, © 2007 GrandPalaisRmn, Musée du Louvre, Paris, Thierry Le Mage).

or brightness; rather, it is dominated by this oligochromatic use of various brown tones, against a poorly-lit background. Nonetheless, the genius is once more able to captivate the viewer with this spectacle of piety, completed by the crucifix on the rock in the background (this time without the vivid white of the cloth around Christ's waist), the stone in the saint's hand, and the open Bible on which his other hand rests. This painting lacks the vivid red cardinal's hat, but instead includes a violet-red tunic, painted in broad strokes with little elaboration of the folds. This is sufficient to cover a saint of unequivocal dedication and devotion, whom Titian captures in an extraordinary painting. The strength of his gaze and his devotion, in my opinion, surpass those of the Louvre painting, despite the reduced chromatic richness. Once more, the genius was able to overcome his limitations, sensory or otherwise, achieving equal or superior results than those of his earlier works, produced at a time when he was not affected by internal or external constraints.

5) The burial of Christ (1572), Museo Nacional del Prado, Madrid

This painting depicts a traditional religious and devotional subject, which was painted by Titian on numerous occasions; two of these paintings, made for king Philip II, are displayed at the Prado museum in Madrid. The first was executed in 1559 and the second in 1572 (Figure 5). Titian's mature style is easily recognised in the 1559 painting, in its composition, dramatism, light, and above all in the use of colour, with reds, blues, yellows, and intense whites. The figures are arranged in a semicircle, crossed by a diagonal line formed by the body of Christ and the stone sepulchre in the foreground, which is impressive due to its relief details and great dimensions, which give it a central role. Christ's anatomy is highly detailed, and the portrait of his face, which is darkened and clearly lifeless, shows the psychological value of the master painter. The white shroud on which he rests, with its elaborate folds and intense lighting and contrast, hangs alongside Christ, reinforcing the vividness and

Figure 5. *The burial of Christ*: 1559 (above) and 1572 (below). The latter painting represents a rupture with the work of the late Titian and includes imperfections that are not befitting of the master; it was finished by his disciples and only preserves the general scene drawn by the first Titian. © Museo Nacional del Prado, Madrid.

poignancy of the work. The deceased Christ is supported at his head by Nicodemus, once more a portrait of the mature Titian, and at his feet by Joseph of Arimathea. Nicodemus is dressed in a dark yellow tunic with a white hem, painted next to a dark, muscular leg that contrasts greatly with the whiteness of the deceased Christ's arm, dangling beside Nicodemus' leg. Joseph of Arimathea wears a red tunic, acceptably detailed, with the front covered in the lower half with a yellow fabric, somewhat brighter than the yellow of Nicodemus' tunic. The red of the tunic contrasts strikingly with the blue, so characteristic of Titian, of the Virgin Mary's tunic, painted in a vivid, luminous blue that highlights its volume. The Virgin supports her son's left arm, her hands displaying a highly realistic grasp and detail. Mary Magdalene, wearing a white dress with folds that hang and sway in the wind, is depicted standing, leaning toward Christ as she cries in sorrow. To the spectator's left, just above the head of the Virgin Mary, we see the head of Saint John; in the shadows, we glimpse only his face and his hands, clasped together in prayer. In the upper right part of the painting, above the figure of Mary Magdalene, we see a landscape with a clouded sky, with well-defined blues, greys, and white tones. The light illuminating the work is also clearly identified, striking the figure of Christ from the front and left; it also hits the face of the Virgin Mary and leaves the remaining figures in a soft shade that is only broken by the illuminated white of Mary Magdalene.

Let us now analyse the later work, from 1572; this comparison reveals the most striking of the contrasts studied in the article. Firstly, the composition is poorer: there is a flattening of the top of the semicircle described above, and the lower diagonal lacks the strength seen in the 1559 painting, with a smooth, unadorned sepulchre and a Christ whose face, once again dark and lifeless, is excessively expressive, contrived. The anatomy of Christ's neck and collarbones does not show the accuracy typical of the master from Cadore, and the white shroud lacks the colour and expressive power we would expect of the late Titian, even within the trend towards an oligochromatic colour palette. Christ's left arm, supported by the Virgin Mary, lacks the accurate position seen in the older work, as though her hands and the arm they support are inappropriately positioned and do not exert the proper force. The Virgin Mary once again wears a blue tunic, while the yellow and red garments of Nicodemus and Joseph of Arimathea have switched places. The earthy yellow of the latter's tunic becomes a light, almost orangey brown, adorned with clusters of black circles, a design and pattern not seen in any other work by Titian. Mary Magdalene's white tunic has become pink. All the portraits have lost their psychological and expressive power, and the landscape to the right of the scene has become urban, with a castle standing over rocks and a sky with the blue and pink tones of sunset, incongruous with the work of the late Titian. Therefore, as noted in the label accompanying the painting at the Prado museum, this is a work that was finished by Titian's disciples. The composition resembles that of the 1559 piece, but neither the drawing, the scene, or the portraits are those of Titian; neither is the colour, which does not fit within the oligochromatic trend that characterises this late period of his work, described above. This piece presents an abundance of vivid colour, with blue and pink shades and highlights that diverge from the style of the late Titian. In all likelihood, the master's design was completed by his disciples, making this a Titian painting that contains little of the master himself. This contrasts greatly with the *Pietà* discussed above, in which the final addition of Palma Giovane is limited to a single, easily identifiable figure (the angel carrying the torch), in a painting that is characteristic of the late Titian, particularly in the thick brushstrokes and the colour palette used.

Table 1 summarises the most relevant characteristics of these five paintings.

Discussion

Cataracts are defined as an opacity of the crystalline lens of the eye, a transparent, lentil-shaped structure located between the iris and the vitreous humour. The function of the crystalline lens is to focus rays of light on the fovea, independently of distance. For nearby objects, the lens contracts due to the action of the ciliary muscles, which pull it from its two poles or extremes. This increases the diameter of the biconvex lens, increasing its refractory power to enable focus for correct near vision, for instance when reading. With age, the lens loses flexibility: while adolescents are able to focus at just 7.5 cm, this distance increases from the age of 40 years, a phenomenon known as presbyopia. However, age is also associated with another disorder of the crystalline lens, which occurs almost universally from 70 years of age[10]: opacity of the lens, or cataracts. The phenomenon generally presents a slowly progressive course. It causes loss of transparency of the lens, reducing visual acuity and colour perception, and often causes worsening of night

Table 1. Main characteristics of colour in the five Titian works analysed.

	BRIGHTNESS AND LUMINOSITY	POLYCHROMATISM AND TONES	VOLUMES/SHAPES WITH COLOURS	ATMOSPHERE/AMBIENT LIGHT
The crowning with thorns *(1570 vs 1542)*	Very little	Predominant earthy tones and reds (except a figure with blue, red, and yellow garments)	Few. Indistinct anatomy. Dark flesh tones	Artificial light from a lamp, flames. Close, dark atmosphere
Flaying of Marsyas *(ca. 1570-1576)*	Little. Bright clearing over the musician Apollo, alien to pain (left half). Shadows in the right half (underworld, suffering)	Reds (blood, bow, clothing) and earthy tones mixed with reds (earth); vegetation in the background. Thick brushstrokes that reverberate like sounds (cries of pain)	Poor contribution of colour to volume. Poorly detailed yet accurate anatomy	Natural light contrasts between the two halves. White where the sky opens
Pietà *(ca. 1576)*	Generally sombre and oppressive appearance	Work in greys and dark whites (sculptures). Figure of Christ highlighted in white, sense of degeneration	Little. Complex impression in Christ: washed-out brightness	Central light elevated above the figures, centred on Christ. Reddish reflection at the top of the crypt (symbolises sunrise). General oppressive atmosphere
The penitent Saint Jerome *(ca. 1575 vs ca. 1530)*	Very little. Dark, gloomy painting	Predominance of greys and earthy tones	Poorly defined vegetation and rocks. Striking monochromatism. Geometric drawing	Shadow, with highlighted, asphyxiating compassion of the saint
The burial of Christ *(1572 vs 1559)*	Contrived	Vivid colours, patterns uncharacteristic of Titian, out-of-place polychromatism	Unsuccessful. Portraits with contrived expressiveness (face of the deceased Christ)	Light with blue and pink tones from an urban landscape. Work finished by disciples (initial scene by Titian)

vision under artificial light; the most frequent manifestation cited in the literature is dazzling when driving at night, which is typical in early stages of the disease.[11-13] This is the result of internal reflection and rebounding of rays of light in an opaque lens, which acts as a mirror.

Cataracts are one of the most frequent causes of vision loss in developing countries. In countries with more healthcare resources, millions of cataract surgeries are performed each year. In these procedures, the opacified natural lens is removed and replaced with a transparent synthetic lens; outcomes are generally satisfactory in improving vision limitations, including colour vision. The most frequent form of crystalline lens opacification is age-related cataracts. However, several non-age-related forms exist, with earlier onset. These forms are secondary to trauma, local infections, uveitis, or the local metabolic impact of systemic diseases, such as Steinert myotonic dystrophy. Several factors have also been identified that accelerate the deposition of non-transparent solid material in the lens, hastening the onset of cataracts. These include intense, prolonged exposure to sunlight; alcohol and tobacco use; dietary alterations; physical inactivity; diabetes mellitus; HIV infection; and use of steroids (local or systemic), non-steroidal anti-inflammatory drugs, or statins (results for the latter are inconclusive).[13]

Age-related cataracts result from the structure of the lens itself, which includes an outer capsule, a cortex, and a nucleus, in an avascular anatomical formation. This lack of vascularisation prevents drainage or evacuation of epithelial cells from the cortex. The transparency of these cells is due to an abundance of proteins called crystallins. As they degenerate with age, epithelial cells reproduce and renew themselves. Due to the crystalline lens' lack of capacity for drainage, degenerated epithelial cells

accumulate, typically in central areas, in the nucleus. These deposits typically grow in the nucleus (nuclear cataract, the classic age-related type), but may also appear in the form of spicules in the cortex (cortical cataract, associated with ageing but also with structural damage, such as trauma) or affect posterior areas (posterior subcapsular cataract). Combinations of the different forms may also occur.

The clinical course of cataracts is slow and painless, with great variation in clinical expression between individuals. As they develop, cataracts reach different grades of maturity (from immature to mature and hypermature), with increasing opacity, rigidity, and visual degradation. In nuclear forms, far sight is more severely affected than near sight, whereas both near and far sight are affected in posterior subcapsular forms. The reduction in near or far visual acuity is fairly well tolerated, even with significant degradation. The same is true for colour vision: patients often do not notice the degradation until they are able to compare the vivid colour vision of the recently implanted artificial lens against that of the second eye, yet to undergo cataract surgery.

At this juncture, we must consider the impact of cataracts on colour perception in artists, in whom chromatic richness, elaboration of colours, tone, and contrast are key to understanding their work. Such is the case in Titian, who is recognised as a master of colour. Clearly, an artist's perception and nuanced use of colour is not the same as that required by a non-expert. It is probably for this reason that the reduction in the chromatic spectrum is so well tolerated in non-artists with cataracts, who are only able after surgery to express the vividness and intensity of colour that they now see with the new lens, which they often liken to the colours of their youth. These patients are not conscious of the loss of colour perception, probably because they do not rely on it in their daily lives. Therefore, these patients more frequently complain of loss of acuity in near or far vision (or both), depending on the localisation of the crystalline opacity; ophthalmologists may indicate surgery to slow or prevent such complications as glaucoma, which is facilitated by cataracts, even when the reduction in visual acuity is well tolerated. The most characteristic manifestation is visual glare, particularly when driving at night; this can be torture for patients with cataracts and is further exacerbated by their difficulty reading signs without large lettering.

Cataract surgery was practised as early as 4000 years ago, by the ancient Egyptians. The procedure, known as the reclining technique, consisted in accessing the lens from the lower part of the cornea using a copper instrument, which was used to gently push the crystalline to the floor of the vitreous, at the eye fundus. The technique was used until the 19th century, and continues to be performed in developing countries.[14] The use of conventional (extractive) cataract surgery was very limited until little more than a century ago; it was restricted to cases of severe reduction in visual acuity secondary to mature or hypermature cataracts, externally visible without the use of a slit lamp. This does not seem to have been the case in Titian, as this disease stage typically causes a loss of visual acuity that would have been incompatible with his late work, which, as we have discussed, is of great quality despite the clear change in the use of colour. Furthermore, there is no evidence that the incidence of age-related cataracts was lower in the 16th century than it is today, although their diagnosis would logically have been limited to hypermature forms that opacify the lens, preventing the passage of light. The concepts of normality, pathology, health, and disease have changed over the course of history,[15] and there is no reason to believe that this would be any different in the case of eye health. The incidence of cataracts is also known to be higher in less developed regions, with lower healthcare standards and higher rates of vascular risk factors, poor diet, or prolonged exposure to sunlight. The 16th century would almost certainly fit this description; therefore, we may expect the incidence of senile forms in the population at that time to be even higher than today. Titian died at 86 years of age (the quote from Vasari at the beginning of the article puts Titian's age at the time of Vasari's visit to his studio at over 100, surely the result of a miscalculation) and, given that all his faculties, vision, and pulse were preserved,[5] his cataracts obviously would not have been the hypermature type that was removed by surgeons using the reclining technique.

The change in colour in Titian's late works is characterised by a reduction in the chromatic spectrum, particularly in short-wavelength colours such as blues and greens. There is also a noteworthy change in whites, which are darkened. His works become oligochromatic, almost monochromatic, dominated by the use of medium- or long-wavelength colours: browns, earthy tones, yellows, and shades of red, often applied with broad strokes or even with his fingers.[4] The use of colour shows little

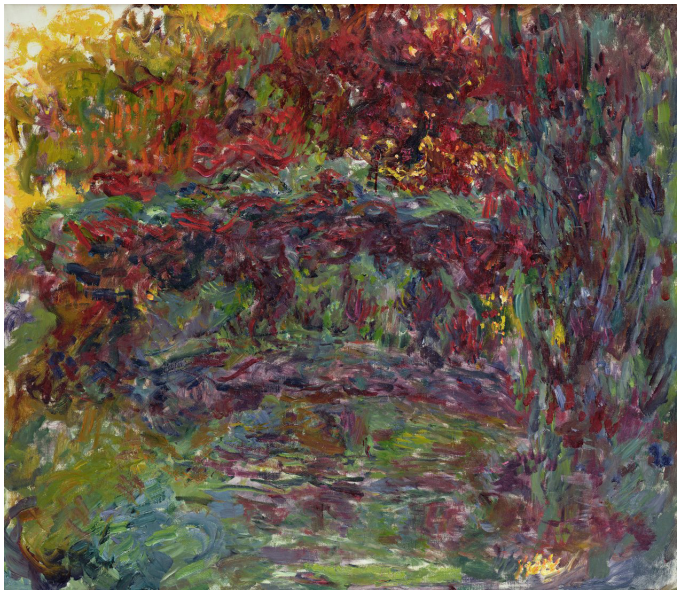

Figure 6. Successive images showing the Japanese footbridge in Monet's garden in Giverny. This is one of the recurrent themes appearing throughout the painter's career. Top: a painting from 1900 (© Philadelphia Museum of Art, Filadelfia). Below: paintings from 1918-1924, after development of cataracts. The image at the left (© The Museum of Fine Arts, Houston) is dominated by yellow tones, and the one at the right (© Musee Marmottan Monet, Paris) by blues.

elaboration, giving less sense of volume and creating less contrast than the vivid colours of his earlier works; he paints darker scenes that nonetheless transmit a greater sense of mystery and uncertainty. This change in colour is what we would expect to observe in somebody who has lost the ability to perceive the chromatic richness and the brightness of blues, greens, and whites seen in his earlier periods. The nuance of longer-wavelength colours (precisely the colours he uses) is preserved. For these reasons, the hypothesis of this article is that Titian had age-related cataracts that made him lose the colour vision and acuity of his earlier years. Through his genius, he substituted these with a more reduced chromatic palette, consistent with this disease, and was able to maintain his strength and artistic power despite this visual perceptual limitation and the ensuing reduction in colour.

The best known and most studied example of an artist with cataracts is probably Claude Monet (1840-1926); let us analyse some details of his work in relation to cataracts and the associated change in the use of colour.[16,17] Monet reported the first symptoms of cataracts in 1908, at 68 years of age. Four years later, aged 72, he was diagnosed with bilateral cataracts. By then, he had been forced to change his working methods. The loss of visual acuity prevented him from painting outside. He could barely distinguish colour, shade, or depth. He worked around this by reading paint tubes, and later by ordering the placement of paints on his palette. He selected the times when the lighting was ideal for painting; this indicates the severity of his visual involvement, as he had previously painted obsessively, in his garden with its immense flowerbeds or on the boat he designed to carry his easel in order to capture the essence of colour variations in water. Only in 1923, aged 82 years and practically blind, did he consent to cataract surgery on his right eye, which was more severely affected. By then, his visual acuity is calculated to have been 20/200: very severe involvement that makes it hard to comprehend how he was able to paint. His visual acuity was calculated at 20/100 in 1918 and 20/50 in 1912, the year of his diagnosis. The complaints noted in his correspondence increase with the passage of the years. He refers repeatedly to limitations in colour perception: "colours no longer had the same intensity for me […] reds had begun to look muddy […] my painting was getting more and more darkened."[18] This was the time when he guided himself by the labels of paint tubes and by "force of habit," in 1918, when he was still able to read and write, though not without difficulty. The same occurs with yellow tones, and Monet himself acknowledged that his paintings and colours had become monotonous. Therefore, not only are blues affected, but the "yellowing" of the crystalline lens also affects overall visual acuity and the perception of practically all colours; a painter would rapidly notice the loss of these tones, which were essential in Monet's art style. These details are clearly reminiscent of the late Titian.

The ophthalmologist Prof Marmor studied the painting of Degas and Monet from the perspective of perceptual limitations related to retinal degeneration, in the former, and cataracts, in the latter. For these purposes, he used filters that caused a loss of visual acuity and a blurring of borders and colour, which enabled him to achieve surprising colour effects. The effect was applied to photographs of the original scenes painted by Monet, or to paintings he made when his visual acuity was unaffected. By inserting successive filters, it is possible to achieve an equivalent acuity to that of the later years of Monet's life, before he underwent surgery. This simulation forces us to reconsider the results of perceptual limitations on painting, which may generate what appear to be new styles, although in reality they are no more than the consequence of a visual acuity impairment. The assertion that the late Monet is an antecedent to expressionism or abstraction, precisely because of the coarse, indistinct lines, built up in thick, monotone layers, can probably be interpreted as an artistic theory that is countered by an opposing (clinical) theory, which also merits consideration (Figure 6).[19]

Dr Charles Coutela operated on Monet in January 1923. Two procedures were scheduled. The first was an iridectomy, followed three weeks later by an extracapsular cataract extraction and mass aspiration. Due to a complication of the second operation, a third was conducted to perform a section of a residual membrane. It is unsurprising that Monet never consented to surgical treatment of his left eye. However, several months later, he was able to dedicate himself intensely to painting using aphakia glasses, a second youth in terms of vision.[20] These spectacles had the opposite effect to cataracts, potentiating blue tones. This causes a phenomenon known as cyanopsia, a perceptual alteration with an excess of blue tones, which may be related to the violet shades of his last painting of the footbridge at Giverny; this was painted in 1924 and is dominated by beautiful lilac tones (Figure 7).

Figure 7. The footbridge at Giverny painted in 1924, with aphakia glasses. The predominance of lilac tones may be the result of the dyschromatopsia due to cyanopsia observed in patients with aphakia glasses, which are used after extraction of the crystalline lens with the surgical procedures of the day. © Musee Marmottan Monet, Paris.

The surgical outcome was not optimal, although a clear improvement is observed if we compare the previous two images.[21] However, even the paintings executed during times of greater perceptual alterations clearly show how the charm and attraction of his early works is maintained. The blurred forms and edges, the apparent monotony of colour, and the lack of a background do not prevent the viewer from appreciating and enjoying the piece. The painter's artistic capacity, planning, and management of concepts and space surpass even his severe limitations. Genius remains present in the paintings of Giverny from 1922 and 1923; despite their inspiration in abstract expressionism and the continued ability to captivate the spectator, these are probably the result of severe cataracts and the painter's (triumphant) struggle against his poor visual acuity. This is the same effect as that observed in Titian, although the latter's cataract is very unlikely to have reached the same grade of maturity as Monet's.

Finally, let us mention Rembrandt (1606-1669), a master portraitist whose painting style also presents a late change.[22-24] In his last self-portraits, colour is simplified and the background shows geometric structures, such as circles and squares. A study of more than 40 late portraits found that in the majority, the artist's left eye deviates laterally. This is suggestive of phoria and altered depth perception, which some authors consider an advantage for the representation of three-dimensional image in a two-dimensional space.[22] Despite the reduction in his colour palette, Rembrandt was able to capture his

own psychological essence, his authentic self, including death as a part of life, a feat that only he and Shakespeare had ever achieved.[23] This psychological depth is part of Rembrandt's brilliance, and probably its most important aspect. In this case, the reduced colour palette is probably the result of the abandonment, solitude, and poverty of his final years. As in Titian and Monet, Rembrandt surpasses all limitations, regardless of their origin. The oligochromatic colour palette that characterises these artists' late works does not always consist in sad, washed-out yellows and earthy tones. For instance, it has been said of Turner that in his final works, the light shifts to bright, vibrant reds in an attempt to compensate for a loss of visual acuity of unknown cause.[24]

Therefore, the history of art includes parallels between Titian and other painters, with a late stylistic change due to perceptual limitations; given the colour palette of the pieces analysed, this limitation was most likely due to a non-hypermature senile nuclear cataract. This is the hypothesis of the present study, and appears to be consistent with the five works analysed and with the works of other artists, particularly Monet. Titian is said often to have left pieces unfinished,[4,5] and this may have been the case in his late works.[4] If this were the case, the thick brushstrokes would constitute part of his style, but the other characteristics analysed would still not be explained (Table 1). Furthermore, some of the late works of Titian are truly colossal, and show polychromatic colour use and contrasting volumes painted in grisaille. The only possible explanation for this is that these pieces were fully or partially painted by Titian's disciples, as was typical with the great masters of the day, who working alone would struggle to paint these enormous late works, some of which are displayed in the Prado museum. Examples would include *Religion assisted by Spain* (1572-1575), *Philip II offering the Infante Fernando to Victory* (1572-1573), and *Tarquin and Lucretia* (1572; displayed at the Fitzwilliam Museum in Cambridge).

Other hypotheses have been proposed to explain the late change in Titian's painting style. Stylistic changes observed at earlier points in his career that have been analysed in post-structuralist terms, with consideration of the reception of the work of art or the taste of the customers commissioning the works. Thus, for instance, Titian's self-portrait displayed at the Gemäldegalerie of the Berlin State Museums, painted in 1550 (ie, prior to the eye disease discussed in this article), also shows changes reminiscent of those caused by cataracts.[25] Similarly, the *sprezzatura* (unfinished or unpolished) style characterising Titian's late works has been linked to psychological factors, such as pessimism about death, the desire to experiment, or awareness of artistic recognition; it has even been characterised as a precursor to Baroque naturalism.

Conflicts of interest

The author has no conflicts of interest to declare.

References

1. Bordin G, D'Ambrosio LP. Medicine in art. Los Angeles: Getty Publications; 2010.
2. Martí-Vilalta JL. Neurología en el arte. Barcelona: Lunwerg; 2007.
3. Álvaro LC. Lo neurológico y médico en la pintura barroca. Neurosci Hist. 2017;5:26-37.
4. Kennedy IG. Tiziano. Cologne (DE): Taschen; 2020.
5. Vasari G. Vidas de grandes artistas. Mexico: Editorial Porrúa; 2000. Tiziano; p. 99-111. [Vasari G. The lives of the artists. Conaway Bondanella J & Bondanella P, tr. Oxford: Oxford University Press; 1991.]
6. Falomir M. Tiziano. Madrid: Ediciones Museo Nacional del Prado; 2003.
7. Longhi R. Breve pero auténtica historia de la pintura italiana. Madrid: Antonio Machado Editores; 2023.
8. Museo del Prado [Internet]. Madrid: Museo del Prado; © 2024. Tiziano, Vecellio di Gregorio; [cited 19 Nov 2020]. Available from: https://www.museodelprado.es/coleccion/artista/tiziano-vecellio-di-gregorio/d5a82a70-aa3f-4355-b733-97c04d9690ab
9. Museo Nacional Thyssen-Bornemisza [Internet]. Madrid: Museo Nacional Thyssen-Bornemisza; © 2024. Tiziano (Tiziano Vecellio); [cited 30 Aug 2024]. Available from: https://www.museothyssen.org/coleccion/artistas/tiziano
10. West SK, Valmadrid CT. Epidemiology of risk factors for age-related cataract. Surv Ophthalmol. 1995;39:323-34.
11. Asbell PA, Dualan I, Mindel J, Brocks D, Ahmad M, Epstein S. Age-related cataract. Lancet. 2005;365:599-609.
12. Liu CH, Wilkins M, Kim T, Malyugin B, Mehta JS. Cataracts. Lancet. 2017;390:600-12.
13. UpToDate [Internet]. [s.l.]: Wolters Kluwer; ©2024. Jacobs DS, Gardimer MF, Gives J. Cataract in adults; [cited 20 Nov 2023]. Available from: www.uptodate.com
14. Vistaláser Oftalmología [Internet]. Málaga (ES): Vistaláser Oftalmología; ©2024. Operación de cataratas a lo largo de la historia; [cited 20 Nov 2023]. Available from: https://www.vista-laser.com/operacion-cataratas-historia
15. Álvaro LC. Recorrido histórico por los conceptos normal/patológico y salud/enfermedad. Neurosci Hist. 2024;12:1-19.
16. Zaidel DW. Neuropsychology of art: neurological, cognitive and evolutionary perspectives. Hampshire (UK):

Routledge Editors; 2016. The eye and the brain in artist and viewer; p. 49-74.
17. Ravin JG. The visual difficulties of selected artists and limitations of ophthalmological care during the 19th and early 20th centuries. Trans Am Ophthalmol Soc. 2008;106:402-25.
18. Xavier Sierra Valentí. Un dermatólogo en el museo [blog]. Las cataratas de Monet; 30 Jan 2020 [cited 15 May 2024]. Available from: https://xsierrav.blogspot.com/2020/01/las-cataratas-de-monet.html
19. Marmor MF. Ophthalmology and art: simulation of Monet's cataracts and Degas' retinal disease. Arch Ophthalmol. 2006;124:1764-9.
20. Álvarez Suárez ML. Las cataratas de Monet. Arch Soc Esp Oftalmol. 2005;80:126-8.
21. Hajar R. Monet and cataracts. Heart Views. 2016;17:40-1.
22. Livingstone MS, Conway BR. Was Rembrandt stereoblind? N Engl J Med. 2004;351:1264-5.
23. Simmel GS. Rembrandt: un ensayo de filosofía del arte. Madrid: Casimiro; 2020.
24. Cage J. Colour and meaning: art, science, and symbolism. London: Thames and Hudson Ltd.; 2019. The contexts of colour; p. 11-20.
25. Wikipedia: La Enciclopedia Libre [Internet]. [s.l.]: Wikipedia; 2024. Autorretrato (Tiziano, Berlín); 25 Jul 2024 [cited 15 May 2024]. Available from: https://es.wikipedia.org/wiki/Autorretrato_(Tiziano,_Berl%C3%ADn)#