



Analytical Study of the Visual Content of Khuwy's Tomb in Saqqara in Egypt

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Abstract

The remarkable tomb of Khuwy, a dignitary from the fifth dynasty is one of the largest and most important discoveries of the era. It contains complete colorful detailed illustrations showing the visual organization and the artistic vision of the ancient Egyptian artist in a unique condition. Therefore, this historical discovery requires the descriptive-analytical study to conclude the development of art in the fifth dynasty, and therefore reveal the inspirational sources of the ancient Egyptian artist, and his understanding of color harmony, grid systems, and mathematical ratios and maintaining a clear evidence of the use of golden ratio implemented to organize the visual content in Khuwy's tomb illustrations.

Keywords

Egyptian arts • Fifth dynasty • Khuwy's tomb • Inspiration source • Color scheme • Grid system • Golden ratio

1 Introduction

On the 13th of April 2019, Egyptian officials have announced the discovery of a remarkably well-preserved tomb found in Saqqara, south of Cairo created for a man named Khuwy, a dignitary from the fifth dynasty, where it was announced in a press conference with publishing detailed pictures of its unique artistic content, to be opened for the visitors soon. "The mission uncovered this tomb while documenting the collection of pyramids that belong to King Djedkarea who was the eighth and penultimate ruler of the fifth dynasty of

Egypt in the late twenty-fifth century to mid-twenty-fourth century BC, during the Old Kingdom" (Essam 2019), he ruled for 32 years or more and moved 6 km from Abusir to build the first pyramid in South Saqqara.

Khuwy's tomb is L-shaped and has a small interior tunnel that leads to an antechamber. A main larger chamber with walls covered in remarkable paintings—preserved in a unique condition with bright colors that are related to royalty colors of this period— shows Khuwy facing a table of offerings. Khuwy's tomb leads to another burial room containing the remains of Khuwy's body inside a destroyed limestone coffin (Essam 2019) and also broken canopic jars containing the body organs of the tomb owner Khuwy. Archaeologists have questioned the relation between Khuwy and the King Djedkarea, as the main design of the cemetery, its entrance and north wall illustrations are simulated from the design of the fifth dynasty royal pyramids in Saqqara (Guy 2019).

2 Analysis of the Artistic Scenes

Most of the remains from ancient Egypt came from tombs and temples, as the Egyptians believed in eternity in afterlife that is similar to life on earth, therefore Egyptians required tombs containing the mummy, with the inscribed name and carved painted scenes of food and drink and other desirable services which would provide the dead with magical power. They believed that as long as the mummy is secure his eternal life was assured (Wilson 1986).

Khuwy's tomb contains three walls with different artistic drawings; the front wall (Fig. 1) shows Khuwy sitting on the right-facing before a table of offerings. A decorating border is used around the scene containing a repeated geometric pattern with alternating colors. The space within this border is divided into six horizontal registers in addition to two lower registers below the scene. The offerings occupy the height of the four upper registers. All the figures are drawn from the side (in elevation) in the profile including Khuwy's

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Fig. 1 The front wall of Khuwy's tomb with the main scene of Khuwy sitting on the right-facing the offerings. Photo adapted from Megahed and Vymazalová (2019) republished with permission

figure, and all items are placed on the baseline of each register to maintain balance.

The artist wasn't concerned with giving an illusion of depth to the drawing surface, but he tried to employ some depth cues to show overlapping, that was clear in the relationship of figures and objects they are carrying, the figure of Khuwy's arm passing in front of his body carrying an item shows that it lies between the figure and the viewer, and also the standing figures carrying offerings passing in front of their bodies giving an illusion of depth (Robins 1994). The two lower registers contain no elements or patterns, they are evenly colored to maintain balance in the whole scene and acts as a ground for the composition. The ratio between the height of the lower register colored in yellow and the one

above is colored in red maintains the golden ratio as depicted later in this research.

The basic element of Egyptian pictorial art in the fifth dynasty was the single human figure, either standing, seated, or in action. The most important role of the single figure is to act as a main focal point and unify the surrounding smaller elements in the composition (Abrams 1999). The figure of the tomb owner Khuwy is occupying three registers of the main scene of the tomb. The two lower registers are larger in size than the upper four registers in a ratio depicted in this research to be following the exact golden ratio. The lower registers contain scenes of boats carrying offerings and goods for the owner of the tomb Khuwy as Egyptians believed in the actual independent life of images (Wilson 1986).

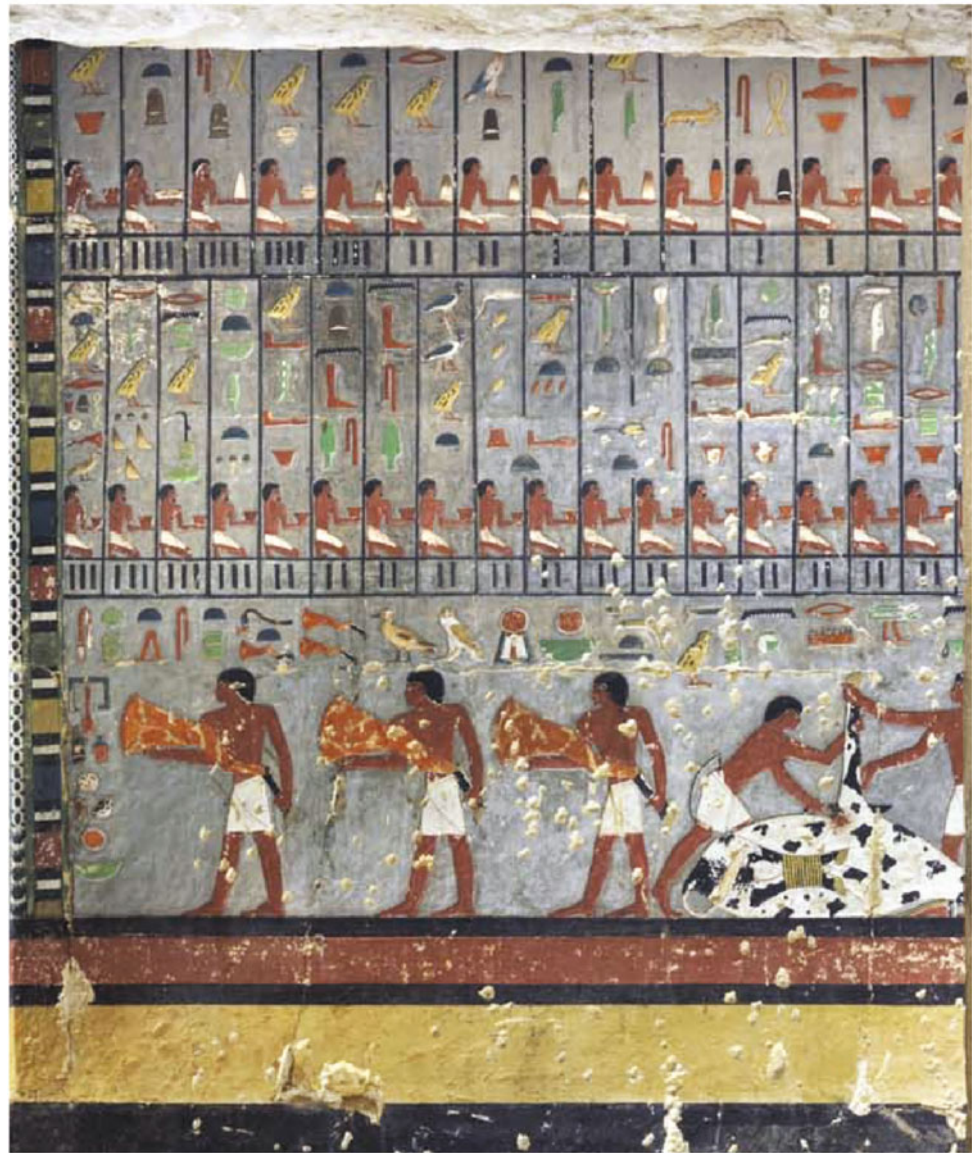
The hieroglyphic texts shown in the vertical columns above Khuwy's figure—as studied in researches about Egyptian tombs in the fifth dynasty—should include requests for offerings for the dead. The ancient Egyptian artist modified the arrangement of the hieroglyphic texts to adapt his design. The hieroglyphs were not only writing, they were a decoration in themselves. The arrangement of the groups of hieroglyphic texts was ruled by their decorative effect, as signs were grouped to compose a harmonious scheme (Petrie 1999). They also form an integral part of the main artistic composition, as the blocks of hieroglyphs are set against the other elements to maintain balance and complete the scene. The left wall (Fig. 2) contains a secondary scene. A decorating border is used all-around the scene containing geometrical patterns. The scene is divided into main three horizontal registers containing the artworks, and three lower registers with solid colors.

The upper two registers are divided vertically into columns; each column contains a figure carrying offerings, with hieroglyphic texts that should include requests for offerings for the dead. The third horizontal register shows figures larger in size, three of them holding offerings and beside them, a scene of four figures each two of them slaughtering an animal that was also an offering to the tomb owner, while overlapping the figures with the animal they're holding gives an illusion of depth. Repetition of the identical figures creates a row of figures that are depicted along the tomb walls emphasizes a visual transition from one architectural space to the following one (Hawass 2002). The right wall (Fig. 3) is divided into vertical columns. The main centered column is wider in size and contains hieroglyphic texts. The surrounding columns are decorated with geometrical patterns influenced from plants, water waves, and animal skin.

3 Art in the Fifth Dynasty

The fifth dynasty of ancient Egypt dates approximately from 2494 B.C to 2345 B.C, it represents the Dynasties III, IV, and VI under the title of the Old Kingdom (Hawass 2002). The

Fig. 2 The left wall contains a secondary scene divided into three main horizontal registers, the first two divided into vertical columns containing figures carrying offerings. Photo adapted from Megahed and Vymazalová (2019) republished with permission



construction of the pyramids and the artistically decorated walls inside the surrounding royal tombs during the reigns of the kings Khufu, Khafra, and Mankaura of the Fourth Dynasty and the early fifth dynasty, 2551 to 2465 B.C was the main influence for the development of art in both the fourth and fifth dynasty in the Giza necropolis. In the fifth dynasty, art took a remarkable and completely unexpected course, as it became elegant, imaginative, and bright, instead of remaining stiff. Due to the changed political situation within Egypt (The journal of Egyptian archaeology 1937).

“The ancient Egyptians had no word that corresponded exactly to our abstract use of the word art, they had words for individual types of monuments that we today regard as examples of Egyptian art statue, or tomb, but there is no reason to believe that these words necessarily included an aesthetic dimension in their meaning” (Robins 2008, p. 12),

so Egyptians didn't have the same idea of art as we think of it today. They created images that would function as meaningful parts of the cults of the Egyptian gods and the dead.

4 Color Analysis

4.1 Degradation of Colors

The Egyptian artist in the fifth dynasty used pigments made from inorganic substances, which explains the extraordinary good preservation of most of the colors on the walls of Khuwy's tomb. But even those inorganic pigments are affected by degradation factors through the years, therefore studies of the chemical compositions of pigments used in the fifth dynasty and their effect on the degradation of colors are

Fig. 3 The right wall is divided into vertical columns containing hieroglyphic texts and geometrical patterns influenced from plants, water waves, and animal skin. Photo adapted from Megahed and Vymazalová (2019) republished with permission

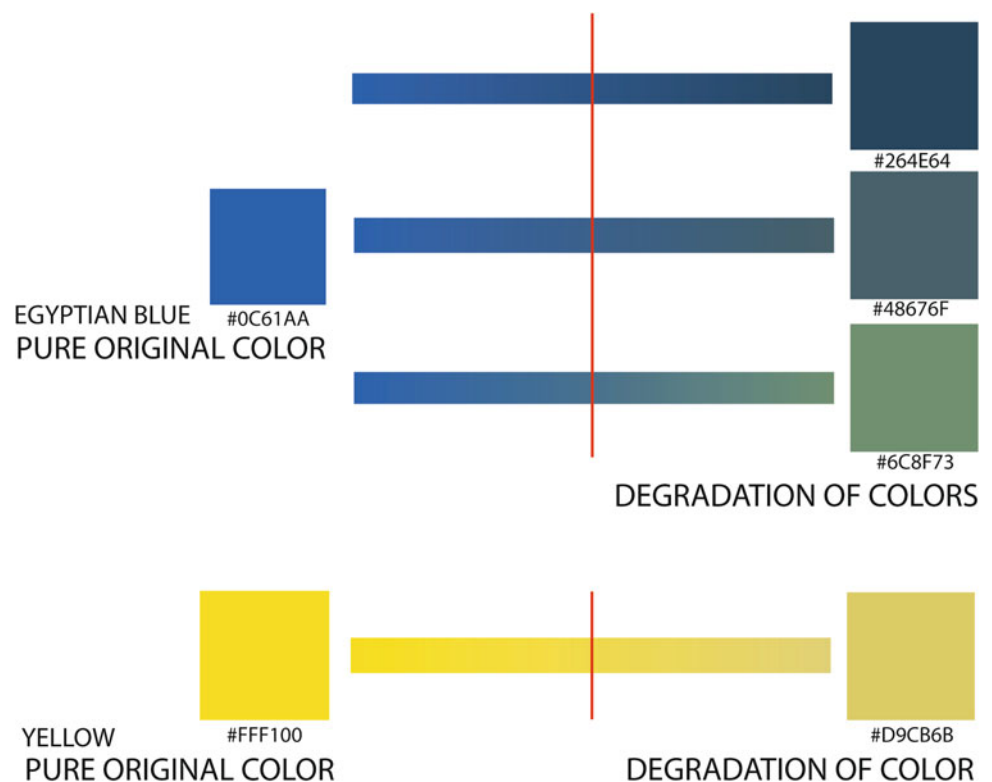


important to analyze the original colors used and understand the color scheme chosen by the Egyptian artist in Khuwy's tomb illustrations.

The white color in the fifth dynasty was usually obtained from calcium carbonate. Black color was obtained from

carbon, most commonly charcoal which was almost stable in most studies of ancient Egyptian arts. All ranges of colors from light yellow to dark brown were obtained from iron oxide. Blue was obtained from azurite (copper carbonate), which changes to malachite—a different form of copper

Fig. 4 A virtual assumption of the original colors before degradation. The degradation of colors in Khuwy's tomb, all greens and tints and shades of greens were originally Egyptian blue pigments, and a shade of yellow-green (corn yellow) was pure and vibrant yellow representing gold and sunshine



COLOR ANALYSIS



EXTRACTED COLOR SAMPLE
#D9CB6B



EXTRACTED COLOR SAMPLE
#831B1B



EXTRACTED COLOR SAMPLE
#264E64 #49676F



Fig. 5 Digital samples of the colors visible in Khuwy's tomb after degradation; dark shade of brown (Amber, shades of green (olive green), a shade of yellow-green (corn yellow), black, white, and grey. Photo adapted from Megahed and Vymazalová (2019)

carbonate green in color. Orpiment was used to create a bright yellow color that was frequently used to present gold, but it fades overtime to a dull shade of yellow so mostly its bright effect is lost today. Gold color was made from orpiment and was restricted to royal tombs, but usually loses its brightness and fades to off-white through the years (Robins 2008, pp. 12–27).

4.2 The Color Scheme

The colors that can be seen today on the Khuwy's tomb after degradation effects are: a dark shade of brown (Amber), multiple shades of green (olive green), a shade of yellow-green (corn yellow) in addition to black, white and grey (Fig. 5). Digital samples were extracted and analyzed and the result is that the three colors are almost evenly spaced around Newton's color wheel, resembling the tertiary triadic color scheme. Resulting in a harmonious and lively composition.

A virtual assumption of the original colors before degradation has been proposed based on recent researches regarding chemical degradation of Egyptian colors. All greens and tints and shades of greens were originally Egyptian blue pigments, and shades of yellow-green (corn yellow) were pure and vibrant yellow representing gold and sunshine. Gold was restricted to royal tombs, so the white color and tints of yellow were not originally gold color as analyzed in some other royal tombs in the fifth dynasty, but are pure white and pure yellow (Sabbahy 2019, p. 97). The original colors of the color scheme are blue, yellow, and red-brown. The background of the figures was painted in grey, creating a good visual contrast, and easily

distinguishing the elements among the background grey color (Figs. 5, 7, and 8).

4.3 Color Inspiration

The question is, was the ancient Egyptian artist aware of the color wheel developed by sir Isaac Newton, the interrelationships between colors in the modern color theory, or the color schemes and color harmony basics? The answer is no, but he obviously had an inspiration source to learn about these principles.

The surrounding geography of Egypt was one of the most important sources of influence for the Egyptian artist. Egypt is situated in a special location enriched by the river Nile that still runs from Africa and splits in Egypt into several channels in the delta and then to the Mediterranean sea, forming a thread of life into the desert (Robins 2008).

This lively surrounding environment was a great inspiration source for him to learn, feel analyze and extract the color harmony from the nature around him, and so he began to build harmonious color schemes for his artistic compositions, resulting in a pleasing arrangement of colors in his elements corresponding to modern theories in color harmony.

4.4 Color Symbolism

While Color symbolism was associated with particular colors related to various cultural aspects. Also, Significant diversity in color symbolism existed between cultures and

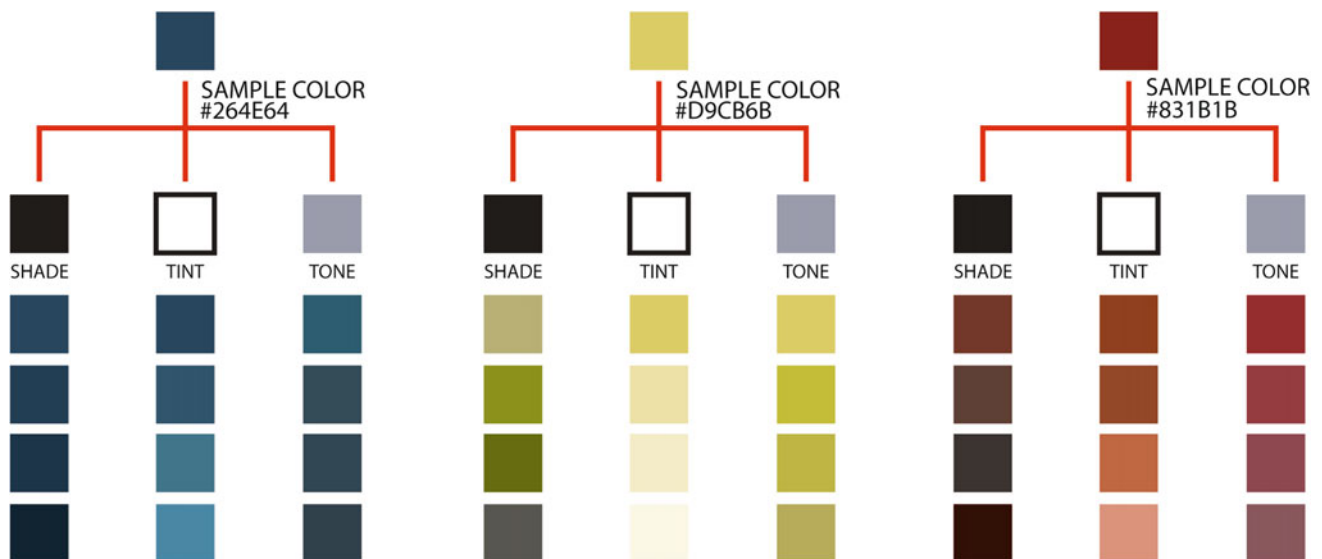


Fig. 6 Tints, tones, and shades extracted from the digital samples of the colors visible in Khuwy's tomb after degradation that were used alternatively by the Egyptian artist in coloring the scene

ANALYSIS OF COLOR SCHEME

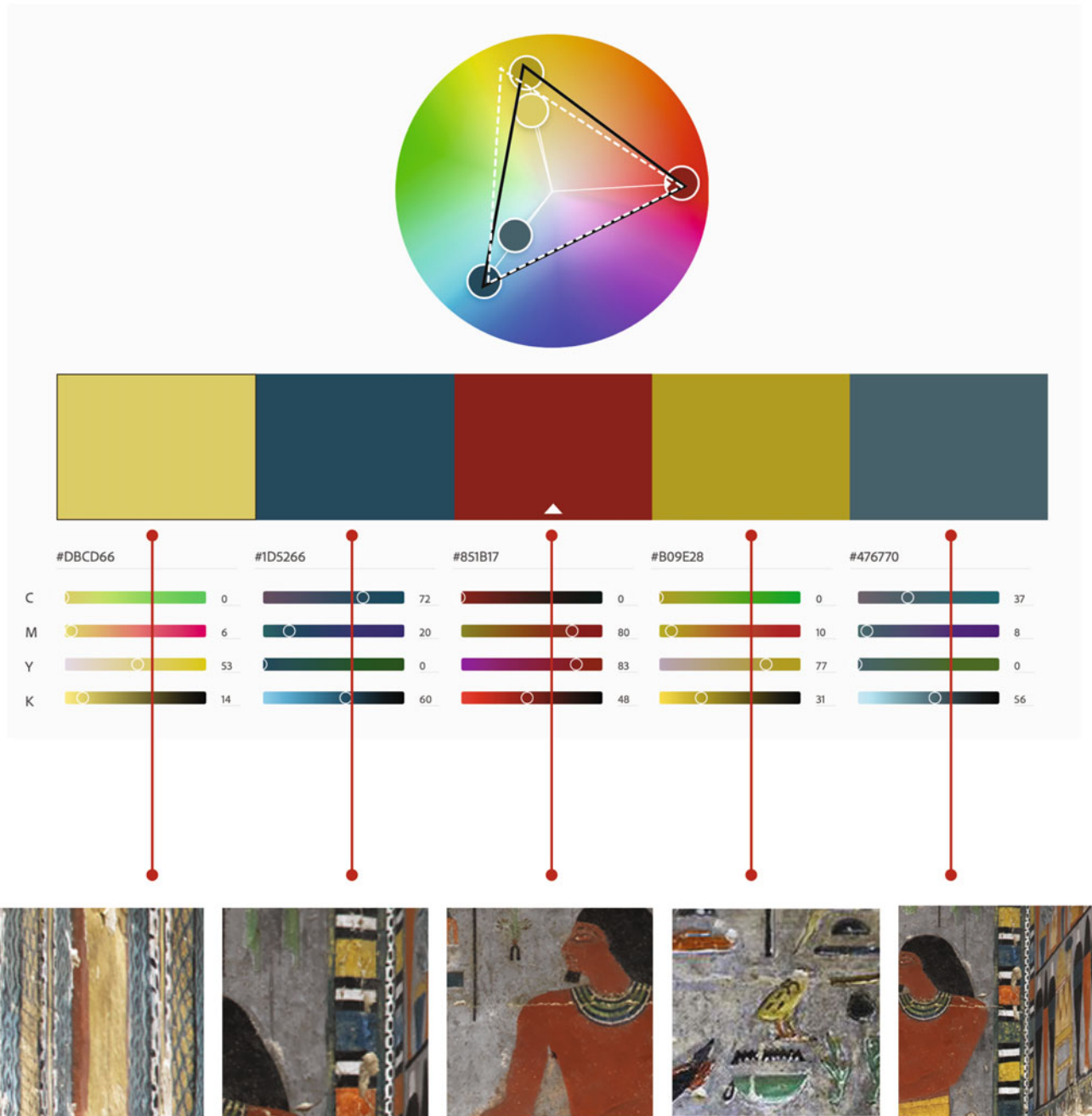


Fig. 7 The analysis of the digital samples of the visible colors after degradation indicates that the three colors are spaced around the color wheel building a triangle—represented by the black triangle in the figure—, the distribution of the colors on the color wheel resembles the distribution of the triadic color scheme which is distinguished by

the equal spacing of colors on the wheel forming an exact equilateral triangle when joined with straight lines—represented by the dashed white triangle. When comparing both triangles the result is that the color scheme of Khuwy's tomb is almost following the triadic scheme. Photo adapted from Megahed and Vymazalová (2019)

Egyptian dynasties (Bleicher 2005, p. 18). Colors used on the walls of Khuwy's tomb were not used randomly, they were intended to convey meaning and give the image greater power (Sabbahy 2019).

The illustrations on the walls of the tomb represent the Nobel Khuwy in front of tables of offerings, the most dominant color in the tomb illustrations is yellow which symbolizes gold and precious offerings, and reflects the integrity

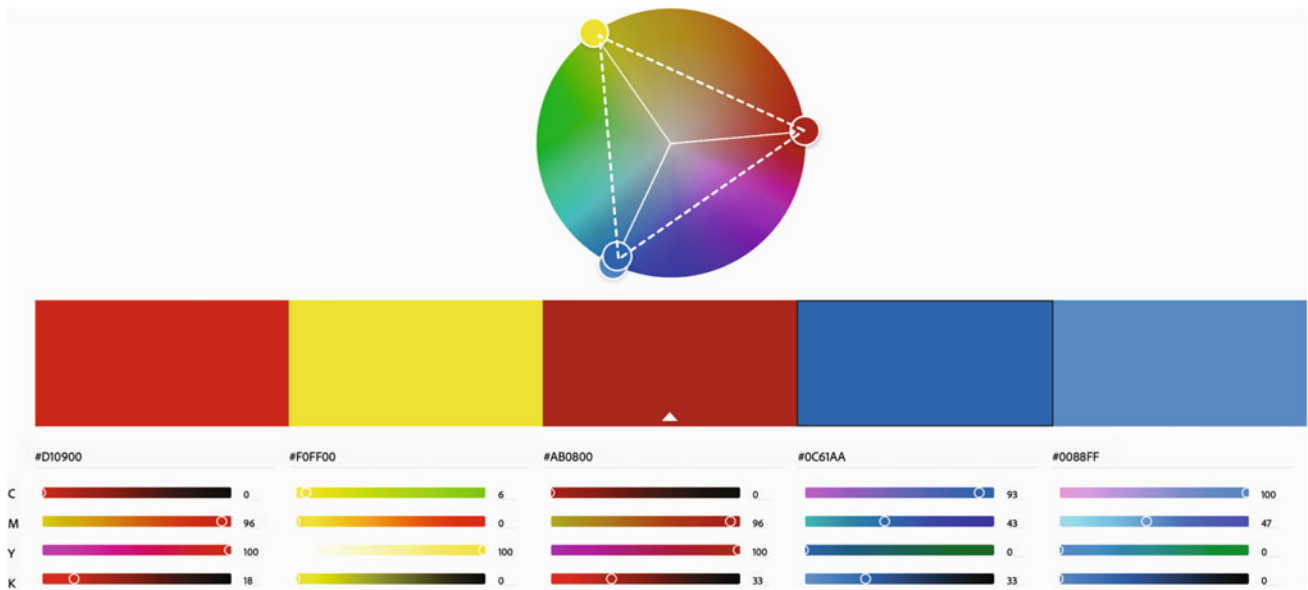
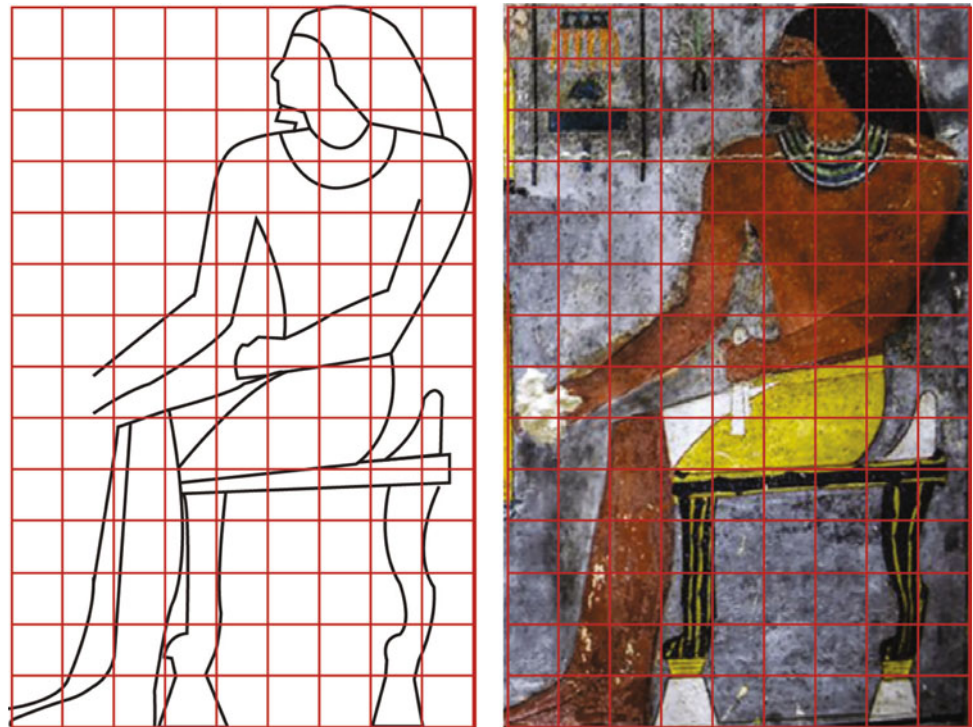


Fig. 8 The analysis of the original suggested colors of Khuwy's tomb, after considering the degradation factors according to the recent researches regarding chemical degradation of Egyptian colors are; Egyptian blue, yellow and red, results in an exact triadic color scheme forming an equilateral triangle on the color wheel

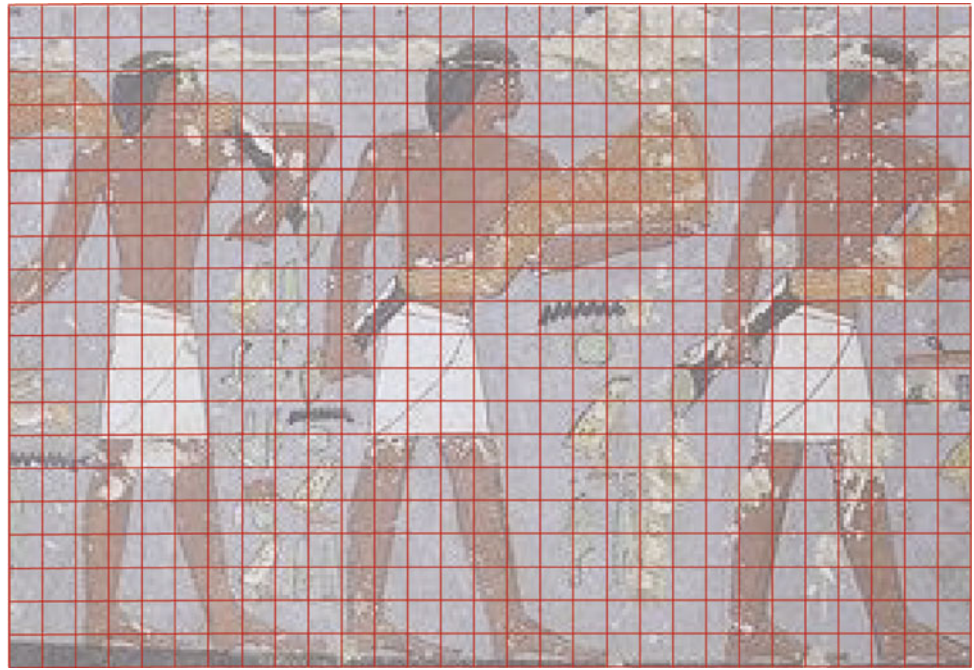
Fig. 9 The main seated figure of Khuwy in the front wall drawn on a 14-squared grid. Following the ancient Egyptian grid and proportions in the fifth dynasty. Photo adapted from Megahed and Vymazalová (2019)



of the scene, the Nobel Khuwy's clothes are colored yellow the color of gold (Sabbahy 2019). The blue color in ancient Egypt was the color of the heavens, the dominion of the gods as well as its significance to the Nile river the source of life in Egypt, the blue color is not as dominant as yellow in Khuwy's tomb, but is used intensively in patterns of water waves

that may symbolize the Nile river, the source of life and heavens to the Egyptians, and so to the tomb owner Khuwy. The green on Khuwy's illustrations symbolized fresh growth, new life, and resurrection, it was also the color of the eye of Horus, which had healing and protective powers that the ancient Egyptians believed in (Nicholson and Shaw 2000).

Fig. 10 The standing figures on the right wall drawn on an 18-squared grid. Following the same proportions and grid systems in the fifth dynasty. Photo adapted from Megahed and Vymazalová (2019)



5 Analysis of Grid Systems and Mathematical Ratios

5.1 Khuwy's Figure

A grid system is a set of measurements an artist can use to align and size objects within the given format (Madsen 2019). The grid is such a strict mathematical concept. A squared grid was accurately used by the ancient Egyptian artist to draw the figures in all positions that ensured consistent proportions in the representations of human figures and also to layout the composition as a whole. The ancient Egyptian artist used a grid of 14 squares to draw the seated figure of Khuwy and an 18 squared grid for the standing figures, that was the same rules and proportions followed in the fifth dynasty with minor changes in proportions in the following dynasties in the middle and new kingdom (Figs. 9 and 10).

Khuwy's figure—following the Egyptian rules in the fifth dynasty in drawing figures—was illustrated from a dual perspective. The head is drawn in profile, but the human eyes, eyebrows, shoulders, and upper torso were drawn in full view so that the arms, hands, and fingers are visible to the viewer. The abdomen from armpit to the waist, the legs, and feet were all drawn in profile (Bunson 2002).

Through most of the ancient Egyptian dynasties the artist organized the objects according to a scale system, encoding the relative importance of figures, the more important a figure in relation to others the bigger in size it's represented, that's why the figure of Khuwy overlooks the scenes around

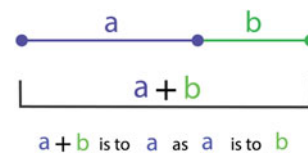
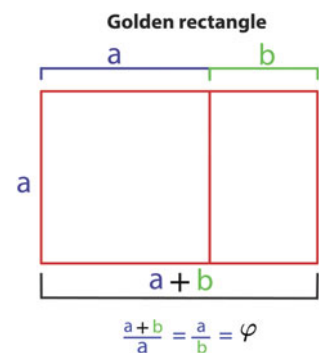


Fig. 11 The golden ratio (phi) represented as a line divided into two segments a and b , such that the entire line is to the longer a segment as the segment is to the shorter b segment (Birch, 2006, p. 2). Graphics adapted from https://en.wikipedia.org/wiki/Golden_ratio

Fig. 12 A golden rectangle with longer side a and shorter side b , when placed adjacent to a square with sides of length a , will produce a similar golden rectangle with longer side $a + b$ and shorter side a . This illustrates the relation $\frac{a+b}{a} = \frac{a}{b} = \varphi$ (Birch, 2006, p. 2). Graphics adapted from https://en.wikipedia.org/wiki/Golden_ratio



him and is much larger than other figures presented in the scene. As from at least the early Fourth Dynasty onward artists handled the combination of a large figure with several registers of smaller figures with ever-greater proficiency, and such proficiency requires accurate analysis to exclude the scale system and proportions between the elements, to know more about the ancient Egyptian artist (Abrams 1999).

5.2 The Golden Ratio

“The golden ratio is an irrational number defined to be $(1 + \sqrt{5})/2$ and has a value of 1.61803. It is an accurate ratio between the visual elements that are considered as the most pleasing visible proportion to the human sensation” (Dunlap 1997, p. 2), it exists in many forms surrounding us, in the natural world, the human body proportions and the patterns in many plants (Akhtaruzzaman and Shafie 2011), which is suggested to be a source of inspiration for the Egyptian artist in learning about the golden ratio.

The unique golden ratio “is derived from dividing a line segment so that the ratio of the total length of it to the length of the longer segment is equal to the ratio of the length of the longer segment to the length of the shorter one” (Dunlap 1997, p. 2), then this ratio is considered an accurate golden ratio (Fig. 11). A golden rectangle is constructed from these line segments (Fig. 12), mathematicians believe that a rectangle based on the golden ratio is the most aesthetically pleasing rectangle (Birch 2006).

Many researches have been made on the ancient Egyptian civilization, a civilization with astonishing architectural monuments that have been under investigation for the use of the golden proportions for a long time. As there was evidence of the golden ratio in the great pyramids in Saqqara (Birch, 2006). But none of these studies has investigated the use of golden proportions in the organization of the artistic scenes in the ancient Egyptian illustrations on the walls of tombs and temples, although all of the Egyptian wall arts are

visually pleasing and astonishingly organized, the main reason is that most of the illustrations were not preserved through the years in a complete condition which makes geometrical measurements and analysis not accurate.

5.3 Analysis of the Geometric Proportions

An accurate analytical study was applied by the researcher to exclude the proportions between the visual components in Khuwy’s tomb. The complete colored elements and the unique condition of Khuwy’s tomb provide clear definite measurements of the elements, columns, and rows during the analysis as they are clearly outlined due to the completion of colors, which helped in obtaining accurate results.

Khuwy’s tomb contains three walls; the front wall has a decorating border around three sides of it. The space within this border is divided into six horizontal registers in addition to two lower plain registers below the scene.

Calculating the measurements of the horizontal registers and the ratios between them revealed accurate proportions in distributing the elements. The length of the first four registers all-together (the figure of Khuwy on the right and the offerings facing him) to the length of the two registers below them (containing the four boats) reveals golden rectangles (Fig. 13).

The size of Khuwy’s figure—occupying a rectangular space in the second, third, and fourth register—when compared to the space in front of him reveals accurate golden

Fig. 13 Accurate golden rectangles in the proportions between Khuwy’s figure and the space in front of him containing the offerings. Photo adapted from Megahed and Vymazalová (2019)

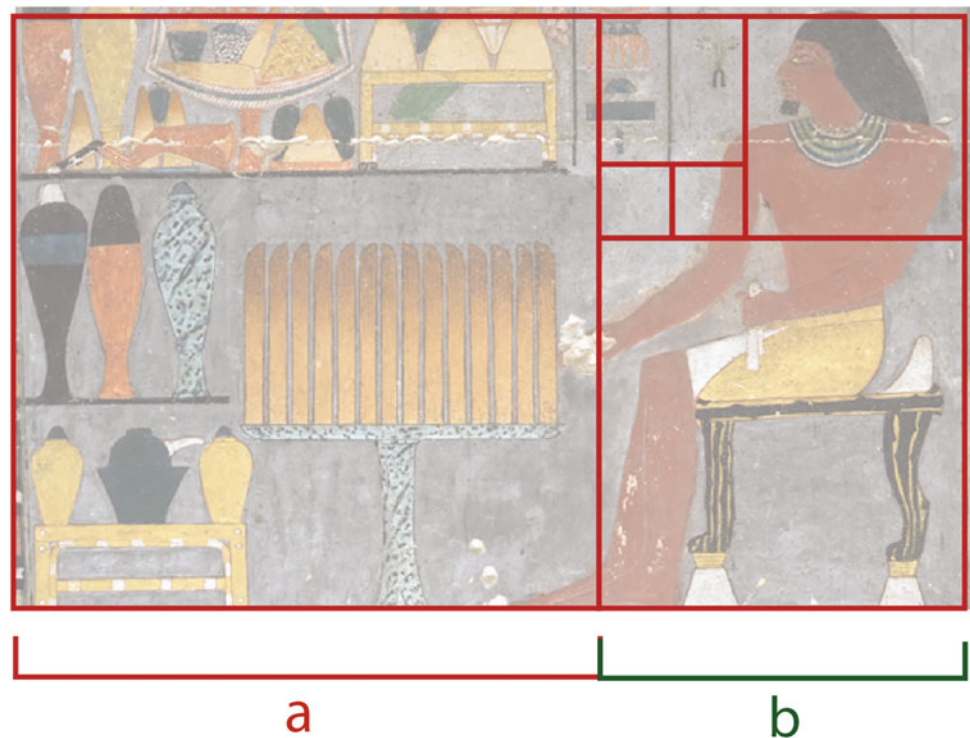
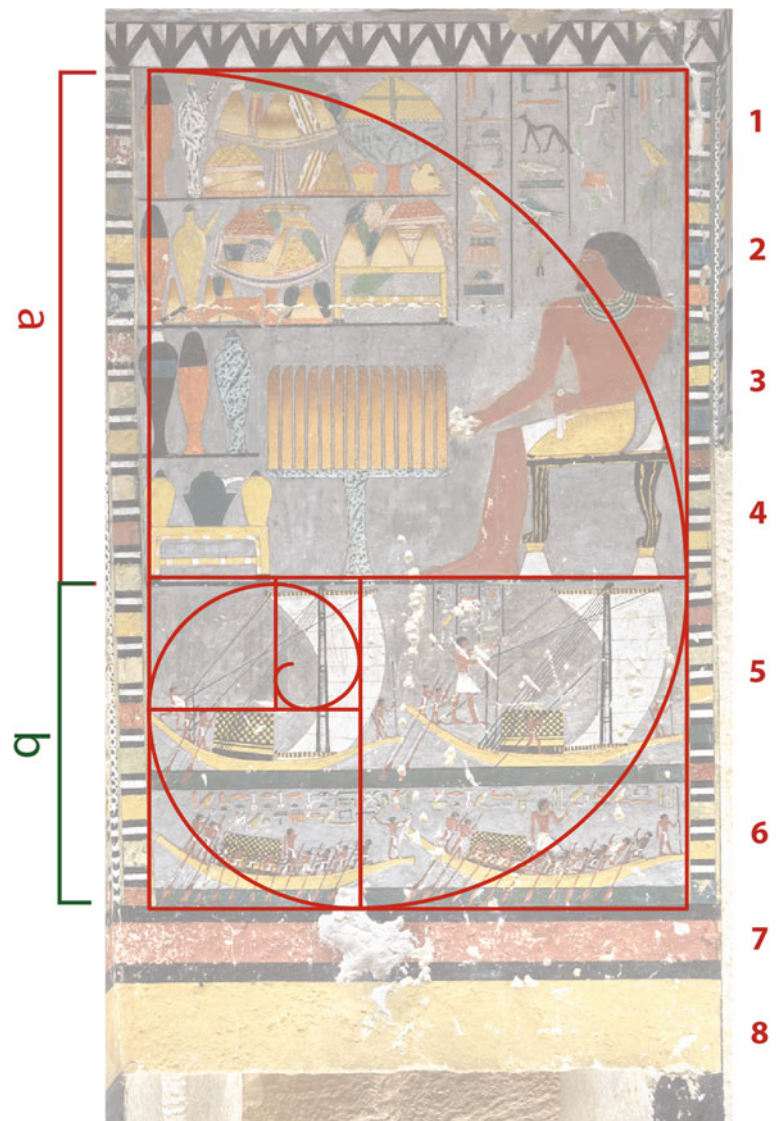


Fig. 14 Golden rectangles between registers (1-2-3-4) altogether to registers (5-6). Photo adapted from Megahed & Vymazalová (2019)



ratio through golden rectangles (Fig. 14). Also, golden ratios were remarkably measured between the height of the fifth to the sixth horizontal registers and the height of seventh brown register to the eighth yellow register (Fig. 15).

The golden ratio indicated between the heights c:d is calculated from the top of the second horizontal black row to the middle of the first horizontal black row (height d) compared in ratio to the height measured from the middle of the first horizontal black row to the end of the wall (height c).

The golden ratio calculated between the heights a:b is measured from bottom of the first horizontal black row to the top of the second horizontal black row (height b) compared in measurement to the (height a) calculated accurately from the top of the second horizontal black row to the bottom of the third horizontal black row resulting in accurate golden ratio indicated between heights a:b.

The golden ratio indicated between e:f is calculated from the bottom of the third horizontal black row to the dashed line indicating the top of the offerings carried on the boats (height f) compared to (height e) measured from the dashed red line to the top of the horizontal row of the boat scene, resulting in accurate golden ratios between e:f.

The boat scene is also organized with accurate golden proportions (Fig. 16) the figure standing on the boat is perfectly centered in a golden square facing the boat sail. The boat sail also follows the curve of the golden spiral, and the height of the boat hull including the offerings box and the horizontal black row below it when compared to the height of the space above them maintains accurate golden ratios (Fig. 17).

The left wall contains a secondary scene where a decorating border is used all-around the scene containing geometrical patterns similar to that in the front wall. The scene is



Fig. 15 Golden ratios indicated accurately between the heights of the lower registers in the main scene in the front wall. By geometric calculations ratios between the heights a:b, c:d, e:f and g:h indicates golden proportions. Photo adapted from Megahed and Vymazalová (2019)

divided into main three horizontal registers following the same horizontal lines in the front wall which emphasizes the visual movement through one architectural space to the following one, and therefore maintaining the same heights of the registers and revealing the same accurate golden ratios between their heights following the other walls (Fig. 18).

The upper two registers are divided vertically into columns. Each column contains a kneeling figure and hieroglyphic writings above it. When measuring and analyzing the height of the figure to the space above it in the column it maintains accurate golden ratios (Fig. 19).

The right wall is different in the organization of the scene, as it is not following the same horizontal registers used in the front and left wall, but is divided into vertical columns. The main column wider in size containing hieroglyphic texts is the center of attention that acts as a vertical axis for the scene maintaining symmetrical balance, where columns on the right side are reflected on the left side as a mirror. The right and left columns contain geometric

patterns. Clear accurate measurements for all vertical columns have been calculated and analyzed mathematically revealing multiple golden proportions in tremendous accurate measurements (Fig. 17).

6 Geometric Patterns

Patterns were frequently used in the ancient Egyptian arts in the fifth dynasty, but there isn't any real evidence that the patterns themselves had a religious significance, but it is believed that the Egyptians tried to maintain balance and fill the spaces in their work with patterns (Sorensen 2013).

The right wall of Khuwy's tomb contained several geometric patterns filling vertical columns, the patterns are extracted from the surrounding environment as it was a great inspiration source for the Egyptian artist to study and extract patterns from. Water waves, plants, and animal skin were the most obvious patterns in Khuwy's tomb (Fig. 20).

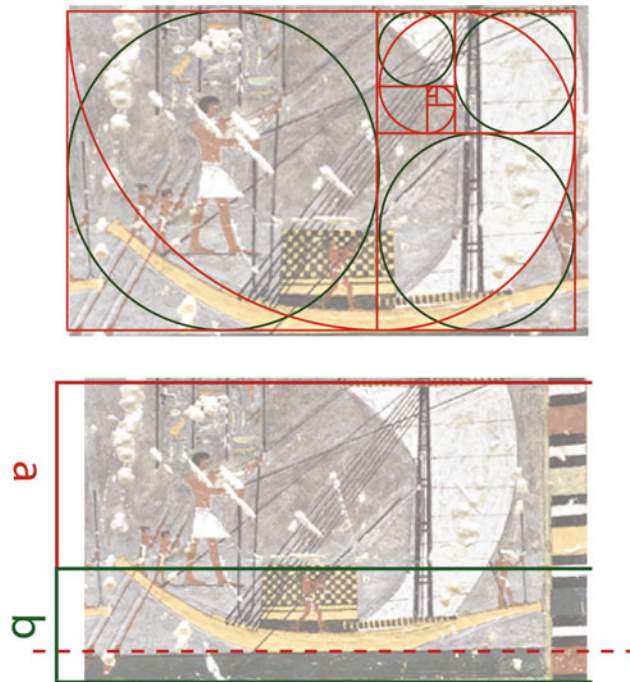


Fig. 16 Accurate golden proportions in the organization of the boat scene. The figure is centered in a golden square facing the sail that is following in its structure the golden spiral. The height (b) measured from the top of the offerings to the bottom of the horizontal black row

below the boat hull altogether compared to the height of the space above them (a) follows golden ratios represented in the figure a:b. Photo adapted from Megahed and Vymazalová (2019)

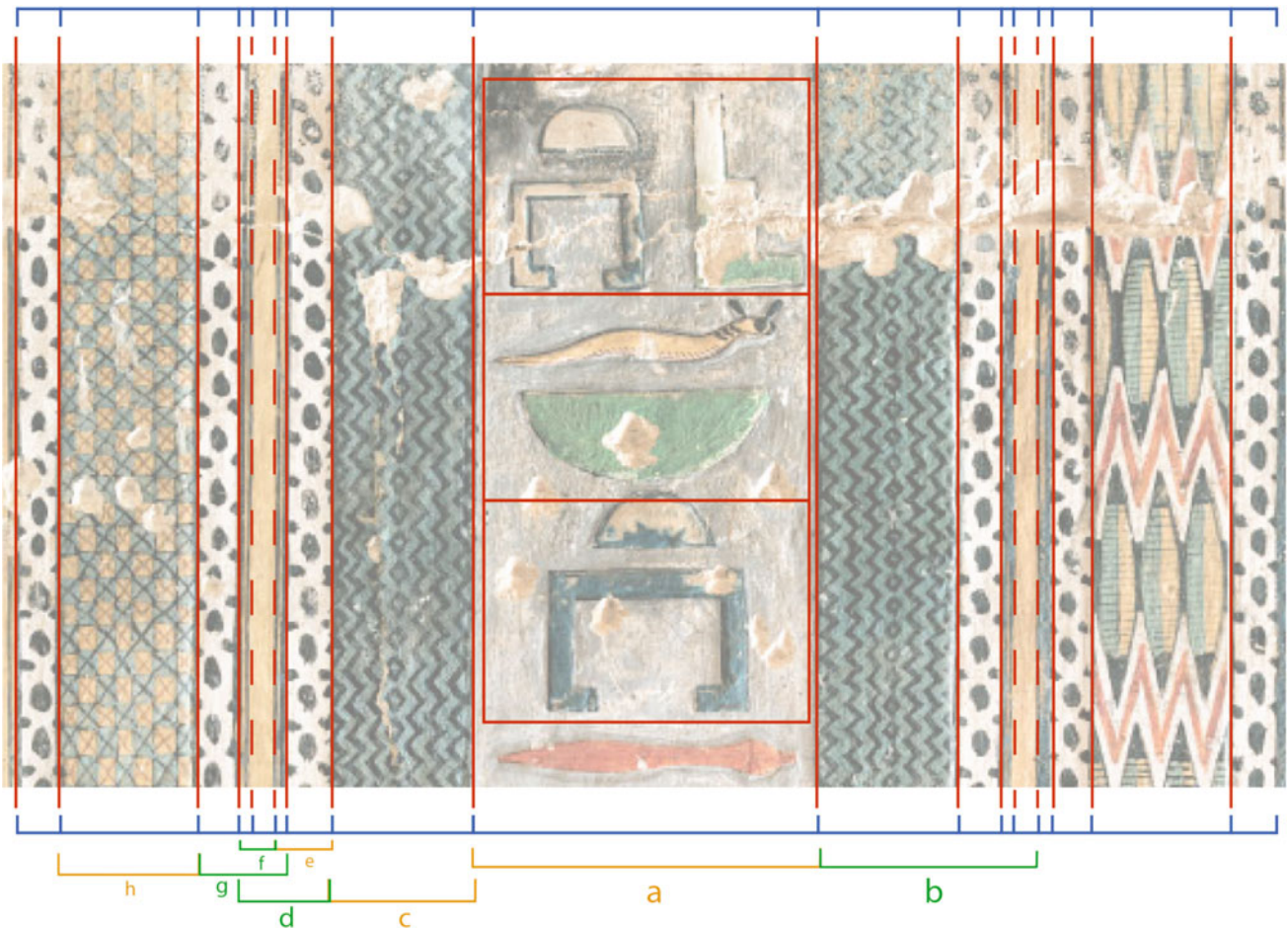


Fig. 17 Calculating the width of the columns and analyzing the ratios between their measurements reveals accurate golden ratios shown in the figure between the width a:b, c:d, e:f and g:h. Photo adapted from Megahed and Vymazalová (2019)

Fig. 18 Geometric measurements of the left wall horizontal registers indicate accurate golden ratios between the heights $a:b$, $c:d$, and $e:f$, following the same proportions on the front wall. Photo adapted from Megahed and Vymazalová (2019)

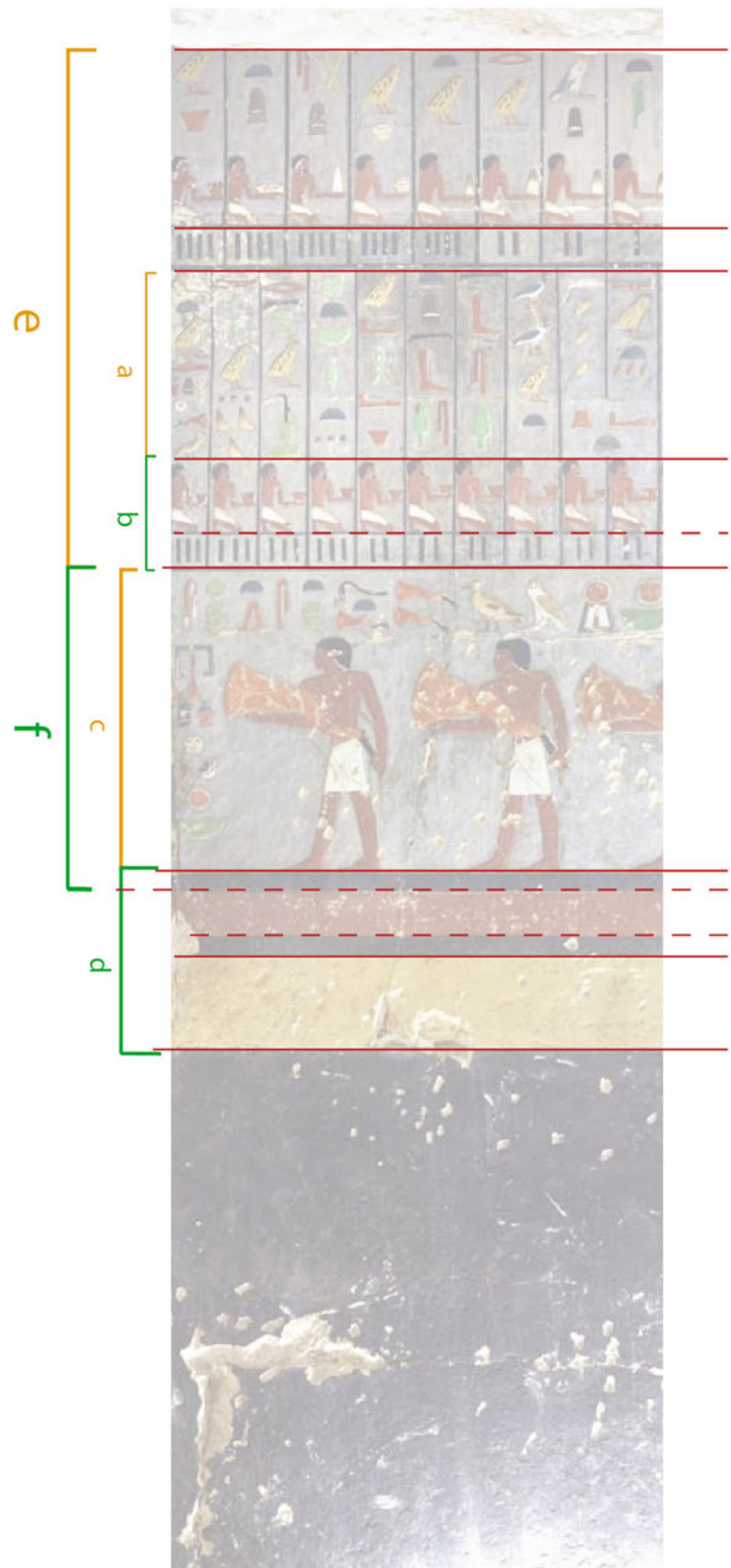


Fig. 19 The detailed study of the left wall vertical columns in the first and second upper registers shows accurate golden ratios between the heights occupied by the kneeling figures and the space above the figures, a: b. Photo adapted from Megahed and Vymazalová (2019)

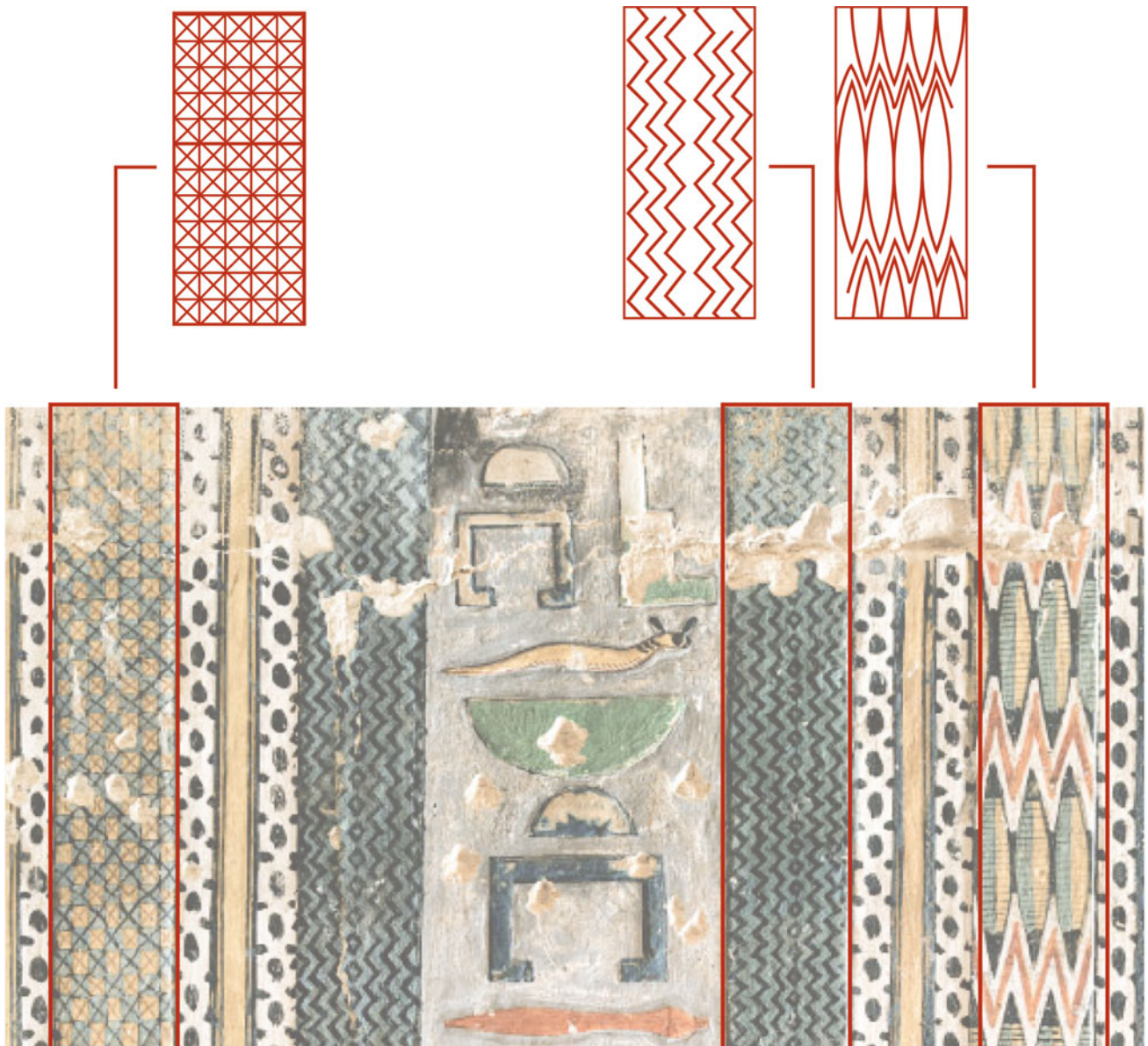


Fig. 20 Extraction of the geometric patterns in Khuwy's tomb. Photo adapted from Megahed and Vymazalová (2019)

7 Conclusion

This research is a progress in the study of art in the fifth dynasty, as it revealed more information about the ancient Egyptian artist and his understanding of color harmony, grid systems, and golden ratios implemented to organize the visual artistic content. The surrounding environment of Egypt was a great inspiration source for the ancient Egyptian artist to learn and feel the color harmony in nature and therefore build remarkable color schemes, which explains the use of the triadic color scheme in Khuwy's tomb. Also, new geometrical patterns have been concluded from Khuwy's tomb inspired by water waves, plants, and animal skin as the Egyptian artist tried to maintain balance and fill the spaces in his work with patterns.

Many researches have been made on the ancient Egyptian civilization to discuss the use of golden ratios in the Egyptian sculptures and architecture, as there was evidence of the golden ratio in the great pyramid complex, but the study of its appliance in the organization of elements in wall arts was not proved. The complete colored elements and the unique condition of Khuwy's tomb provided clear definite measurements of the elements, columns, and rows during the research analysis, as they are clearly outlined due to the completion of colors, which helped in obtaining accurate results, and therefore concluding numerical evidence of the use of golden ratios in all the proportions of the artistic scene in the three walls and in the detailed figures, which is a starting point to the comprehensive studies about the Egyptian artist from the old to the new kingdom.

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