

Scientific analysis of pigmentation by Raman ~ Laser spectroscopy and artistic study of an oil on canvas, dimensions 53 cm x 38 cm

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1. Visible photography





## 2. Introduction



**Subject:** Male nude

**Technique:** Watercolor and ink on paper

**Dimensions:** 53 cm x 38 cm

**Inscription:** dedication and unidentified signature (Lower left corner); “4505, m.d. y.”  
(On the back of the paper)

The work that has been investigated in the Raman Spectroscopy laboratory of the Polytechnic University of Catalonia is a drawing done in ink and colored with watercolor that measures 53 cm x 38 cm. It has a dedication on the bottom left and a signature that is difficult to read. Its condition is excellent.

### 2.1. Importance of the research and origin of the work

This work comes from a private collection in Arizona (United States). The owners ran an auction house and an establishment selling antiques since a while back, and they acquired this watercolor sometime between 1980 and 1990 as part of a large private collection integrated by different artists' paintings, sculptures, architecture books, first editions books, and furniture of the American designer Charles Eames.

The interest that has motivated the investigation of this work lies mainly in the quality of the drawing, with firm and flawless stroke, in which certain artistic personality is shown. The manner in which forms are depicted and the subject matter represented, which share reminiscence with the figures in the Volland Suite by Picasso, support a priori, a possibility that the work had been created by the Malaga-born artist around the thirties.

## 2.2. Preliminary observation with optical technology aid

The first part of the research was to conduct a thorough observation analysis of the pictorial surface using a binocular Leica Z12 which allows up to 800x augmentation. It was possible to observe the excellent state of conservation and the different shades that appear in the work, ruling out the existence of repainting or additions that could provide misleading or inconsistent information with that of the rest of the original palette.



**Figure 1:** Macro photographs of two areas of the pictorial layer.

A study of the work was then done using Infrared reflectometry.

The observation of a work of art with Infra-Red reflectometry allows to determine the underlying drawing, that is, the carbon strokes made by the artist

on the backing material (in this case paper) before coloring with pigments. Figure 2 shows four photographs of Infra-Red Reflectometry done on the work being analyzed.

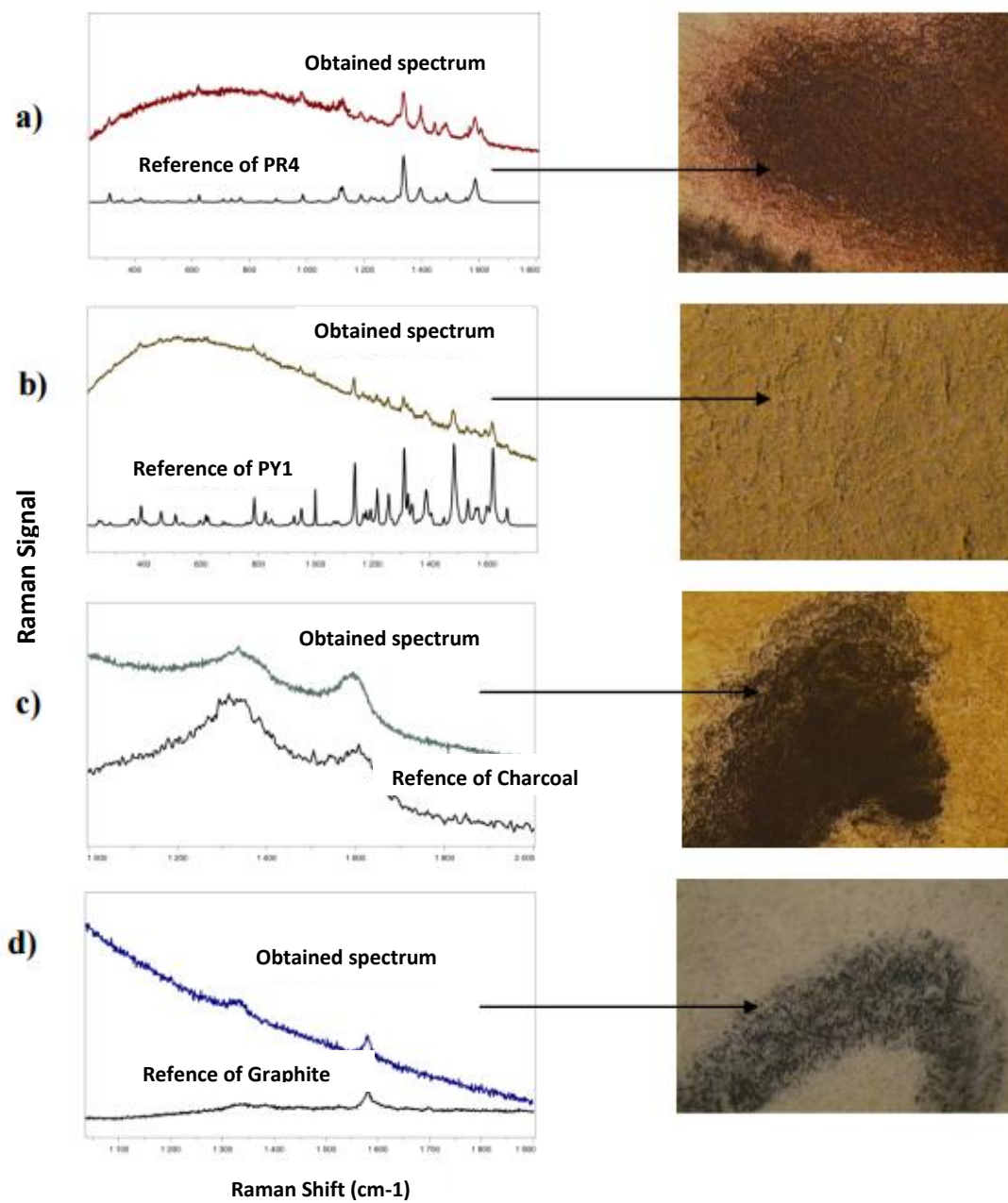


**Figure 2:** Photographs taken with Infra-Red Reflectometry of several details of the work being analyzed.

### 3. Identified pigments with Raman spectroscopy

Once the preliminary optical examination was concluded, a scientific pigment analysis was performed using Raman spectroscopy, a non-destructive technique (no need to obtain micro samples), which provides molecular information. The different shades of colors seen in the work are formed with the following pigments (see spectra obtained compared with its pattern of reference in figure 3 and the areas analyzed in Figure 4):

- Red: Organic Red Pigment PR4
- Yellow: Organic Yellow Pigment PY1
- Black: Charcoal
- Maroon: PR4 mixed with charcoal
- Text: Graphite



**Figure 3:** Raman spectrum and microphotographs of the pigments: a) PR4, b) PY1, c) Charcoal, and d) Graphite.



### 3.1. Areas analyzed using Raman spectroscopy

In order to obtain the maximum possible information about the pigments used by the artist, the most representative points of the watercolor work have been analyzed.



Figure 4: Points analyzed with Raman spectroscopy

The pigments identified in the areas shown in Figure 4 are:

- PR4 in zones 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, and 11.
- PY1 in zones 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, and 22.
- Charcoal in zones 2, 6, 23, 24, 25, and 26.
- Graphite in zones 27, 28, and 29.

### 3.2. History of the pigments that were identified

#### Organic Yellow pigment, PY1 (Hansa Yellow G)

The discovery of the chemical family of organic Arylida pigments, also known as Hansa yellows, dates back to 1909. It was then that Dr. Hermann Wagner synthesized and patented PY1 in Germany. A year later, in 1910, the Hoechst AG company began the manufacture of large quantities of this pigment.

The excellent pictorial qualities of Hansa yellows turned this family of pigments into the replacement for cadmium yellow pigments. Nevertheless, although tenths of different pigments were synthesized, only PY1 and PY3y managed to play an important role in watercolors painting<sup>1</sup>.

#### Organic Red pigment, PR4 (monoazo, $\beta$ -naphthol)

Synthetic Organic red pigment that appears in the Colour Index under the code PR4. It was discovered in 1907 by W. Hertzberg and O. Spengler. The monoazoic red pigments (such as PR4) quickly occupied an important place in the palette of painters for dark red tones that could hardly be achieved with pre-existing pigments of the time<sup>2</sup>.

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<sup>1</sup> S. Lake, S. Q. Lomax, Arylide (Hansa) Yellow Pigments, en Artists' Pigments, a Handbook of their history and characteristics, Vol 4. 2007 ; F. Perego, Dictionnaire des matériaux du peintre, 2005.

<sup>2</sup> W. Herbst, K. Hunger, Industrial organic pigments: production, properties and applications, 2004; F. Perego, Dictionnaire des matériaux du peintre, 2005.

## Vegetable Charcoal (amorphous carbon)

Undoubtedly, this black pigment is one of the oldest man-made pigments. Its use dates back to prehistoric times, since it is present in cave paintings dating from 15,000 B.C.

Charcoal is obtained by burning organic plant material, and its use is common in all types of painting techniques.<sup>3</sup>

## Graphite

It is one of the semi-crystalline states of carbon. It can be of mineral or synthetic origin, and its use in painting dates back to pre-historic times. However, due to the invention of synthetic graphite and, consequently, to the manufacture of graphite mines for pencils, this material became commonly used in paintings on paper.<sup>4</sup>

### 3.3. Conclusions of the pigment analysis

Based on the history of the identified pigments, it is concluded that the work of art being analyzed could not have been created before 1910. The first organic pigments were first synthesized in the late nineteenth century, and in the second decade of the twentieth century there was only a small range of these pigments, including those that make up this work (PR4 and PY1). In subsequent decades, the development of aromatic chemistry led to the creation of hundreds of new pigments with better pictorial qualities, that became commonly used by most artists. Therefore, it is logical to consider that this work was created between 1910 and 1940.

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<sup>3</sup> J. Winter, E. W. FitzHugh, Pigments based on Carbon, en Artists' Pigments, a Handbook of their history and characteristics, Vol 4. 2007; F. Perego, Dictionnaire des matériaux du peintre, 2005.

<sup>4</sup> F. Perego, Dictionnaire des matériaux du peintre, 2005; J. Winter, E. W. FitzHugh, Pigments based on Carbon, en Artists' Pigments, a Handbook of their history and characteristics, Vol 4. 2007.

## 4. General description and notable features



The investigated work is an ink and watercolor drawing that measures 53 cm x 38 cm. It depicts a naked man in an attitude of repose, seated, with legs and arms crossed, located in what looks like a natural environment. Both his nakedness, his beard and vegetables headdresses (probably ivy or grape leaves), portray indications of a character from classical mythology.

### 4.1. Watermark

The researched work has been done on a high-quality paper which contains the watermark RIVES in the upper right (Figure 5). This type of paper was manufactured in the French town Rives-sur-Fure, where the paper industry became of high importance since the sixteenth century.

Figure 5



Figure 5: Watermark Microphotography that appears in the investigated work



The Rives factory was founded by brothers Blaanchet and Emile Kebler, and experienced great economic growth in the second half of the nineteenth century<sup>5</sup>. In addition to the watermark that appears in the investigated work, this type of paper can also have another type of watermark that includes the initials of the founders (Blanchet Frères and Kebler), or BFK Rives (Figure 6)<sup>6</sup>.

In 1950, RIVES merged with three other renowned paper companies (Arches, Johannot, Marais) to form the Arjomari group. Therefore, the fact that the table watermark RIVES is displayed, indicates that the paper corresponds to the pre-1950 years and therefore is consistent with the pigments obtained in the scientific analysis with Raman spectroscopy, and the subject represented attributed to Picasso during the 30's.



Figure 6: Macro photograph of the BFK RIVES watermark

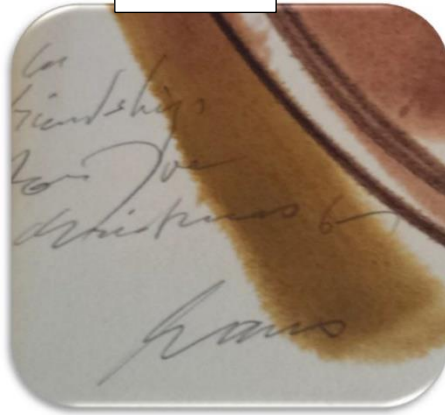
#### 4.2. The Dedication

A difficult- to- read dedication and a signature, both made with graphite over watercolor appear on the bottom left corner of the piece (Figure 7).

<sup>5</sup> Pierre Bozon. L'industrie du Seuil de Rives, en: Revue de géographie alpine, 1943, t. 31, n° 3, pp. 280- 282.

<sup>6</sup> [www.watermarks.info](http://www.watermarks.info) y [www.memoryofpaper.eu](http://www.memoryofpaper.eu)

Figure 7



**Figure 7:** Macro photographs of the text that appears in the work investigated, located in the lower left corner

Once the possibility of the handwriting being Picasso's was discarded, according to authorship basis<sup>7</sup>, we attempted to decipher its content, but unfortunately we had no success in doing so.

The text seems to begin with the words "*Les friendships ...*" but the rest of the text, so far, has not been able to be transcribed. The curious fact is that this text seems to be signed "Eames" (Figure 7), a last name that matches the famous architect and American designer Charles Eames (Missouri, 1907-Los Angeles, 1978) and his wife, the artist and designer Ray Kaiser Eames (California, 1912-Los Angeles, 1988). At first the possibility that the Eames couple had known the Malaga-born painter was considered, and that perhaps he had given or sold them the watercolor, and the Eames had then given it to a friend. For this reason, the signature on the watercolor was compared with the signatures of Charles Eames and Ray Eames <sup>8</sup>(Figure 8), and despite the similarities with Charles Eames's signature, there is no absolute certainty that it corresponds with the one belonging to the famous architect and designer.

<sup>7</sup> According to the expert calligraphy study made by Carme Font (Barcelona).

<sup>8</sup> The photograph of the signatures by Charles Eames and Ray Eames was obtained from: [www.vitra.com/esun/corporation/designer/details/charles-eames](http://www.vitra.com/esun/corporation/designer/details/charles-eames)

Figure 8



**Figure 8:** Visual comparison between the signature on the investigated work and signatures of Charles Eames and Ray Eames.

In addition, there is no information linking Charles Eames with Picasso<sup>9</sup> personally or professionally. Therefore, the question of the text that appears in the investigated work remains open to future research.

## 5. Artistic context

### 5.1 Picasso at Boisgeloup: Curvism

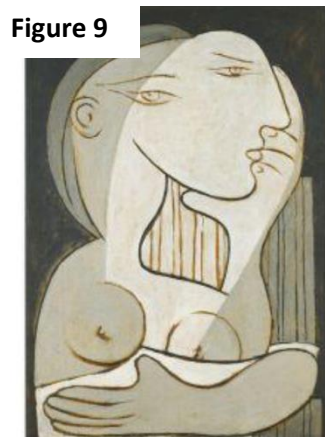
In June 1931 Picasso settled in Boisgeloup Castle, near the town of Gisors, about seventy kilometers from Paris. Shortly before, he had met Marie-Therese Walter, a seventeen-year-old woman who became his new love and muse. Marie-Thérèse provided, as each new relationship that the painter began, a breath of fresh air and youth. Nevertheless, Picasso was obligated to live a double life with his wife Olga Khokhlova.

The Boisgeloup Castle was an ideal location for Picasso to install workshops for painting, sculpture, and engraving, necessary for his prolific creations that had Marie-Thérèse almost as absolute protagonist until 1936.

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<sup>9</sup> Donald Albrecht, et. al. The work of Charles and Ray Eames: a legacy of invention. Harry N. Abrams. New York, 1997.

Josep Palau i Fabre labeled this period (between 1931 and 1937) with the name of Curvism,<sup>10</sup> precisely due to the perfect and harmonious lines inspired by his new model. This new aesthetic was progressively integrated into his work until blossomed exuberantly in the bright palette of his oil paintings and sculptures volumes. The portraits of Marie-Therese are also very particular because they offer a very pronounced range of features: a prominent nose, very large eyes, and a pronounced chin and jaw. (see Figures 9 and 10). Over time, Picasso hardened those same factions, and simplified them to obtain a more schematic face that would become one of the protagonists of Guernica, an important aspect for the research of the current work.



**Figure 9:** Pablo Ruiz Picasso. Buste de femme, Marie-Thérèse Walter (1932). Oil on panel, 74 cm x 52 cm (Lee A. Ault Collection, New York)

**Figure 10:** Pablo Ruiz Picasso. Tête de femme, Marie-Thérèse Walter (1932). Plaster Sculpture, 133,4 cm x 65 cm x 71,1 cm (The Museum of Modern Art, New York)

Likewise, Marie-Therese was also the main protagonist that symbolically embodied the classic model in the most important graphic series that Picasso made in his career: the Vollard Suite.

<sup>10</sup> Josep Palau i Fabre. Picasso. Edició Centenari, 1881-1981. Ed. Polígrafa. Barcelona, 1981, p. 116.



## 5.2 The Vollard Suite

Picasso completed The Vollard Suite commissioned by the famous art dealer Ambrose Vollard between 1931 and 1937. The Vollard Suite is a series of one hundred engravings which overall constitutes one of Picasso's best graphic productions, and through which the artist reflects all his inner universe, which was strongly influenced by classical mythology.

This series consists of several successive or intertwined subjects that do not follow a logical sequence or storyline. The first part consists of various nude pieces. Another part includes topics related to the theme of the Minotaur. There are five etchings which have been titled "The Battle of Love"; five others are inspired by Rembrandt, followed by "The sculptor's studio", and the series ends with three portraits of Vollard.

Some of the prints that make up the whole series, especially "Minotauromachy" are, as already mentioned, a premonition of Guernica.

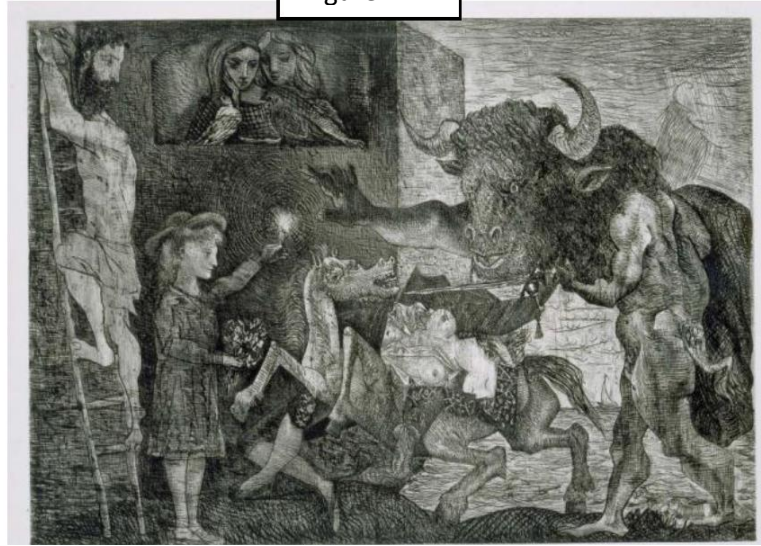
Picasso symbolically incarnated himself as the protagonists in two of these subjects: in the classical sculptor and the Minotaur, both of which were evoking contrasting facets of his personality. Without losing sight of the contrast, Picasso applied, depending on the theme, a certain style. While the style in "The sculptor's studio" is very classical, linear and bare of artifice (example in Figure 11), "Minotauromachy" generally is more baroque and dark, with a tendency to avoid empty areas (e.g. in figure 12). Therefore, the piece here being investigated corresponds to the more style deprived of classical reminiscences.

Figure 11



**Figure 11:** Pablo Ruiz Picasso. The sculptor in rest before a torso (Vollard Suite, 1933). Etching, 34 cm x 44.5 cm (San Fernando Royal Academy of Fine Arts Collection, Madrid)

Figure 12



**Figure 12:** Pablo Ruiz Picasso. Minotauromachy (Vollard Suite, 1935). Etching, 57 cm x 77.5 cm (Reina Sodia National Art Centre, Madrid)

### 5.3 Drawings and Watercolors

According to Juan Carrete Parrondo<sup>11</sup>, Picasso drew many sketches and notes (some done in watercolor) that ended up not being included in the final series one hundred etchings, but indicates that the artist before painting, would rehearse again and again repeating the motives that insistently appear in the Vollard Suite.

Examples of watercolors made during the thirties (which were not included in the Vollard Suite) are the works entitled *The Artist and His Model* (Figure 13) and *Female Nude and Minotaur* (Figure 14). There, it can be observed that Picasso repeats the theme of the bearded sculptor of classical reminiscence and in the purist drawing and the face that would become a symbol of Guernica.

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<sup>11</sup> Juan Carrete Parrondo. Picasso. Suite Vollard. El taller, la modelo, el minotauro..., en: Arte Procomún. Documentos y estudios para la Historia del Arte Gráfico, 2007.



Figure 13



Figure 14

**Figure 13:** Pablo Ruiz Picasso. The artist and his model (Paris, 1933). Watercolor (Rosengart Gallery, Luzern)

**Figure 14:** Pablo Ruiz Picasso. Female Nude and Minotaur (Cannes, 1933). Ink and wash, 40 cm x 50 cm (Mairie de Vezelay Collection)

Similarly, this also occurs with the drawings in ink or charcoal. In the work *Reclining Nude* (Figure 15) the face of the model is outlined in the classic crescent shape that will appear in 1937 in *Guernica*, and in the *Flute Player* (Figure 16), where Picasso practiced other versions and positions of a bearded male nude.

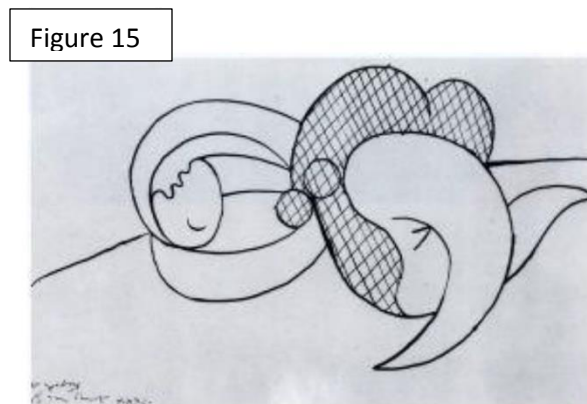


Figure 15



Figure 16

**Figure 15:** Pablo Ruiz Picasso. Reclining Nude (Boisgeloup, 1932). Ink on paper, 24.5 cm x 37 cm (Private collection)

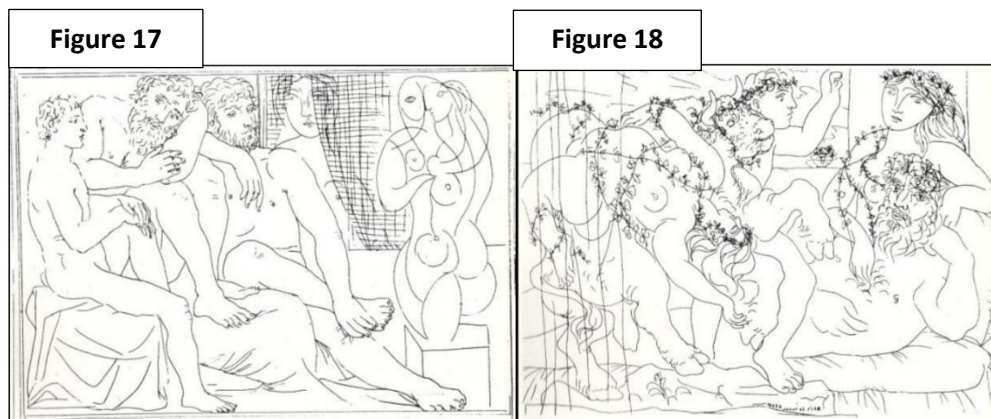
**Figure 16:** Pablo Ruiz Picasso. Flute Player (Boisgeloup, 1932). Ink on paper, 37 cm x 24.5 cm (Private collection)

The fact that there are both watercolors and drawings that ultimately were not included in the famous series commissioned by Ambrose Vollard is an important piece of information because it indicates that the investigated work could be one of these drafts, related specifically to the topic of the sculptor's workshop.

## 6. Style analysis by comparison with cataloged works by Picasso

The investigated work is characterized for displaying high-quality drawings, done in ink, clean and with precise lines in which no hint of hesitation or regret can be seen. Moreover, the strokes made with watercolor applied over the ink, seem to have a specific intention, not only to create a color frame, but also to evoke a very characteristic shape, that as has been seen in previously discussed examples, refers to the shape of one of the faces of Guernica.

Both the style and the subject represented are consistent with the iconography used by Picasso in the Vollard Suite in some nude portraits and engravings dedicated to the study of the sculptor (Figures 17 and 18).

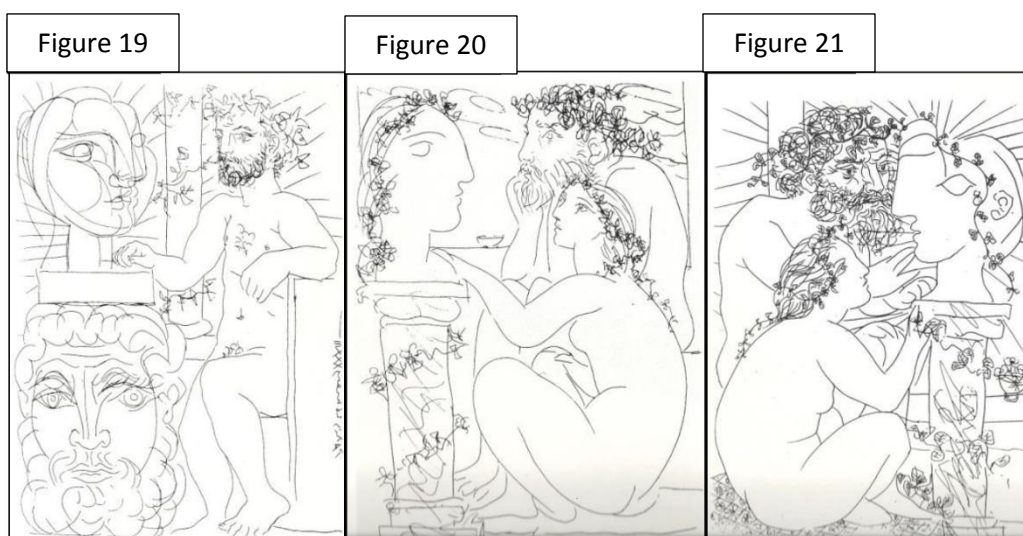


**Figure 17:** Pablo Ruiz Picasso. Sculptors, models and sculpture (Vollard Suite, 1933). Etching, 34 cm x 44.5 cm (Museum of Contemporary Art Spanish Collection, Madrid)

**Figure 18:** Pablo Ruiz Picasso. Sculptor at rest and bacchanal with bull (Vollard Suite, 1933). Etching, 34 cm x 44.5 cm (Museum of Contemporary Art Spanish Collection, Madrid)



The protagonist of the investigated work is a nude man, bearded and crowned with ivy or vine leaves resting with his legs and arms crossed and in a slightly forced position. Both his nakedness and stated features, as well as the type of drawing that defines it, are the elements that relate this work with the Vollard Suite Picasso, specifically with the theme of the contemplative sculptor or at rest (taking various postures) as can also be observed in other examples (figures 19-21).



**Figure 19:** Pablo Ruiz Picasso. Sculptor and two sculpted heads (Vollard Suite, 1933).

Etching, 44.5 cm x 34 cm (Museum of Contemporary Art Spanish Collection, Madrid)

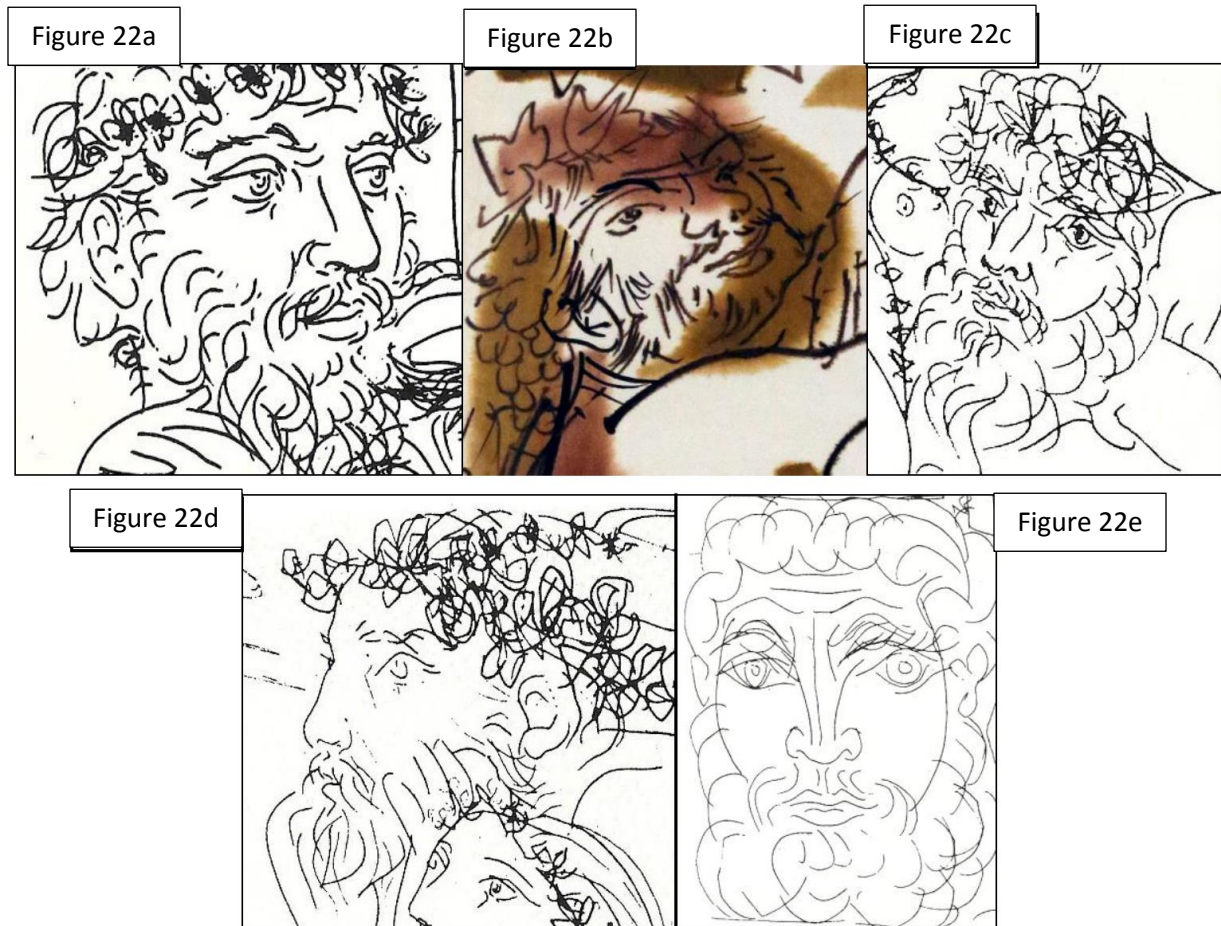
**Figure 20:** Pablo Ruiz Picasso. Sculptor and Model Admiring a Sculpted Head (Vollard Suite, 1933). Etching, 44.5 cm x 34 cm (Museum of Contemporary Art Spanish Collection, Madrid)

**Figure 21:** Pablo Ruiz Picasso. Sculptor, Model and Sculpted Head (Vollard Suite, 1933).

Etching, 44.5 cm x 34 cm (Academy of Fine Arts of San Fernando Royal Collection, Madrid)

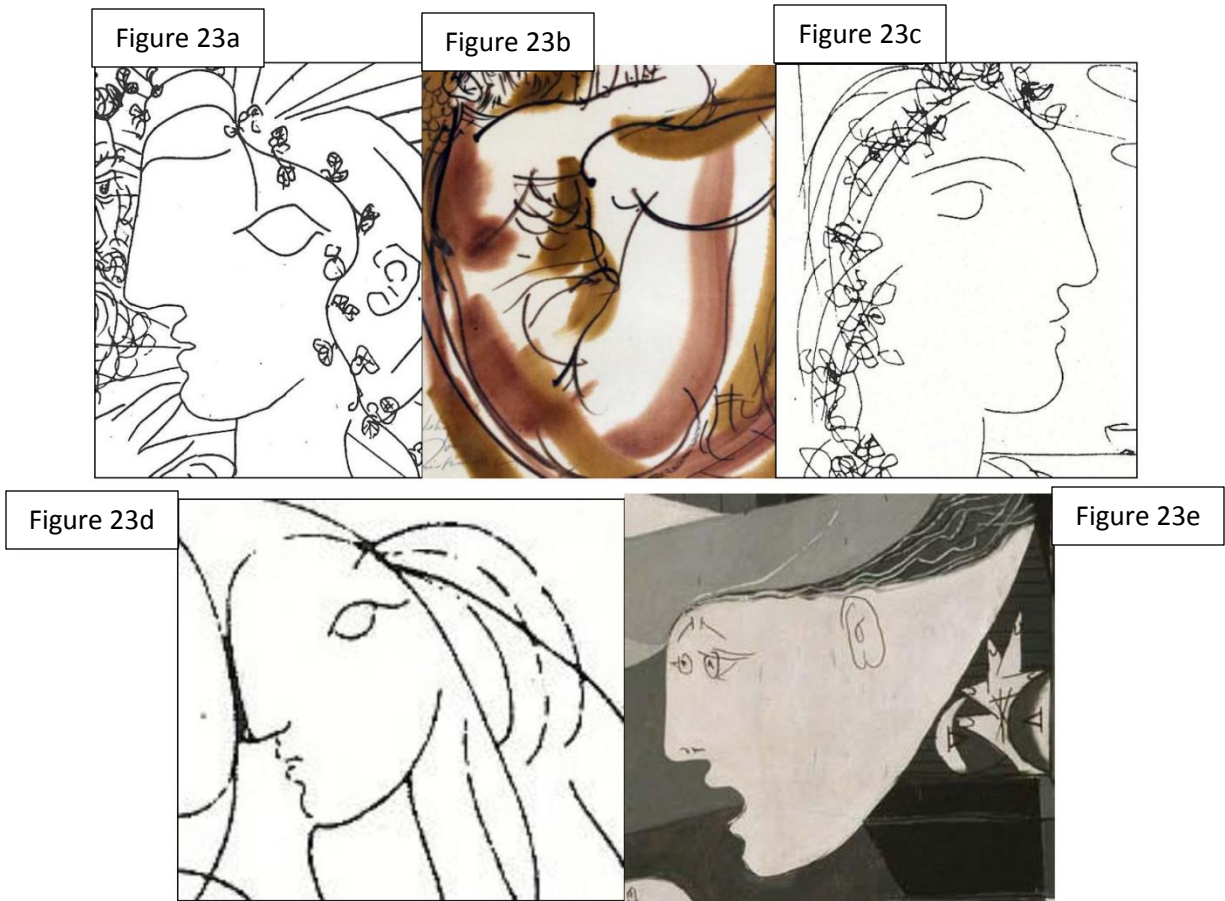
Picasso's sculptor is a timeless and symbolic figure that evokes the classical tradition, and it is not represented in the same way in all pieces. Nevertheless, they all share common elements which help to identify them with the character of the sculptor (Figure 22). In the case of the investigated work the beard is made with short, separate strokes, sometimes straight; the nose is wide,

and the eyes are large and of a serene and beatific expression. These features can be seen in several Picasso prints belonging to the Vollard Suite:



**Figure 22:** Comparison between researched figures and several examples of the Picasso's Vollard Suite belonging to Figures 11, 18, 19 and 20 reproduced in this document.

Finally, the watercolor strokes with brown hue make a silhouette which is the famous deformed profile of Marie-Therese Walter which became one of the representative aspects of Guernica (Figure 23).



**Figure 23:** Comparison of silhouette that appears in this investigated work which appears in Picasso's *Guernica* and some of the examples of the *Vollard Suite* taken from Figures 17, 20 and 21 reproduced in this document.

## 7. Conclusions

The work that underwent investigation at the Polytechnic University of Catalonia is a black ink drawing colored with watercolor and measures 53 cm x 38 cm. It is made on a high-quality paper with the Rives watermark indicating that it predates 1950.

This work depicts a male character, nude, bearded and crowned with ivy or vine leaves character. Physiognomic characteristics, anatomical proportions and drawing quality are closely related to the engravings Picasso made on the topic of the sculptor's workshop for the Vollard Suite during the 1930's.

An inscription and signature appear in the lower left corner. Researchers were unable to decipher the entire contents of the text, but the first two words ("Les friendships ...") indicate that it is a dedication. The signature has not been able to be deciphered objectively, but it seems to read "Eames". Although it could be the name of the famous American architect and designer Charles Eames, no relationship between him and the alleged author of the work has been found.

This work is in excellent state of preservation. Preliminary observation with a binocular Leica Z12 allowed researchers to rule out any repaired or added features. In other words; ink and watercolor strokes are part of the original work.

Pigments which have been identified with Raman spectroscopy are: vegetable charcoal, graphite, organic red pigment PR4 and organic yellow pigment PY1. According to the history of these pigments researchers have been able to establish an objective approximate date between 1910 and 1940. This date is consistent with the years when Picasso made the Vollard Suite, between 1931 and 1937.

The comparison between the researched work and prints, drawings and watercolors that Picasso made for the series of the Sculptor's workshop, has made it possible to establish affinities that are not only thematic but also stylistic. In addition, watercolor strokes make up a shape that matches with the simplified

faces that Picasso made of Marie-Therese Walter in the Vollard Suite, and that shortly thereafter appeared in Guernica.

Considering all the data obtained at a scientific level (in terms of physical-chemical reality), as well as artistic and documental levels, this researched work presents relevant aspects that link it directly to the production of Pablo Ruiz Picasso between 1931 and 1937 and deserve to be considered under his final authorship.

Dr. Sergio Ruiz-Moreno

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Barcelona, January 21st, 2015.



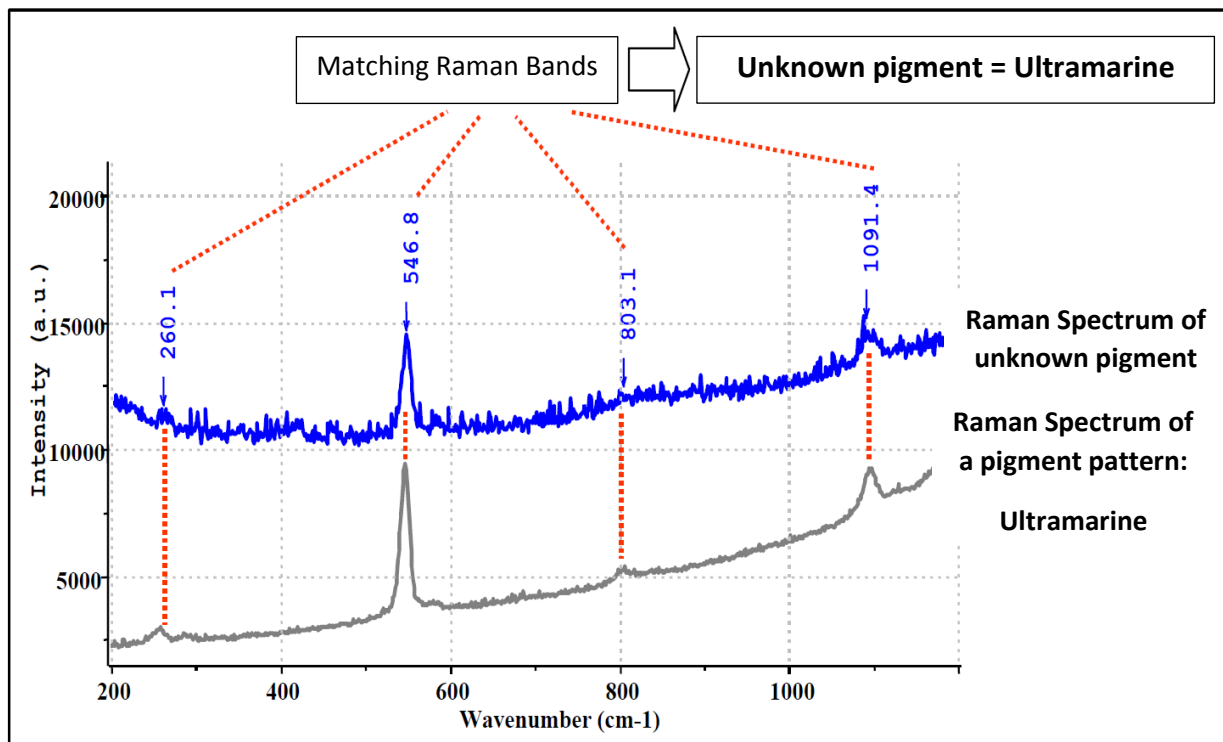
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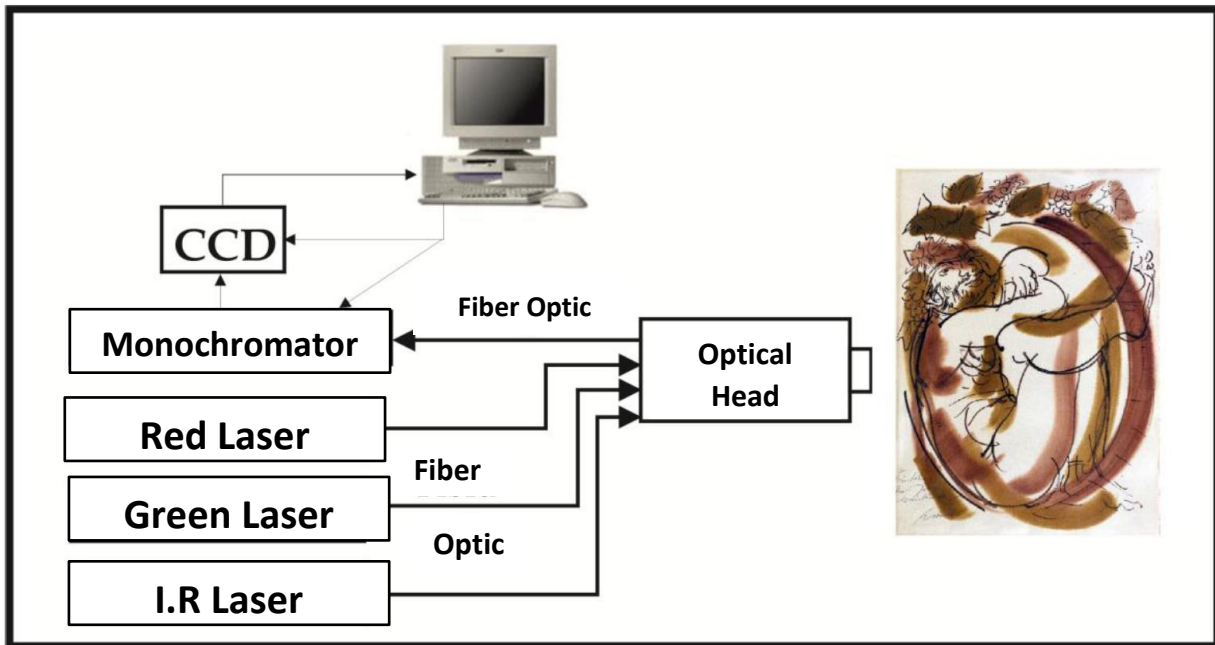
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## 10. About Raman Spectroscopy

Raman spectroscopy is a molecular analysis technique that allows the identification of pictorial materials that make up a work, and functions mainly by focusing a laser on the area in question to collect and detect the light re-emitted or scattered by it. Thus a spectrum is obtained, called Raman spectrum, which is similar to a fingerprint, in the sense that it is characteristics of the material illuminated by the laser. This Raman spectrum obtained is compared to those we have stored in a database and that belong to pictorial material patterns previously analyzed. This comparison provides identification of pictorial material corresponding to the Raman spectrum obtained (figure 1).



**Figure 1:** Identification of an unknown pigment from the comparison of its Raman spectrum with one stored in a database of pictorial material patterns.



**Figure 2:** UPC equipment used in the analysis of the work.

The Raman spectroscopy equipment used during this analysis is an Induram model from the JobinYvon house (Horiba Group).

Figure 2 shows the block diagram of the system used in the UPC for the analysis of the works shown. Broadly speaking, its operation is as follows. It consists of three interchangeable monochromatic light sources (He-Ne laser 632.8 nm, AR laser at 514.4 nm, and I.R. semiconductor laser at 785 nm) whose output is guided through the fiber optic stimulation. The optical head's purpose is to focus the light in the area to be analyzed and collect the scattered light (Raman signal) through the collected fiber. This fiber guides the dispersed light to the monochromator where it is spatially and spectrally separated. The CCD detector performs the conversion from optical intensity to electric intensity, gathers the spectrum and forwards the information to the computer, which is also responsible for controlling the rest of the equipment.