

# REPORT

## MALEVICH'S SUPREMATIST PALETTE – “Colour is Light”

- Zinc whites
- Vermilion
- Cadmium and chrome yellows
- Emerald green
- Cobalt blue
- Ultramarine
- Carbon blacks



The subject matter (what is seen) and the content (the idea) of Kazimir Malevich's Suprematist painting between 1915 and early 1919 is *light*. As he himself said, “Colour is light”.<sup>1</sup> When one looks at a Suprematist painting one is entering a world of light.

The artist's fascination with light in his Suprematist canvases of 1915 and into 1916 was inspired by the experience of colours seen in pure optical phenomena. Later in 1916 and over 1917 and into 1918 Malevich was capturing colours and structures determined by the centrifugal forces of spinning discs. Also from 1917 to early 1919 he turned to the use of projectors and was composing with beams of light. At the same Malevich was exploring ways of integrating the different systems of optical phenomena, rotation and raying light in canvases that he called “new Suprematist constructions” in his 15 June 1918, “Second Declaration of the Suprematists”.<sup>2</sup>

The different sources of Malevich's light compositions gave rise to variations in the way the artist was selecting his colours and, hence, the pigments he was using. Nevertheless, until he reached what he called his “colourless Suprematism” in mid to late 1918,<sup>3</sup> Malevich's basic palette was generally consistent because the range of pigments used to depict the colours of light remains the same.

So that there is absolute coincidence between the colours of the light spectrum and those on the canvas, Malevich chose a palette that was derived from scientific findings about light. These included the work of James Clerk Maxwell and Ogden

N. Rood in particular, whose studies had been translated into Russian by the end of the 19<sup>th</sup> century.

Although Maxwell was famous primarily for his *Treatise on Electromagnetism*, his colour theories were widely known for two significant reasons. Firstly, in the 1850s Maxwell had been able to confirm the three light primaries by experiment.<sup>4</sup> Secondly, Maxwell had discovered the pigments that are parallel to the main saturated colours in the spectrum so that the painter's art would be more faithful to nature's world of objects and light.<sup>5</sup>

Ogden Rood developed by experiment Maxwell's work and his 1879 *Modern Chromatics – Students' Text-Book of Color with Applications to Art and Industry* became the source for the new creative ideas of the French Neo-Impressionists with colour and light, Rood's book published in French translation in 1881. Paul Gauguin, Henri Matisse and many others relied on Rood's numerous experiments as the means to explore light and colour in painting. Malevich, Olga Rozanova, Alexandra Exter, Ivan Kliun, and others in their circle were among them.

Using a spinning top which he called a “teetotum”, James Clerk Maxwell resolved in the mid-1850s the current disputes about the identification of the primaries of light. Maxwell determined that they are red, green and ultramarine blue, although Ogden Rood would tend towards a middle or cobalt blue. Then, as Maxwell wrote in his “Manuscript on the Comparison of Colours & Using a Spinning Top” (27 February 1855):

“By means of this instrument any natural colour within a very extensive range, may be exactly imitated. For this purpose more than four discs are never required. The best for the purpose are Black, White, Vermillion, Ultramarine, Emerald Green & Chrome Yellow”.... In this way the colours of flowers, leaves, rocks &c may be imitated.”<sup>6</sup>

The presence of black is to bring the saturation of colours down and so make them darker. The presence of white is to bring the saturation of colours up by adding light into them which makes them paler. Vermilion – red – ultramarine – deep blue – and emerald green – a middle green – are the three pigments that correspond to the light primaries not only according to Maxwell but also for subsequent researchers such as Rood. The presence of chrome yellow sets up a contrast with ultramarine blue and as rays of light, yellow and blue are known as light complementaries – when they are mixed in correct proportions they produce white light. As Maxwell writes, these four colours plus black and white are all the colours needed by the painter in order to “imitate” the colours of *nature* in the spectrum. By extension, this would apply even more to “imitate” the colours of *light* in the spectrum.

Although Malevich talks about light and colour in his writings of the early 1920s,<sup>7</sup> the only full outline he gave of his palette that is so-far known is a list of the “Suprematist colours” of “1915” with some of their corresponding pigments. Malevich set this out in a text that is also thought to be of the mid-1920s. There he writes:

“Suprematist colours:	
	{ red
	{ black
Basic	{ green (emerald)
	{ white
	{ blue, cobalt
Complementary	{ ultramarine
	{ lemon yellow
Rare condition	{ rose madder.” <sup>8</sup>

Now apart from his blue being cobalt (which follows Rood’s findings), Malevich’s “Basic” list of colours and pigments is otherwise the same as Maxwell’s – Malevich’s red is vermilion which is known from the analysis of paintings of 1915. His “Complementary” colours are the light complementaries, ultramarine blue and lemon yellow, the latter being a general

term for several synthetic pigments<sup>9</sup> in a single colour range including chrome yellow, cobalt yellow and cadmium yellow; zinc yellow is a pale lemon yellow while certain light ochres are a somewhat attenuated lemon yellow. Malevich used all of these lemon yellow pigments.

Hence, Malevich’s Suprematist palette of 1915 is a palette of the colours of light and their corresponding pigments in which scientific theory and artistic content coincide.<sup>10</sup>

To these basic pigments used for the dominant planes of colour in 1915 Malevich added a number of other pigments both in this year and throughout 1916, 1917 and 1918 in order to capture a variety of colour-light phenomena as they change in intensity, as they shift between light and darkness, or so that he could vary their weight in the composition. These pigments include the range of cadmiums, chromes and cobalts which would be used when the artist wanted, say, a full prism that would include orange or spectral violets. For certain greens Malevich would sometimes mix Prussian blue and a lemon yellow, but the subtle shades of cobalt green and chromium oxide green were also part of his palette.

Malevich used a variety of black pigments including carbon black, lamp black, bone black and ivory black.

In this small article about a very big topic, the pigments found in representative paintings in each of the three main stages of Suprematism are presented.<sup>11</sup> They reveal that the pigments Malevich was using correspond to the spectral colours and to the subject matter of these paintings that originate in light. Material and idea are coincident in these compositions, for the pigments themselves are coincident with the colours of spectral light as had been determined by scientists.

The paintings of 1915 do, indeed, conform to the “basic” and “complementary” colours and pigments as Malevich set them out in his list, while in the paintings of 1916 to 1918 the pigments found show that Malevich used his palette of spectral colours and pigments as was appropriate to the given stage of Suprematism.<sup>12</sup>

## The Basic White Ground

Colour arises between light and darkness. Every Suprematist canvas is white because it is a field of pure light, although Malevich sometimes worked this field with tones of white to tints of pinks or blues to capture additional light phenomena.

The most commonly used pigment for the white ground of the Suprematist painting is zinc white although white lead is frequently found, Malevich applying one on top of the other to obtain different luminous qualities over the surface. The extenders, calcium carbonate and barium sulfate in particular, are often found in the ground.

## Suprematism of 1915 and Early 1916

The first stage of Suprematism is characterised by paintings depicting optical phenomena.

These are the phenomena of the pure sensation of seeing when the eye is affected by light and darkness. These effects occur when the eye, stimulated by a bright light such as the sun, produces luminous planes of colour in the eye's optical field, numerous shapes of colours floating in front of the closed eyes.

These planes are in the range of reds and magentas shot with blues and greens, to change to oranges and yellows and more blues to violets in a constantly shifting light show as the eye is stimulated or moves. If the eye encounters an area of darkness that blocks the light (such as haze, a cloud or the crown of a tree), the colours shift instantly and various tones of greens, blues and violets become dominant.

The colours also shift as the initial effects of light on the eye begin to change. Reds turn to violet reds and red-browns, greens turn to darker greens and blues into black.

Malevich called these phenomena "colour masses", an expression he included in the titles of works shown in the Last Futurist Exhibition of Painting 0.10 of December 1915 to January 1916, Petrograd. He undoubtedly took this expression from Ogden Rood who used "masses of coloured light" to describe all manner of colour sensations visible in the optical field.<sup>13</sup> Other artists were experimenting with such optical effects and for Robert Delaunay they gave rise to his Disc paintings of 1913 and 1914. Sonia Delaunay described this:

*"Robert wanted to look straight at the midday sun, the absolute disk.... He tried to stare at it to the point of being blinded by the sunlight. He closed his eyes and concentrated on the reactions in his retina. Back home, what he sought to put on the canvas was what he had seen both with his eyes open and with his eyes shut, to put down all the contrasts that had registered in his eyes.... He had discovered spots in the form of disks. He would move from prismatic colours to circular forms [in spring 1913]."*<sup>14</sup>

When they first appear in the optical field the colour masses are pure spectral colours, saturated and full of light. That is why the pigments Malevich used for the "basic" planes of colour are saturated and unmixed since the exactly corresponding pigments to the optical phenomena were as he had listed them in his 1915 palette. As the eye is further stimulated by light and dark or simply begins to return to normal, the colours shift so Malevich would need to select pigments to correspond to darkening such as chromium oxide green. Deep reds and violets would be mixed in order to obtain the spectral colours he saw.

Two paintings of 1915 are considered here, one having a single group of Suprematist elements and the other being made



up of a two-part composition. Both of these paintings figure in the installation photograph of the Last Futurist Exhibition of Paintings 0.10 in which about one half of the thirty nine Suprematist paintings he showed can be seen. Although he gave individual titles to a few works, and group titles to the other works, all were under the general title, "Suprematism".

The painting in the Museum of Modern Art, New York, 1, would have belonged to the group of works which Malevich designated in the catalogue as "Pictorial Masses in Movement". In this canvas Malevich has captured strong contrasts between the optical stimulation of light in the yellow and red planes and bars, with sudden shifts to darkness in the black planes and blue bars. In the repeat planes in black Malevich has registered the succession of afterimages that occur in the optical field as the eye moves. All these optical "colour masses" in movement have been captured on the canvas as "pictorial masses in movement".<sup>15</sup>

The composition is arranged between the light-end of the spectrum and the dark-end of the spectrum, a division that is demonstrated by the prism in the way a ray of light is divided between light – red, orange, yellow – and dark – green, blue, violet.

The pigments used in this painting are –

- vermilion
- cadmium yellow
- ultramarine blue
- bone black.

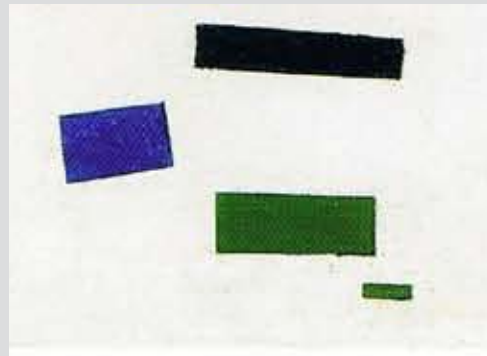
The ground is zinc white and white lead with barium sulfate.



2 • *Suprematism*, 1915  
Oil on canvas, 101.5 x 62 cm.  
Stedelijk Museum, Amsterdam



3 • Vermilion Lemon yellows



4 • Black, Ultramarine, Prussian blue +  
chrome yellow

The two-part Suprematist painting in the Stedelijk Museum, Amsterdam, 2, is made up of large planes of colour masses in the upper area below which is another composition of colour masses. In the lower section the original stimulus of bright light would have produced a mass of red, rendered as a red square, behind which stretch bars of yellows, followed by flashes of blue, green and black seen in the short bars. From the red and yellow group the eye lifts up to renewed stimulation which reinforces the transition to a brilliant yellow colour mass appearing over a sudden black plane of darkness, the eye briefly holding both stages in the optical field. Beneath the yellow rectangle the three light primaries, red, green and blue, are captured at successive stages of shifting as the eye moves. The small group of perpendicular lines and planes at the very top depict fleeting occurrences produced in the eye as it moves. This painting would also belong to the group,

“Pictorial Masses in Movement”.

The main pigments are –

- vermilion
- cadmium and chrome yellows
- emerald green
- Prussian blue and chrome yellow
- cobalt blue
- ultramarine

In the details above, 3 and 4, it can be seen how Malevich arranged the colours prismatically: red and yellows are together and the spectral sequences of greens and blues fall together. The juxtaposition of light complementaries, yellow and blue, can be seen in the upper section of the composition.



5 • *Suprematism*, 1915  
Oil on canvas, 53 x 53 cm.  
Formerly Stedelijk Museum, Amsterdam  
Malevich Family

Malevich did a number of paintings that were divided prismatically and so are devoted to colours either at the dark-end of the spectrum or at the light-end of the spectrum. At 0.10 another painting can be seen in the installation photograph which is a very beautiful array of middle and deep blues sliced through by a narrow yellow band; its placement serves to set up the contrast between two complementary colours of light (5). The arrangement is capped by the green rectangle and the wide black plane of darkness is fitted to either side of this colour composition of optical effects at the dark-end of the spectrum. The planes in this painting reveal the shifting progressions of masses as they change their colours in the eye's optical field. The painting is a perfect harmony of light-filled spectral colours in movement.

The pigments are –

- cadmium yellow
- emerald green
- cobalt blue
- ultramarine

A painting devoted to colour masses seen in the light-end of the spectrum, here interspersed with interruptions occasioned by jumps to darkness, is in the Ludwig Museum, Cologne (7). Away from a central red band a yellow rectangle arises. The light has been intercepted by a black band which is nearly the same shape and size as the red band, the effect of the eye moving quickly between a light and a dark area and so carrying with it an afterimage. Around the group of large planes, small fragments of red are caught by the eye,

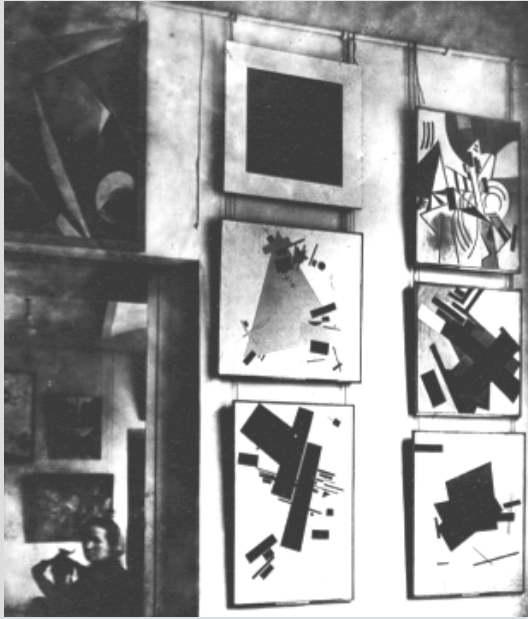


7 • *Supremus* [No. 38], 1916  
Oil on canvas, 102.4 x 66.9 cm.  
Ludwig Museum, Cologne

while narrow strips of a red-brown catch the shifting of the colours away from their state of being saturated with light. Groups of small black rectangles and lines reveal how flashes of dark elements are seen in different areas of the eye's optical field. Thus Malevich has set up a visual dialogue between colours at the light end of the spectrum, their shifts, and pure darkness. The pigments are –

- vermilion
- cadmium yellow for the large plane
- chrome yellow for the small bars
- Prussian blue and chrome yellow
- Prussian blue and ultramarine
- purple lake for the violet bars
- bone black

Zinc white, with barium sulfate used as an extender in the ground.



6 • Ludwig Museum *Dynamic Suprematism* on view at Artists in the RSFSR Over the Last Fifteen Years, Tretyakov Gallery, Moscow, Autumn 1932. Above it can be seen *Supremus* (No. 57), today in Tate Modern, London, and above that, *Quadrilateral*, the *Black Square*. Both the Ludwig Museum, *Dynamic Suprematism*, and Tate Modern, *Supremus*, were deaccessioned from the Tretyakov Gallery in the early 1970s. On the panel to the right are visible, top to bottom, O. Rozanova, "Disc Painting", O. Rozanova, *Non-Objective Composition*, and Ivan Kliun, *Suprematism*.

## 1916 and Supremus

Although Malevich continued to explore the painterly possibilities of such pure optical phenomena in 1916, with



8 • O. Rozanova, "Disc Painting", 1915, Private Collection



9 • A. Exter, *Abstract Construction of Plane Surfaces*, 1916  
Oil on canvas., 68 x 54.5 cm  
Jean Chauvelin Collection, Paris

the formal gathering of the SUPREMUS Society of Artists by the autumn of this year Malevich turned his attention to another phenomenon of light. This is what was produced by the spinning disc of colours that had been initiated by James Clerk Maxwell. Other scientists followed the technique Maxwell had invented and in his *Modern Chromatics*, the American physicist, Ogden N. Rood, described many experiments using rotating discs in order to discover such phenomena as the duration of a colour in the eye (its degree of saturation), the wavelength of a colour, and the purity of a colour (how much light or darkness is added to a colour). There were rich opportunities for the discovery of colour in light in Ogden Rood's book.

Olga Rozanova seems to have originated this colour exploration in what she called her "disc paintings" of 1915,<sup>16</sup> one of which is illustrated here, 8, and another can be seen in the 1932 installation photograph, 6. In these canvases Rozanova was experimenting with the black and white Benham discs and their particular characteristic of producing colours in the eye of the observer.<sup>17</sup> For her part, Alexandra Exter began her "absolute, pure" painting in 1916, according to Jakob Tugenhold,<sup>18</sup> in works that capture the flashing colours and luminosity generated by the spinning disc such as her *Abstract Construction of Plane Surfaces* (9).<sup>19</sup> All the Supremus painters – which also included Ivan Kliun, Liubov Popova, and Nadezhda Udaltsova – found different solutions to the depiction of dynamic colours produced by discs of spinning colours and light. Malevich experimented with a number of possibilities and this accounts for his "Supremus" disc paintings being apparently so different.

One of Malevich's solutions was to depict a cluster of variously coloured bands radiating around a central point (10). What is particularly significant is that there are several drawings for the three known paintings in this group, on two of which Malevich indicated the colours and pigments for the bands – they are perhaps the only known such informative drawings to have come to light.

On the drawing that is in the Musée national d'art moderne, Paris, the colours are indicated as: "light ochre, middle ultramarine, middle white". On the drawing in the Ludwig Museum, Cologne, Malevich has been more specific: "1) vermilion red 2), 3) black 4) cadmium and chrome yellow 5) white 6) cobalt blue 7) cobalt blue".

The pigments in one of the paintings are –

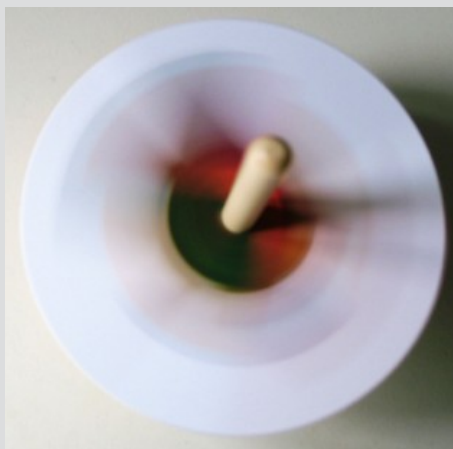
- vermilion
- yellow ochre
- emerald green
- ultramarine blue



10 • *Supremus*, 1917  
Oil on canvas, 73.5 x 66 cm.  
Private Collection



11 •



12 •

This is almost a text-book painting of Maxwell's theory of the main pigments in order to depict the colours of spectral light. In addition, Malevich has placed the red and green bands next to each other, and the yellow and blue bands in relation to each other, making it a painting about the complementary colours of light. For, like yellow and ultramarine, rays of red and green light shone together also produce white light when in the correct proportions.

And, indeed, if this painting is reproduced on a disc and fitted to a top and spun, the result is white light shining over the surface of the disc. It is lightest where the speed of spin is fastest, while the speed is too slow at the spindle to mix the red and green. This is a beautiful painting arising directly out of the colour theory of light.

## 1917

Another innovation occurred in 1917 in Malevich's Suprematist painting and this innovation, like the use of discs, was also that of Olga Rozanova. This is known from Aleksandr Rodchenko's tribute to her at the time of her death in November 1918, Rodchenko writing:

*"Wasn't it You who wanted to illuminate the world with cascades of colour?"*

*Wasn't it You who designed colour compositions in the air with projectors?....*

*You thought of creating colour through light.*"<sup>20</sup>

Rozanova seems to have begun experimenting with projections of light in 1914 or 1915 in her collages, and her paintings of 1916 and 1917 reveal the number of ways she was composing with light.

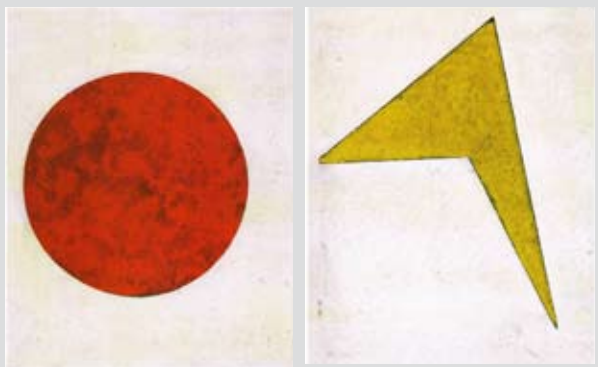
Other artists were composing with light. In the 1917 *Knave of Diamonds* in Moscow, Ivan Kliun showed his "Investigations into Colour" with groups of works called "One Colour Compositions", "Two Colour Compositions", and

"Three Colour Compositions". His paintings such as "Cadmium Red" and "Lemon Yellow", 13 and 14, for example, belong to the first group and are Suprematist compositions made with rays of light.<sup>21</sup>

Malevich also exhibited a light painting in the 1917 *Knave of Diamonds*. It is *Supremus*, in the Stedelijk Museum, Amsterdam (15).

That it is a light painting is deduced first of all from what is written on the back of a photograph of the other known work in this group: "K. S. Malevich – Suprematism – moment of diffusion of a brown plane in space", "diffusion" being a clear reference to light theory.

On the back of this canvas, however, Malevich wrote, "SUPREMUS". Hence, the yellow plane would also belong



13 • I. Kliun, "Cadmium Red", c. 1917  
 14 • I. Kliun, "Lemon Yellow", c. 1917  
 Both are oil on paper, 27 x 22.5 cm.  
 Museum of Contemporary Art, Thessaloniki

to dissipate in intensity and sharpness. The colour begins to be "diffused" in a light-filled space.

In order to capture the effects of this plane's light-filled colour and its diffusion in space, the artist used a group of lemon yellow pigments –

- chrome yellow
- cadmium yellow
- zinc yellow

## 1918-1919

In his diary entry of 25 December 1918, written in the context of the planning of the April 1919 exhibition, Non-Objective Creation and Suprematism, Aleksandr Rodchenko wrote:

*"Malevich paints without form or color. The ultimate abstracted painting. This is forcing everyone to think long and hard. It is difficult to surpass Malevich."* <sup>22</sup>

And, indeed, Malevich had arrived at his "colourless Suprematism", the Suprematism of pure light. These canvases are the corollary of his Suprematism of pure thought, his "abstract Suprematism", Malevich's philosophical

to this group of Supremus paintings and be a "moment of the diffusion of light of ... a yellow plane in space".

If one places a coloured glass slide – say, yellow – over a beam of projected light and then in front of it puts a heavy card in which a small shape has been cut out, the image thrown onto the screen is a large, luminous colour in that shape. The quality and depth of the coloured light is spectacular, it appears to shimmer slightly, and the edges may be sharp or fading depending on the way the cut-out is held in front of the beam. At an angle, the edge furthest away from the beam begins



15 • *Supremus*, 1917  
 Oil on canvas, 106 x 70.5 cm.  
 Stedelijk Museum, Amsterdam



16 • *Suprematism*, early 1919  
 Oil on canvas, 97 x 70 cm.  
 Stedelijk Museum, Amsterdam

pronouncements being drawn from the implications of creating with light.<sup>23</sup>

In a White on White canvas in the Stedelijk Museum, Amsterdam, 16, the pigments are –

- white lead
- zinc whites
- titanium white on upper surface, retouching

Light varnishing gives effects of luminosity.

## Practical Implications of the Unity of Material and Content

The fact that Malevich's palette of colours and pigments was coincident with the idea of Suprematism itself between 1915 and early 1919 means that there are clear methods by which one can proceed in the understanding of Suprematism at the time it was being created. Three fundamental questions lead into the essence of a painting or group of paintings:

- 1 What are the pigments being used?
- 2 What spectral law or laws are being explored creatively?
- 3 What are the coherent relationships among the pigments, colours and spectral law(s)?

In needing to base an enquiry on a knowledge of the pigments (as well as on how they are laid in together with various other technical factors) means that the art historian must have all the cooperation of the scientist and museum conservation departments. Research must be shared so that the art historian can proceed on the basis of a knowledge of the most essential components of a painting, ones that carry within them so much meaning since the pigments are the starting point for the analysis of the spectral laws that lie at the foundation of a painting or group of paintings. This, in turn, leads to the possibility of discovering how materials and idea are integrated.

From such a method a much better understanding of Malevich's creativity will begin to emerge, art historians will be able to date paintings with more confidence, and the work of other Suprematists will be more easily identified and understood for their differences. At the same time, scientists and conservators will be able to have insights into the painterly practice of Malevich which they otherwise could not have had.

With the interdisciplinary cooperation and collaboration between art historians and scientists from

museums, universities and independent laboratories, Malevich Suprematist studies will be able to go forward in ways that were impossible without such sharing of the information and the ideas that each of these disciplines can bring. And this is not limited, of course, to the painting of Kazimir Malevich because craft and creativity cannot be separated in an artist's work.

Patricia Railing

## PIGMENTS MENTIONED

These notes are taken from Patricia Railing, *Pigments and Colours in Painting from Antiquity to the 19<sup>th</sup> Century*, forthcoming. They are classified in accordance with the categories of the historical treatises, those particularly relevant here being the natural mineral pigments (calciums, ochres), the ancient manufactured pigments (white lead), and the synthetic pigments (chemicals synthesized in the laboratory).

### Blacks

The various black pigments are made from burning woods – *carbon blacks* – animal bones – *bone black* – antlers, horns and ivory scraps – *ivory black* – or from soot – *lamp black*.

### Cadmiums

Cadmium orange and cadmium yellow are synthetic pigments made from cadmium sulphides, their colours varied by the production process; they are 19<sup>th</sup> century pigments. Cadmium red is obtained by the addition of cadmium sulphide selenide and was developed in 1907 by a German chemist.

### Calciums

Basic calcium pigments are calcium carbonates made from chalk that are washed (levigated) or simply ground to make the pigment. They have been used since antiquity.

### Cobalts

Cobalt pigments are synthesized from basic cobalt salts plus other compounds to produce the range of cobalt yellow, cobalt green, cobalt blue, and cobalt violet. They were developed over the 19<sup>th</sup> century by Swedish, French, German and English chemists and were marketed under different trade names by the various colour makers (e.g., Aureolin).

### Chromes

Chrome pigments were synthesized in the laboratory from the early 19<sup>th</sup> century using a variety of different compounds which produce the range of chrome red, chrome orange, chrome yellow, and the chrome greens (chromium oxide green and viridian, a blue-green).

### Emerald Green

Emerald green is a copper aceto-arsenite pigment that was developed by a paint manufacturer in 1814 in Germany, Wilhelm Sattler of Schweinfurt, hence its other name, Schweinfurt green; Scheele's green has a higher arsenic content. Because of its arsenic content it is toxic and was taken off the market around 1960.

### Leads

Lead pigments – white, red, orange, yellow – have been manufactured since antiquity by corroding sheets of lead or by roasting. There were numerous ways of corroding lead sheets to obtain a white crust which is then scraped off the sheet and ground. Manufactured on a large scale, these processes produced toxic fumes that are dangerous to the workers and so white lead as a basic white pigment was gradually replaced in the 19<sup>th</sup> century largely by zinc white, although white lead (sometimes called lead white) is still available.

### Lemon Yellows

“Lemon yellow” is a colour term used to denote a number of different saturated yellow pigments including cadmium yellow, chrome yellow, cobalt yellow, the lighter zinc yellow and the duller yellow ochre.

### Ochres

Yellow and red ochre pigments are derived from natural mineral earths found in soils and quarries all over the world. They have only to be ground and mixed with a liquid. The range of brown earth pigments are called siennas and umbers.

### Prussian blue

A pigment synthesized in Paris by around 1710 but which originated in 1704 as an animal pigment when a certain Diesbach, working in his Berlin (in Prussia) laboratory, was making a carmine lake. The alkali had been contaminated with bullock's blood, however, whose iron content turned the pigment a rich dark blue.

### Ultramarines

Ultramarine is commonly used as a synonym for a deep blue pigment, although by varying the manufacturing process red and yellow ultramarines are obtained. As a pigment name, “Ultramarine blue” is used to distinguish it from genuine ultramarine made from lapis lazuli. Synthetic ultramarines were developed in the 19<sup>th</sup> century.

### Vermilion

Although in antiquity vermilion was made from genuine cinnabar, a stone or sand found naturally, methods of fusing its base compounds, mercury and sulphur, were discovered by the classical Greeks. This synthetic pigment has been used around the world since that time, although genuine cinnabar is still available.

### Zincs

The base ingredient of the zinc white pigment is zinc oxide. Although developed in the late 18<sup>th</sup> century, it was not commercialised until the middle of the 19<sup>th</sup> century in France and England. Zinc yellow is a zinc chromate.

### Footnotes

- [1] “Colour is light, light is light depending on the circumstance”. K. Malevich, “Non-Objectivity”, c. 1924, in *The World as Non-Objectivity* Unpublished Writings 1922-25, Vol. III, translated by Xenia Glowacki-Prus and Edmund T. Little, edited by Troels Andersen. Copenhagen: Borgen, 1976, 90-1.
- [2] This article is drawn from the author's forthcoming book, *Colour into Light – Towards Non-Objective Creation and Suprematism*, for 2012, where the stages of Suprematism are explained and discussed in depth. Malevich's article is “Second Declaration of the Suprematists (1918)”, in *A Legacy Regained: Nikolai Khardzhiev and the Russian Avant-Garde*, St. Petersburg: Palace Editions, 2002, 234.
- [3] Malevich refers to “abstract Suprematism” in his “Declaration of the Suprematists” of 1918 (in *A Legacy Regained: Nikolai Khardzhiev and the Russian Avant-Garde*, *ibid.*, 234) where “abstract” would be the Suprematism of “thought”, while “colourless Suprematism” would be the White on White paintings, “sensations of pure thought”.
- [4] For example see J. Clerk Maxwell, “Manuscript on the Comparison of Colours & Using a Spinning Top” (27 February 1855) in *The Scientific Letters and Papers of James Clerk Maxwell*. Edited by P. M. Harman, Vol. 1, 1846-1862. Cambridge: Cambridge University Press, 1991/2008, 284-289.
- [5] *Ibid.*, 284-5.
- [6] *Ibid.*.
- [7] See K. Malevich, “Non-Objectivity”, c. 1924, in *The World as Non-Objectivity* [1], where Malevich writes that “The painter builds the reality of his painting on the basis of the three or seven basic colours but this is only the basis of his eye perception opened by an invented apparatus – the prism – which has introduced this seven-colour law into the apparatus of knowledge.” (96-7) The seven basic colours of the prism are red, orange, yellow, green, blue, indigo, violet, the range of blues being the widest in the spectrum. Malevich's reference to “three... basic colours” would refer to the three light primaries, red, green, blue.

- [8] K. Malevich, "Formula of Suprematism", c. 1925-6, State Russian Museum (Inv. No. PB 23163), in L. Zhadova, *Malevich – Suprematism and Revolution in Russian Art 1910-1930*, translated from the Russian by Alexander Lieven, London: Thames and Hudson, 1982, 125n71.
- [9] See descriptions of the pigments see Pigments Mentioned at the end of this article.
- [10] Rose madder is a plant pigment made from the root of the plant, *rubia tinctoris*, which, depending on the species and the processing, produces shades of very bright to pale pink. Malevich would have used it to capture the optical effects of brilliant magenta pink colour masses.
- [11] For the sake of brevity and clarity the stage in which Suprematist systems were integrated is not discussed here. The pigments used in them are nevertheless chosen to capture the relevant spectral phenomena.
- [12] In fact, Malevich's late palette is made up largely of these same pigments as described by Svetlana Rimsky-Korsakova in "Concerning the Technological Research of Malevich's Paintings" in *Kazimir Malevich in the State Russian Museum*, St. Petersburg: Palace Editions, 2000, 28-31. See also Olga Klyonkova, "Features of Malevich's Painting Technique Revealed in the Process of the Restoration of his Works", *ibid.*, 32-34.
- [13] Some of the titles Malevich gave to his paintings as they are listed in the catalogue are: "Automobile and Lady: Colour Masses in the Fourth Dimension", "Lady – Colour Masses in the Second and Fourth Dimensions", "Pictorial Masses in Movement", and "Colour Masses in Two Dimensions in a State of Rest". The "fourth dimension" refers to "movement" as an experience of time. Ogden N. Rood, *Modern Chromatics – Students' Text-Book of Colour with Applications to Art and Industry* (1879) (Reprint New York: Van Nostrand Reinhold Company, 1973), where, in referring to "revolving disks", for example, says that they "furnish us with a mode of mixing together masses of coloured light", 207.
- [14] S. Delaunay, *Nous irons jusqu'au soleil*, Paris, 1978, 44. Quoted by P. Rousseau, "L'oeil solaire", in *Aux Origines de l'abstraction*. Paris: Musée d'Orsay, 2003, 129. Malevich could have known about Delaunay's experiments through Alexandra Exter because she had lived almost exclusively in Paris between 1912 to 1914 and was on very friendly terms with the Delaunays.
- [15] On the back of the canvas Malevich later ante-dated this painting to 1914 and gave it an alogical title, "Airplane flying".
- [16] In a letter to Aleksei Kruchenykh of December 1915 following the opening of the Last Futurist Exhibition of Painting 0.10, Olga Rozanova wrote that "all of Suprematism consists entirely of my collages, combinations of surfaces and lines, and discs (particularly discs), and are totally without a realistic subject." In *Amazons of the Avant-Garde*, John E. Bowlt and Matthew Drutt, Editors, London: Royal Academy, 1999, 326-7. Rozanova did a number of discs meant for tops. See P. Railing, *Alexandra Exter Paints*, October 2011, 100.
- [17] P. Railing, *Alexandra Exter Paints* [16], 99.
- [18] J. Tugenholt, *Alexandra Exter*, Berlin: Saria, 1922, 13 (French translation).
- [19] Alexandra Exter's disc paintings are discussed in P. Railing, *Alexandra Exter Paints* [16], 95-114.
- [20] A. Rodchenko, "Arts", *Anarkhia*, February 1919, in A. Rodchenko, *Experiments for the Future – Diaries, Essays, Letters, and Other Writings*, New York: The Museum of Modern Art, 2005, 84.
- [21] Ivan Kliun's palette for this group of works of 1917 was also spectral. He used "emerald green, viridian, red lake, vermilion, cobalt blue and lead white", according to Olga Fota and Maria Kokkori in "Colour and Light: A Technical Examination of Selected Paintings by Ivan Kliun, c. 1910-1925", *Light and Color in the Russian Avant-Garde, The Costakis Collection from the State Museum of Contemporary Art*, Thessaloniki, Cologne: Dumont, 2004, 481.
- [22] Aleksandr Rodchenko, *Experiments for the Future – Diaries, Essays, Letters, and Other Writings*. Edited and with a Preface by Alexander N. Lavrentiev. Translated and Annotated by Jamey Gambrell. With an Introduction by John E. Bowlt. New York: The Museum of Modern Art, 2005, 88.
- [23] See note 3.