

Introduction

In everyday life light is something we take for granted. We know that after night, the next day comes with its daylight. The natural rhythm and relationship between light and darkness, between the scorching hot sun and dark summer shadows, between softer contrasts in all other seasons, between moonlight on the surface of water and darkness of the night, the relationship between sunlight in the crystals of a snowy landscape and its dark blue shadows, and between all colours and shadows in a landscape or a town during a day or a night, is not merely a constant occurrence day after day and night after night. The natural rhythm of light and darkness has a calming effect on us, and in relation with us it anchors us in space. Transitions create an awareness of the beginning and end of the day, crowning both with colourful shades of light and shadow across the entire visible spectrum. The transitions are slow – in a slow flow they build up the tension of a turning point, as darkness flows into light and light back into darkness. Our lives are more or less keeping pace with this rhythm without much questioning what is light.

What is light, anyway?

A quick look in some language dictionaries would tell us that there are two different explanations. One is scientific and explains the physical phenomena, the other is symbolic.

The scientific explanation is based on knowledge about the world. The question what light is, is perhaps as old as the old-

est civilizations. In his *Theogony*, Hesiod¹, who was an approximate contemporary of Homer, claimed that cosmogony started with Chaos. Everything was already contained in Chaos, all the potentials and all of the archetypes for everything that constitutes the universe. From Chaos were born the personified darkness and night, named Erebus and Nyx. They became the parents of Aether (Ether) and Hemera, the bright sky and day. Light was conceived by darkness!

Isn't the Big Bang, an explosion in the midst of darkness, which happened 14 billion years ago as claimed by modern physics, a dramatic emergence of light in a way similar to the events in Greek cosmogony? Light dramatically broke out of darkness. In Hesiod's time, the event already lost its dramatic character and softened into personified siblings. Anyway, in ancient cosmology and in modern physics, light and darkness are intrinsically connected, though they are two opposites. In Hesiod's *Theogony*, they are entities with their own names and characteristics.

Modern science goes much deeper. Albert Einstein discovered that light is made up of small grains, particles of light, and he named them *photons*². He also claimed that the energy of light is not continuously distributed in space. This was also later proven by quantum mechanics. A quantum field makes up light only in an

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- 1 '[. . .] First there was Chaos, then broad-chested Gaia, the steadfast seat of all immortals who live upon the snowy peaks of Olympus, then murky Tartarus in the depths of the wide earth, and Eros, most beautiful of the immortal gods, who weakens the limbs and overwhelms the minds and wise counsel in the breasts of all gods and humans. Chaos gave birth to Erebus and black Nix, and from Nyx came Aether and Hemera, conceived after Nyx joined in love with Erebus. [. . .]' Hesiod, *Theogony*, <https://ia803408.us.archive.org/14/items/hesiods-theogony-translated-by-michael-heumann/Hesiod%20Theogony%20-%20Translated%20by%20Michael%20Heumann.pdf>.
 - 2 Rovelli, Carlo, *Reality Is Not What It Seems*, [*La realtà non è come ci appare*, Raffaello Cortina Editore SpA, 2014], UK, Penguin Random House, 2017, p. 92 – 94.

interaction. It is an event on a junction point of interaction where light is born. An interaction of two entities. Of Erebos and Nyx?

Rovelli, the new Hawking, as he was named by *The Times*, in his many books, but we will refer to the book, *Reality Is Not What It Seems*³, luminously explains the contemporary scientific knowledge of modern physics. According to quantum mechanics, the events of nature are always interactions between physical systems. The world is made of quantum fields, so-called *covariant quantum fields*. All variable objects exist only in relation to other objects. Erebos and Nyx could be understood as two interacting fields, or two particles of the same field interacting with each other because, as Rovelli claims, reality is relational⁴, that is to say, a physical system manifests itself only by interacting with another system. It is possible that this is true for all scales, very small and very large. The events are not predictable. They are undetermined. We can imagine undetermined processes and events in the midst of the ancient cosmogonic Chaos. It is possible that Erebos and Nyx met by chance or by their specific attraction. The regularities we see, as quantum physics proves, are ultimately statistical. But, Erebos and Nyx meeting each other or maybe colliding into each other, created Bright Sky and Day. Darkness and Night created Light.

Aether and Hemera are the result of the interaction of Erebos and Nyx. Quantum physics says that the world is a sequence of granular quantum events, which are individual interactions of one physical system with another. Light is formed by *quanta*, that is by parcels of energy of a field only when the granular structure of the field interacts! In other words, the light's properties manifest in granular manner only in the moment of interaction. Small grains, or particles of light named *photons* then exist in space. But, the most interesting is the fact that they do not follow

3 Rovelli, Carlo, *ibid*.

4 Rovelli Carlo, *ibid.*, p. 115.

a trajectory in space, but appear in a given place and at a given time only when colliding with something else. Light manifests itself only by interacting with something else.⁵ We would have a black sky, as is the case on the moon if the sunlight doesn't hit the Earth's atmosphere.

The other understanding of light is symbolical. I assume that the symbolism of the Western world has roots in the classical Greek understanding of the world, which is expressed in Greek mythology. Greek cosmogony was a long and sometimes brutal process. It was Zeus, the son of Kronos, who seemingly created order after dramatic cosmic events. His Olympic family became a symbol for culture and civilization opposed to the previous barbarism and chaos. But even Zeus had his shadowy side. He was constantly cheating on his wife Hera. Leto, the goddess of motherhood, childbirth, and modesty, gave birth to his son Apollo.

Apollo became the god of wisdom and truth, of healing and prophecy, and he protected all nine Muses, and so he was also the god of poetry, music, and dance. He protected the human world from evil, and a bit later also became the god of Sun and Light, very similar to ancient Egyptian god Ra. Apollo was the most beautiful Olympic god and ideal *kuros*. Most probably the contemporary symbolism of light has roots in Apollo's characteristics and duties. Language dictionaries explain the metaphorical meaning of light as knowledge and victory over darkness, also connected to wisdom, truth, and beauty.

The etymologic aspect of light is also very interesting. The ancient Greek *λευκός* (white, blank, light, bright, clear) and *lúkē* (light, morning twilight), and Latin *lux* influenced Romanic and Germanic languages, and the word *light* in all its versions from *la lumière* to *luz*, *leggero*, *lys*, *ljus*, *licht*, etc. is metaphorically rooted in Apollo's characteristics. Meanwhile, the first syllable (sometimes the first two syllables) of almost all Slavic words for light (*svet-*,

5 Rovelli Carlo, *ibid.*, p. 117.

svijet-, *svět*-, *świat*-etc.) means *world*. The exception is Russian where the word for world is *МИР*, meaning in some other Slavic languages *peace*. In all Slavic languages, the same first syllable, sometimes with minor changes, also makes the word for *holy*.

This short analysis touches only European languages, as we presume that the Greek civilization is the cradle of the Western world. Still, there is no doubt that sunlight has meant survival for all known civilizations, and was metaphorically connected to everything that supports survival. In the case of the Western world, light is connected to wisdom, truth, health, culture, beauty, life in the world, and its holiness. It is connected to the basics which support human survival.

Darkness and shadow vs. light

Conversely, opposite to light but intrinsically connected to it, darkness is a synonym for death. It was the case in ancient Egypt and also ancient Greece. In Egypt, darkness is personified in Set, the murderer of his own brother Osiris, in Kek and Kekut, the couple of the principle of darkness, and in the belief that Sun dies behind the Western mountains every evening and goes into the underworld to be born again next morning. Ancient Greeks understood the underworld similarly. The Greek Hades, the god of death is the ruler of the underworld, which is named Hades after him. Metaphorically, darkness is a state of the atmosphere in the absence of light, connected to death. Symbolically it is a mental state of indecision and despair, and it is a state in which freedom, progress, and critical thinking are prevented or even forbidden, as we can read in language dictionaries.

Scientists already know some facts about *black holes*, but they admit that they don't know much about *dark matter*. It cannot be detected by the radiation it emits, but it has a gravitational effect on visible matter. And there is much more invisible, dark matter

than visible matter.⁶ That is why, despite the efforts of physicists, astrophysicists, and mathematicians to explain the universe, we are still left with uncertainties that challenge not only physics and other natural sciences, but also the humanities and arts.

Also, psychology and psychoanalysis have raised a question about darkness and shadow. They have found it in the human psyche. Robert A. Johnson, a disciple of Carl Gustav Jung, in his book *Owning Your Own Shadow*⁷, tells us that the more prosperous a society is, the more shadow it produces. There is no light without darkness teaches Taoism.⁸ Yet, as Johnson claims, the only solution for this drama is a cognition of the dark side. The cognition has a bouncing effect: in the moment of the cognition, we get “enlightened.” The darkness fades away. Everyday life caught in all sorts of relationships, cast shadows. We might only find beauty in the cognition if these shadows become recognized despite the fact that they are causing drama or even because of it. Light creates the magic of the visible, but in such a way that the visible is only recognizable through shadows. It is not until the shadows become visible that everything that moves within, and the space around us becomes visible as well.

Reality is relational

However, light is just seemingly cut out of darkness. Evidently it emanates from its own source. This happens when the granular structure of the quantum field interacts and makes up light. Here we come back to the inspiring book of Rovelli⁹: *photons* are born

6 Rovelli, Carlo, *Sedem kratkih lekcij iz fizike* [Sette brevi lezioni di fisica, Milano, Adelphi edizioni s. p. a., 2014], Ljubljana, DMFA, 2016.

7 Johnson, Robert A., *Owning Your Own Shadow*, San Francisco, Harper San Francisco, [1991] 1993.

8 6th BCE, after Laozi, also known as Lao Tse or Lao Tzu, “the Old Master”.

9 Rovelli, Carlo., *Reality Is Not What It Seems*, UK, Penguin Random House, 2017.

in the interactions. It is only in interactions that nature draws the world, as he says poetically, and also that there is no other reality except the one of the relations between physical systems. Reality is relational, and the relational aspect of it is universal. The world of existent things is only a realm of possible interactions between particles (or between fields). It is a sequence of granular quantum events. The events are individual interactions of one physical system with another. It is only in interaction that physical systems manifest themselves. Similarly, as electrons do not always exist, they exist only when they interact. In a moment of collision with something else they materialize in a place. And this event is not determined in advance. There is a cloud of possibilities of how it will take place and materialize.¹⁰

In this sense, we take a look at the interactions between light and physical objects. As Rovelli beautifully says, light arrives in the form of grains of energy, it has granular structure, and falls on a surface like a gentle hail shower.¹¹ What happens then, when it touches a surface? There is no usual answer. There is no predictable event. Nothing is determined. Each event is different, unique. This is also true for man-made objects, also for sculpture and architecture: two physical systems colliding and interacting, light and man-made surfaces. What happens in artwork depends on individual piece of art. In the relation between light and artwork, we get stories, great thoughts, and astonishing experiences. In this text, we observe four of them: László Moholy-Nagy's, *Das Lichtrequisit* (hereafter: the *Light-Space-Modulator*), Daniel Libeskind's, *Der Holocaust Turm* (hereafter: *The Holocaust Tower*), Senenmut's *Temple of Queen Hatshepsut*, and Aalto's, *Studio Aalto* in Helsinki. They are not depicted purely by chance. Observations are based on beautiful physical facts taken from Rovelli's book¹², as follows:

10 Rovelli, Carlo, *ibid.*, p. 161.

11 Rovelli, Carlo, *ibid.*, p. 95.

12 Rovelli, Carlo, *ibid.*

- Reality is relational. The relational aspect of it is universal.
- A physical system manifests itself only by interacting with another physical system. What happens then when it interacts with light?
- Light manifests itself only by interacting with something else. In this process, results are reciprocal. A manifestation of a physical system depends on another physical system when interacting and vice versa.
- There is a cloud of possibilities of how something will take place and materialize, how a collision of light and an object manifest a physical materialization of both, or a metaphorical story.

In the following text, I am inviting you to observe how light manifests itself while touching and interacting with surfaces of the artworks, while falling on a surface *like a gentle hail shower*, as Rovelli poetically says. We will also try to understand how the masterpieces manifest themselves when interacting with light, and what is the relation between light and the artwork. We need to be aware, as quantum physics proves, that for each solution in space there is a cloud of possibilities. Masterworks are materialized through an artist, through his or her ideas, thoughts, and emotions, and through his or her inner light and shadows, while dealing with the interaction of light and matter. Therefore, each piece of art is unique and unrepeatable. In analysing them, we will not be able to avoid to see the metaphorical meanings and the symbolic use of light while we are observing forms.

In Moholy-Nagy's *Light-Space-Modulator*, light interacts with the surfaces of moving sculpture. The result is moving photographs built up by moving shadows and moving cast and reflected light forms. It is a drama of seemingly playful shadows and light reminding us of everyday human shadows and also light moments that we create throughout our lives.

When there is too much shadow and darkness accumulated, and light is cut off in a society, we confront the dark side of the humankind, which is expressed in all kinds of aggression, wars, and other humiliations. Libeskind's *Holocaust Tower* is a timeless and universal symbol of the worst horrors which are still and again present in our contemporary time. It happens when darkness prevails and light is too weak. If in a society light in relation to darkness is too weak, we witness the most horrible evil we, human beings, are able to perform.

It seems the Egyptian Queen Hatshepsut was aware of how important light is, especially in the period of a year when it was diminishing. Through the magic in her temple, she performed light every year when sunlight was at the lowest point. The moments of magical light consoled her subjects and established her power at the same time.

However, in democratic societies we don't believe in artificial miracles. We do not need such populisms anymore. Aalto proved once again with his *Studio Aalto* in Helsinki that we architects can work with sunlight, that we can cooperate with it also in such a manner that sunlight and architecture manifest themselves together, and at the same time in the best possible form, in a certain place and time, for people. He has created architecture in relation to sunlight, place, nature, and people, considering that all the entities interact with each other. But in the case of *Studio Aalto*, it was mainly the relation to sunlight and the interaction with it that made the forms of the Aalto's masterpiece of art. It was through cooperation with sunlight that Aalto shaped the forms of his studio.



Fig. 1.1: paper model of micro natural structures and photo:

Tatjana Capuder Vidmar

From the exhibition SPACE = LIGHT + (SHADOW), DLUL, Ljubljana,
2024



*Fig. 1.2: paper model of micro natural structures and photo:
Tatjana Capuder Vidmar*

From the exhibition SPACE = LIGHT + (SHADDOW), DLUL, Ljubljana,
2024



Fig. 1.3: paper model of micro natural structures and photo:

Tatjana Capuder Vidmar

From the exhibition *SPACE = LIGHT + (SHADOW)*, DLUL, Ljubljana,
2024

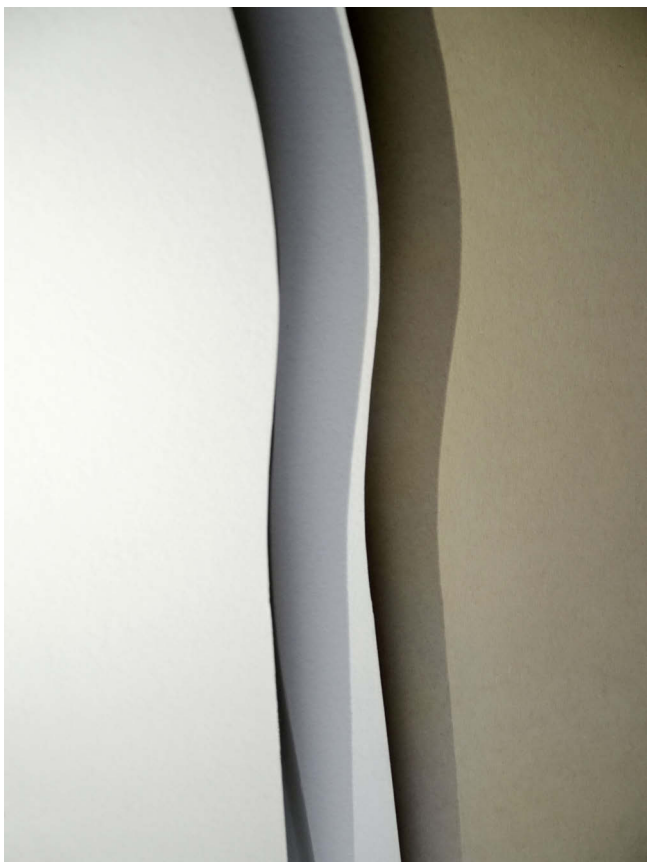


Fig. 1.4: paper model of micro natural structures and photo:

Tatjana Capuder Vidmar

From the exhibition SPACE = LIGHT + (SHADDOW), DLUL, Ljubljana,
2024



Fig. 1.5: paper model of micro natural structures and photo:

Tatjana Capuder Vidmar

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2024



*Fig. 1.6: paper model of micro natural structures and photo:
Tatjana Capuder Vidmar*

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Fig. 1.7: paper model of micro natural structures and photo:

Tatjana Capuder Vidmar

From the exhibition SPACE = LIGHT + (SHADDOW), DLUL, Ljubljana,
2024



*Fig. 1.8: paper model of micro natural structures and photo:
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