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Short Communication
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Demonstration of Light and Shadow by Artworks

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Short Communication

Light is defined as the form of radiant energy that stimulates the organs of sight, having for normal human vision wavelengths ranging from about 3900 to 7700 angstroms and traveling at a speed of about 300,000 km per second. *Shadow*, on the other hand, is a dark shape on the ground or a wall caused by an object (or person, etc.) blocking the light. The shadow looks like the object and moves like it, but is not the object itself. According to Genesis chapter 1, God formed the light as been said: And God said, "Let there be light, and there was light. God saw that the light was good, and He separated the light from the darkness. God called the light day, and the *darkness* he called night". As seen, light and darkness are mentioned in Genesis, whereas shadow is not mentioned. This may be explained as follows. According to the definition of shadow, some object is required in order to block the light. However, this has not been created on the first day but only later.

In the following the models and history of *light* and shadow are presented. One of the models of light is based on nebular hypothesis, first proposed in 1755 by the great German philosopher Immanuel Kant (1724-1804). It may be described as follows. In the beginning it was dark and cold. There was no sun, no light, no earth, and no solar system, just the empty void of space. Then slowly, about 4.5 milliard years ago, a *swirling nebula*, a huge cloud of gas and dust was formed. Eventually this cloud contracted and grew into a mass that became our sun where through the process of thermonuclear hydrogen fusion the sun began to create light. Another

model is based on the Big Bang model suggested in 1948 by the physicist George Gamow (1904-1968).

According to this model, 13-14 milliard years ago, an explosion happened that began at a certain point in which the first light was created. An additional model for the origin of light was suggested in 2001 by the scientist Xiao-Gang Wen. He proposes that light is originated from certain quantum orders in our vacuum. In other words light can simply be a phenomenon of quantum coherence in a system with many degrees of freedom. Recently, at 2007, physicist professor Alan Kostelecky describes light as "a shimmering of ever-present vectors in empty space" and compares it to waves propagating across a field of grain. In recent research Kostelecky contends that light may be a direct result of small violations of relativity. Figures 1-4 demonstrates the light by artworks. Figure 1 by an unknown artist demonstrates surrealistically the "birth" of the sun where above it the authors "transplanted" a simulation of the Big Bang. Figure 2, by the Belgian surrealist artist Rene Magritte (1898-1967), demonstrates simultaneously day and night, light and darkness. Figure 3 was photographed by A. Tamir in the airport of Madrid. It demonstrates a camel that was created from design of lamps of different lights, which were lighted in rooms of buildings near the airport. Figure 4 is an artwork of the Dutch artist Rembrandt (1606-1669) that demonstrates light and darkness. Now a day it is accepted that light is either a wave or a particle, but not simultaneously.

Figure 1.

This phenomenon entitled the Duality of Light is demonstrated in Figures 5-7 and a concise history of it is the following. Throughout the nineteenth century the work of experimentalists such as Michael Faraday, Augustine Fresnel and Thomas Young showed beyond any doubt that light rays were made of waves. James Clerk Maxwell in the mid 1800's came up

with the equations that described the phenomenon of the so-called electromagnetic waves. The wave model is presented in Figure 7 photographed by Karl E. Deckart, German photographer. The figure demonstrates the result of interference when a light beam that behaves like a wave hits the surface of a soap bubble.

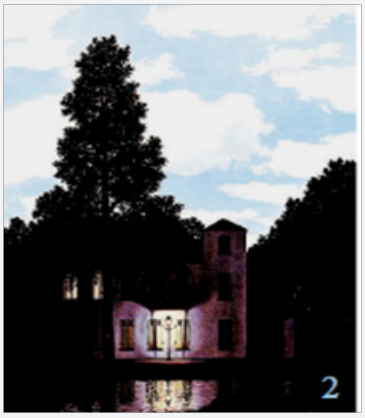

Figure 2.

Figure 3.

Figure 4.

As a result many colours are formed due to the spectrum of light. In 1905 Albert Einstein used the quantum of energy introduced in 1900 by Max Planck and provided a theory of light that departed from Maxwell wave interpretation. Einstein asserted mathematically that light was also made of particles, which would later be called photons, where in this case light moves in straight lines. Figure 5 by the scientific photographer Fritz Goro (1901-1986) demonstrates this situation. The lines, more or less, demonstrate the spectrum of light where the exact spectrum is shown by half of the circle "transplanted" by the authors on Goro's photograph. However, now a day the photon/wave duality of light is a fact of life in physics that is demonstrated in Figure 6 painted by Salvador Dali (1904-1989), a Spanish surrealist. Observing the artwork reveals once a face of a woman and once a flat, but not simultaneously, namely duality, and that similar to the behaviour of light.

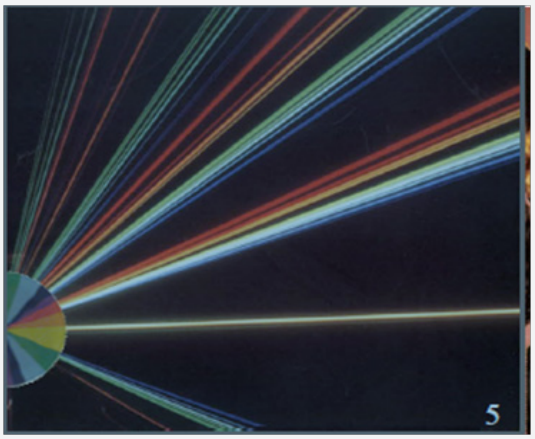

Figure 5.

Figure 6.

We will elaborate now on the phenomenon of shadow by the artworks in Figures 8-18. As indicated a shadow is a region of darkness where light is blocked. It occupies all of the space behind an opaque object with light in front of it. The cross section of a shadow is a two dimensional silhouette, or reverse projection of the object blocking the light. If the object is close to the light source, the shadow is large. The wider the light source, the more blurred the shadow.

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Figure 7.

Figure 8.

Figure 9.

The further the distance from the object blocking the light to the surface of projection, the larger is the silhouette. Figures 8-10 are fascinating artworks formed by the British artists Sue Webster (b.1967) and Tim Noble (b.1966) that demonstrate shadow art in a very creative way. Their artwork is made from piles of rubbish collected from London streets. A light is projected against the pile, and the shadow on the wall creates an entirely different image, in Figures 8 & 9 the couple themselves, that is not at all apparent from looking directly at the pile. Figure 10 is an image of the $ formed by lamps which creates its shadow image on the wall. Figure 11 is an interesting artwork in the sense that two sticks inclined at 450 with respect to the floor create four triangles with sides composed from the shadows.

Figure 10.

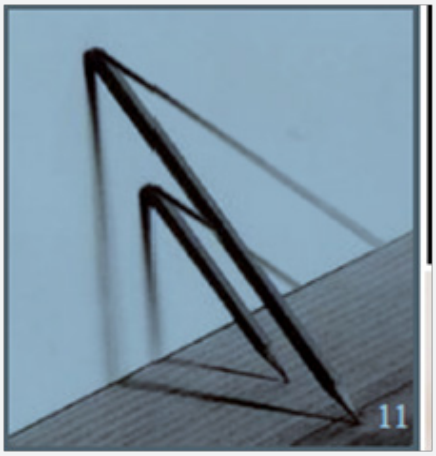

Figure 11.

Figure 12.

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Figure 13.

Figure 14.

Figure 15.

However, it should be noted that in the original artwork by an unknown artist only two rectangular isosceles triangles with two acute angles of 450 were reported. Surprisingly, when the authors carried out an experiment to verify the original artwork, the combination demonstrated in Figure 11 was obtained, namely two additional triangles were revealed in each of which one side was the line formed between the floor and the wall.

Figure 12 was photographed by the Israeli photographer Gilad Benari where below Figure 11 is a shadow self portrait of the American artist Julian Schnabel (1951). Figures 13-16 are nice shadow artworks by unknown artist where Figure 17 entitled "Grandpa" has been painted by the British artist and sculptor Henry Bursell (1793-?).

Figure 16.

Figure 17.

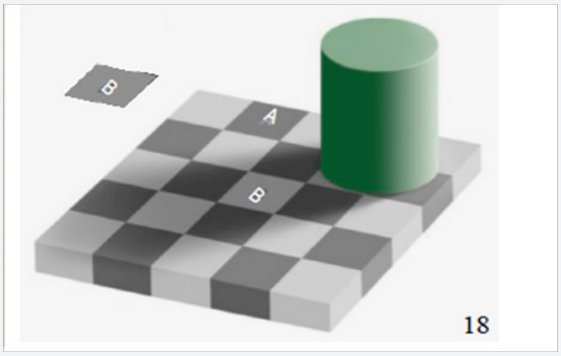

Figure 18.

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His artwork is characterised by different kind of images formed by hand shadows thrown on walls. And finally Figure 18 entitled "The Checker board Shadow Illusion" developed in 1995 by the Professor of Vision Science Edward H. Adelson, an American. It is an attractive and interesting demonstration of the effect of shadow showing how the same thing can differently be seen and how the background has an influence on the colour of the squares. As one can see, the green "column" creates shadow on part of the big square composed of black and white small squares. In addition, the small square in the center, which is designated by B, has a gray colour caused by the shadow; moreover, its colour is significantly different from the colour of square A. Using PhotoShop, the square B was taken out and was located in the white background. Surprisingly its colour changed and became the same as the colour of square A. Adelson gives no explanation to……

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