Colorography

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Vienna, 2021

Written component master thesis
Submitted in partial fulfilment of the requirements for the degree of Master of Arts (MA) University of Applied Arts Vienna, Institute of Fine Arts and Media

Program number: S 066 776
Study program: Art & Science
Supervisor: Virgil Widrich

Universität für angewandte Kunst

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INTRODUCTION

This text is a collection of experiences, stories, thought experiments, images, and observations, that in some ways, structure my work. Color is everywhere, it defines our reality. I find it fascinating how many fields of knowledge this topic touches. We can consider wavelength and frequency, focus on the eye's anatomy, talk about the color wheel, the density of oil paint, or the emotions that it triggers. They are all aspects of the same thing with the same importance, entwined into each other, but that are separated into different fields of knowledge. Color is a place where each discipline has something to say to the other, and where there is the potential to strengthen the overlapping rather than the separation of fields. The discipline of Art and Science is for me a way to answer to this necessity of transdisciplinarity: a hybrid window that supports new ways of seeing.

I want to consider color as a living fluid system, as an environmental factor, and habitat. Through color, I want to bring attention to human and non-human vision and perception, to different ways of life, to its necessity as a matter of life and survival. I will focus my attention on water-based environments and their hue.

The structure of the text will follow my annotations *Possible ways to catch the color (alive)*, and like in a river thoughts will follow unpredictably. For this reason none of the arguments treated is deepened as it would be in a text entirely dedicated to it. So much has been already written and done about color and still so much of it is a mystery. Color is my practice, my way of seeing and navigating through the days.

1. HOW WE MET

Our first encounter happened many years ago, I was a young painting student and I was traveling for the first time to Slovenia. I arrived at Gorizia's train station. Normally I enjoy lingering and looking around when I come to a new place, but this time I didn't care. I was too excited about crossing the border to pay attention. The car ride was on its own an adventure, my eyes thirsty for new experience devoured every frame of the running landscape. It was autumn and I can still distinctly remember the intense dark yellow of the deciduous all lined up on the sidewalk. Some time later, I took the same path and was very surprised to realize how short the ride was. The day we met I was walking in the woods, it was early afternoon and I can recall a slight scent of burned wood. I heard the sparkling sound of water and walked towards it, just behind the trees, it was there, flowing. I expected to find a small creek, but instead I found myself in front of a river, quite calm, at least at that point. It had the most astonishing color that I have ever seen. It was a splendid and saturated aquamarine, very intense, and a bit murky. It stood out from the rest of the landscape in an overbearing manner. It was beautiful, shameless, and proud. This is how we met, Isonzo and I. I came back a few times and from each one of them I remember the awe. But time passed and its color faded from my eyes into a dull grey, until a few years later when I coincidentally visited Nova Gorica again and its vivid emerald repainted my memories.

This time I knew I had to do something. I could not leave without a little piece of that emerald green, I had to take it with me. So I started my research, trying to figure out how to extract the color from the river Isonzo.

Fig. 1: Digital sketch of the Isonzo. Artwork of the author, 2021.

It is not easy for an artist to live up to the expectations that the use of the word *research* has. The artistic community borrowed this word from the scientific universe in the last few decades and started to use it extensively to define its own practice. Research is, in science, a method to obtain answers, an unquestionable instrument cautiously secured in the pocket of every scientist. For this reason the world *research* enters the art field already loaded with this meaning; it is a finger that points decisively to the word results, creating expectation of evaluable progress, or whatever kind of loud newness. This still leaves many minds confused. It seems to be a dissonant association that makes people feel legitimized to question its use in the art field.

On this matter I very much resonate with what Tim Ingold writes in his essay *Art, Science and the meaning of Research*. In the text he talks about a symposium that he attended in Turin about perception and exploration, where hill walkers, artists and a famous mountaineer confronted their visions on the topic. While the artists and hill walkers showed enthusiasm about their exploration, the mountaineer denied its existence. He claimed that all the peaks have been conquered, and there is no mountain left to discover. For him the Earth was a "Terra *incognita*, already laid out in perpetuity and awaiting for the footprint of man" (Ingold, 2018, 32). In the mountaineer's vision the last step on the mountain peak would immediately transport the whole mountain in the domain of the known, adding a check on the list of things to conquer. Little would it matter to him if the same peak had already been walked by generations of indigenous people, who didn't have the urge neither to *conquer it* nor to *brag about it*. In the mountaineer's view nothing new comes from walking the same path again; it is just a useless act that does not add any value to the discovery. On the opposite side of the spectrum the artists and hill walkers acknowledge that every walk is different, they recognize in every walk an opportunity to participate in the experience of a collective, and ever changing life. "A particular going along together of human lives with the lives of plants and animals, with the formation of rocks and stones, with the weather and with the hills themselves" (Ingold, 2018, 32). The idea that something experienced once becomes conquered is absolutely not acceptable for the hillwalkers and the artists.

"If research is not simply to be an instrument of colonization, of closing down the world for future generations, [...] then we have no alternative but to join *with its* human and non-human inhabitants, in the collective task of keeping life going" (Ingold, 2018, 32).

For them the word research means *to look twice*, a *second search* necessary to be part of a world that is not still and finite but mutable and in constant change. In this sense research "It is rather a way of living curiously - that is, with care and attention. And as such, it pervades

everything you do” (Ingold, 2018, 32). Research is a practice of caring for things that might be overlooked in the everyday colonialist view of the world.

A few years ago I had the opportunity to visit the CERN particle accelerator of Geneva, and to meet and talk with some of the scientists and experts working there. I remember still today the sparkle in the eyes that they all shared, and the words of a casual conversation that happened near the Antimatter Factory: it was about the necessity of doing useless stuff and how for being functional a society should always have a certain number of people working on something useless; after all, you never know what you might need or what you could find. In a way, he was sharing the hill walkers position, and looking at the mountaineer’s point of view, the more common point of view. We often fail to see or consider the process rather than the arrival point; we get scared of it and often hide the real value of practice in the word *useless*. In a consumerist society nobody wants to waste time and re-discover something already known.

I also believe that the word *useless* has to be understood for it's more literal meaning, as something that has no use yet, but that has *potential* and indicates the way to a process rather than to a result. In these terms and with those meanings, in the following pages I want to share my experience and my useless research about color.

Fig. 2: Isonzo from above

"This is the Isonzo.
And it is there I
Most see myself
In the universe
A compliant
Thread."

(Ungaretti, Rivers)[1]

Isonzo or Soča is a river that flows from western Slovenia to northeast Italy. Its source is located in the Julian Alps, west of Triglav. The spring is located at an altitude of 867m above the sea level. The mouth goes into the Adriatic Sea, near the city of Monfalcone. The river Isonzo has a total length of 138 km and it is thought to be one of the few rivers in the world with an emerald green color consistent throughout all its length.

I find this river fascinating, not just for its color but also for its position. Just at the edge of Nova Gorica it crosses the border between Slovenia and Italy. This point is particularly interesting to me because different values of the word border overlap. On one hand, the geopolitical imaginary line that separates Slovenia from Italy cuts through the water of Isonzo, on the other hand is the river itself as a natural border, very visible and not so much imaginary.

The river has two names: Soča in Slovenian and Isonzo in Italian. It is the invisible division that gives it its double identity. The two names make the geopolitical border stronger without caring for the identity of the river being cut in half. It becomes a landscape accessory subjugated by the rules of humans.

In the collective imagination, a river is a metaphor for freedom and mutability, it is something that flows freely and always changes, it does not know of any borders different from its own margins, but the reality is quite different.

[1] Giuseppe Ungaretti was an Italian poet who took part and survived WWI. With his *hermetic* verses deeply marked the panorama of Italian poetry of the XX century

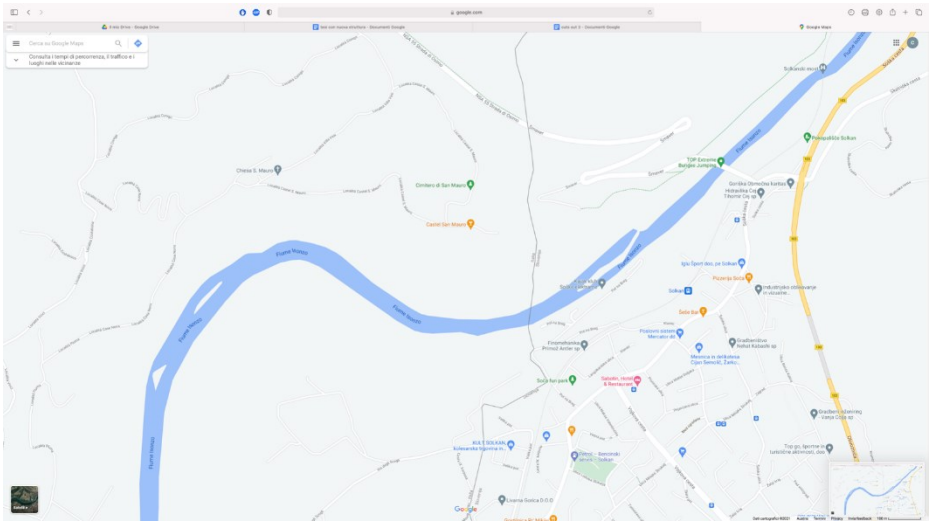


Fig. 3: Isonzo from above, the geopolitical border

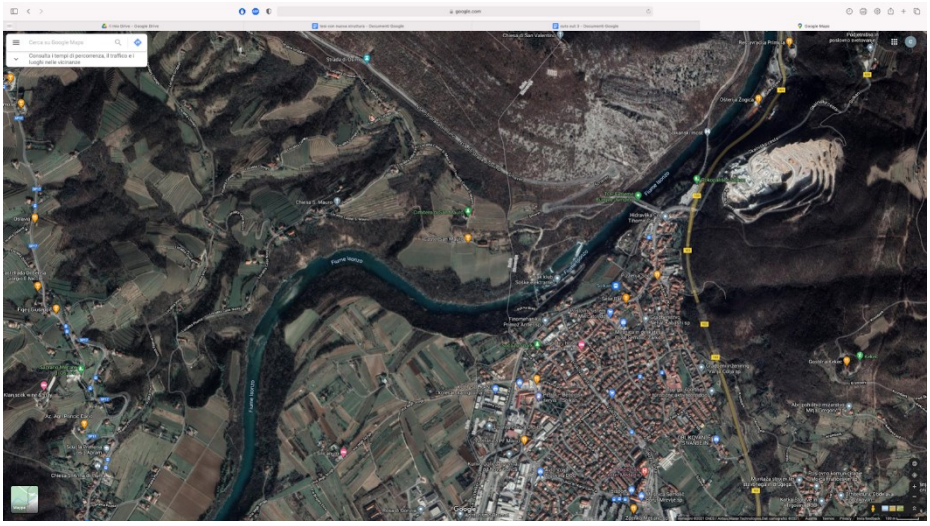


Fig. 4: Isonzo from above, the natural border

Although we are still far from having fully achieved an equilibrium between human and non-human, a lot has already been done. The most outstanding accomplishment is the *Universal Declaration of River Rights* that recognizes the *legal personhood* of rivers, making them entitled to legal representation in court. It also establishes that rivers shall possess the following fundamental rights:

1. THE RIGHT TO FLOW
2. THE RIGHT TO PERFORM ESSENTIAL FUNCTIONS WITHIN ITS ECOSYSTEM
3. THE RIGHT TO BE FREE FROM POLLUTION
4. THE RIGHT TO FEED AND BE FED BY SUSTAINABLE AQUIFERS

5. THE RIGHT TO NATIVE BIODIVERSITY

6. THE RIGHT TO REGENERATION AND RESTORATION

7. THE RIGHT TO MAINTAIN LATERAL AND LONGITUDINAL CONNECTIVITY

(Earth Law Center, 2021).

The idea of attributing civil rights to nature was first discussed in the 70's by Christopher D. Stone who published the book titled *Should Trees Have Standing?*
A few decades were necessary to turn this thought into practice and in 2006, Tamaqua Borough, a small city in Pennsylvania, recognized rights to nature within its territory. Since 2008 Ecuador's constitution gives nature integral respect for its existence. In 2017 the Whanganui River in Australia obtained fundamental rights and legal standing.

Giving civil rights to a river means introducing it into our system made of invisible borders to recognize it, to take care of it and give to it the possibility of being entitled to its own space. It is a process for us, to re-learn how to see nature.

Fig. 5: The mouth of the Isonzo into the Adriatic sea

"It stood out from the rest of the landscape in an overbearing manner. It was beautiful, shameless, and proud".[2]

There is another kind of border that I did not mention; it is color.

[2] My personal note from the day I first met the Isonzo.

Color has the property to give a sense of unity to what we observe, it helps us to understand shapes with clarity. It creates contrasts that make us recognize shapes better. This happens also if color is not constant, if it fluctuates; in *The Problems of Philosophy,* Bertrand Russell writes “Although I believe that the table is *really* of the same colour all over, the parts that reflect the light look much brighter than the other parts, and some parts look white because of reflected light. I know that, if I move, the parts that reflect the light will be different, so that the apparent distribution of colours on the table will change. It follows if several people are looking at the table at the same moment, no two of them will see exactly the same distribution of colours” (Russell,1980, 2)

So far in this research I realized that I put myself in a lot of trouble. How is it possible to extract a color if it fluctuates all the time? Let's not talk about the problem of the water in itself, because it is *transparent,* and nevermind the fact that everyone sees a different emerald green from mine. I needed a plan, so I took a pen and paper and started to think of different possible ways to extract the color from the Isonzo.

POSSIBLE WAYS TO CATCH THE COLOR (alive):

- stare at it
- with a glass
- with a very fine sieve
- with a very old sieve
- collect samples in the shadow
- collect samples in the light
- drink it
- squeeze it
- close your eyes
- open them to see if it is still there
- measure it
- try with a sponge
- throw a stone into it and dry the drops
- let it evaporate and condense it
- take a picture
- take a mirror and reflect the color out
- try with a jar
- try with a bigger jar
- look at it from above
- Look at it upside down

- Look at it from inside
- make pigments from the stones
- make pigments from the algaes
- make pigments from the air
- dry it
- think about the past
- think about the future
- try with your hands
- with a brush
- ask someone where the gold is
- steal their sieve
- try with that one
- take a sample and mix it with glue
- take a sample and mix it with alcohol
- take a fish and try to extract the color from it
- make pigments from the bacteria
- catch the bacteria
- make them grow to see if they have a color
- call it by a new name
- check if it answers
- let the fish go
- breathe
- separate all its components
- put them back
- use a mixer
- go for a swim

2. STARE AT IT

I was there, looking at it flowing.

I find the act of *looking* to be a very personal experience, there are at least as many ways to look at things as there are eyes, if not more. And we are not even considering the *attitude*, because that changes everything.

We can look, stare, see, observe, gaze, check out, glimpse, watch, and view.
Of all these ways to see, only the observation is considered to be part of the scientific method. Observation allows the researcher to study a phenomena in its own environment, to spend time in the field and collect data by using all their senses. But here, I want to refer to observation more for its etymological meaning, it comes from the Latin *ob-servare*, where *ob* stands for forward, ahead and *servare* means to guard. Contained in it there is the idea of defence, of taking care of something.
I want to allude to it as an instrument to learn how to care what we gaze upon.
Throughout this text I want to look carefully, to see, to understand and to become aware, but also to close my eyes, because abstract concepts and emotions cannot neither be seen nor looked at, but they can be observed. To me it is important to bear this in mind because when we talk about color there is more than meets the eye: it goes behind vision.

Aquamarine is not a common color for water to be, neither is it the strangest.
If you have ever been by the sea it would be easy to recall how fast its color can change. Sometimes after a big storm you can notice how much deeper the hue is and maybe just a few hours later it turns more green or greyish. If we don't consider the meteorological factor, color in water varies mostly due to particles suspended in water that can change its scattering or absorption. These particles are known as Colour Dissolved Organic Matter (CDOM). One of the most common and diffused CDOM are cells of phytoplankton also known as algae. Those little floating cells absorb red and blue light, so that the water with high concentration of chlorophyll from the algae will appear more greenish.

A wide range of bacteria is also responsible for determining water coloration, some of them which can be quite unexpected.

Fig. 6: Lake Hillier, Australia

Fig. 7: Salina de Torrevieja, Spain

The salty lake Hillier in Australia and the Salina de Torrevieja in Spain owe to the bacteria *Archaea Halobacterium cutirubrum* and to its combination with the algae Dunaliella salina their strong pink coloration. *Dunaliella* produces a lot of carotenoid pigment, that is used to coat the chlorophyll with a sun resistant layer.

In environments with a relatively small depth like lakes and rivers, the composition of their bed stones also contributes in the making of the river color by influencing the overall coloration. For instance the water of the Isonzo contains a high amount of limestone that paints the whole river as a white glaze.
Color is the resultant of an ecosystem made from the interaction and relation between different elements:

Light

Bacteria

Algae

Stones

With this in mind, I have collected some samples from the river.

Fig. 8: Two different kinds of algae from the Isonzo

Fig. 9: A stone from the river bed

I tried with a glass, and took some transparent water home with me, alongside some different kinds of algae picked at different depths, some stones from the river bed, little insects that were accidentally trapped in my jar, a very small river snail that was hanging out on the algae, and all the bacteria and little organisms that my bare eyes were not able to see. I also saw some little fish but I did not manage to catch any, they were way too agile and I did not have a fishing net with me.

I heard that in the Isonzo there is an autochthonous kind of trout that just exists there called *Salmo Marmoratus*. The species is named *Marmoratus* due to a marble-like pattern on its sides. Each fish pattern is unique and the intensity of the motif's color varies depending on the surroundings. Some fishes even have red spots organized in a horizontal line. I did not meet any of these individuals, maybe because they recently became endangered due to the introduction of non-autochthonous species in their ecosystem, but maybe I just had bad luck.

The ability of this fish to adapt to its surroundings made me reflect on the role of color in nature. Colors are literally everywhere, and they shape our reality for us. They can be very different from each other and have various purposes. Feeding, communicating, reproducing, hiding, and warning are often achieved or facilitated thanks to specific patterns, or colors, that evolved to ensure a better survival of the species.

Color in nature is a matter of necessity and survival. A good example is given to us by plants: in the book *Plant Anatomy* the authors explain very clearly how the plants possess interesting sets of pigments, each one of them with a different specific function, among them there is of course the chlorophyll. This light-trapping pigment allows plants to create their

own nutrients, through a process known as photosynthesis. They can themselves produce carbohydrates, necessary for their growth. This ability makes plants very independent in feeding, and differently from us they just need, aside from light, water and minerals that they can collect from the soil.

Another pigment present in plants is the *phytochrome* that is used to measure the duration of the night. This information can be stored for a few days and used by the plant to understand the period of the year. If the night was shorter than the previous one, spring is approaching, but if the night was longer, winter is coming. The plant uses this information to know when to flower (Crang, Lyons-Sobaski, and Wise 2018, 5-6).

Colors evolved and are evolving for survival and subsistence purposes[3]. Sometimes so, in ways that are far from our perception or understanding. In fact, just in recent years the technological development of instruments such as UV cameras allowed us to augment our perception and to tackle other points of view in nature.

Some plants and flowers evolved patterns that go into UV light that escape from our sight but are clear and visible signals to pollinators like bees, and birds that can see them, recognize them, and follow them.
The ability of the plant to develop a pattern visible for its pollinators is a form of coevolution, a tight interaction between the interested species is sealed into their genetics, a way of living near each other that shapes the aspect of them both.

Fig. 10: On the left: Flowers illuminated from sunlight.
On the right: The same flowers illuminated with UV light.

[3] The corals are bleaching due to global warming and ocean acidification. Some bleached corals are reacting by developing a fluorescent color coating that makes them more resistant to the increased temperatures. Although the corals are adapting it might not be fast enough to prevent their extinction.

The examples are really countless, like the case of tigers and deer. These felines feed principally on deer, which partly explains their mantle and color. Tigers have a pattern that breaks down their shape and allows them to hide very efficiently in the high grass. Why aren't they green if the whole point is to be mimetic? It is chemically impossible for big mammals to produce the color green, but nature used a loophole in the perception of deer to make tigers almost invisible. Deer do not have red color receptors and to them the orange mantle of a tiger looks green.

Fig. 11: A tiger seen from the deer's eye

There is still so much to discover about the color perception in non-humans. Each pair of eyes is linked to a different way to see, a completely different reality, and of course in each one of them the observer is the main actor.

Therefore, I would like to invite you to take a moment:

to close your eyes

and try to imagine what it would be like to be a bee

and to land
on an amazingly UV lit airstrip

or to be our *Salmo Marmoratus*

swimming in the aquamarine of the Isonzo

try to imagine your surrounding
How does it look to you?

Which color can you see?

Or again you can imagine being your dog
or your cat

that walks on the rooftops during the night
and sees effortlessly every
mouse

You can imagine whatever animal you like

take a moment to use your imagination

It doesn't matter if it is realistic or not.
What matters is that you have a glimpse

of the immense possibilities

that are hidden in every single kind of perception

Then go back to yourself

open your eyes

and appreciate your reality.

3. MEASURE IT

“No matter how brilliant the day, if we lack the formative, artistic power of imagination, we become blind, both figuratively and literally. We need a light within as well as daylight without for vision: poetic or scientific, sublime or common”
(Zajonc 1995, 12).

To understand the river’s hue, I felt the necessity to compare it with other colors, to find a scale, and to be able to keep track of its changes and development under different conditions. A scale gives a context, creates a beginning and an ending point, it is necessary for any kind of quantitative measurement.

As Artur Zajonic writes in his book *Catching the Light*: “Sight like hearing requires a modulated and crafted form of light for meaning. Stabilize images perfectly on the retina and they disappear. This is a fact of sense psychology. We see only change, movement, life” (Zajonc 1995, 107).

M. Chirimuuta in her book *Outside Color* describes how during the scientific revolution, fundamental reality starts to be described in pure numerical form, and the natural world turns into stuff to measure. The interest starts to verge to specific qualities of our reality so that it: “Can be measured or mathematically defined, and entirely encapsulated within some mathematical system. Physical objects are understood to have mass, length, and motion, while the status of taste, smell, color and sound becomes unassured. What eludes capture in mathematics is quality” (Chirimuuta 2015, 10). Chirimuuta explains how color and other properties coming from our senses like smell or taste start to be regarded as *secondary*. This, while *primary* qualities such as figure, texture and motion are regarded as inseparable from the body, and the idea that these qualities are the building block for all physical explanations grows. The secondary qualities on the other hand are not considered to be inseparable from the object but they are instead *produced* through the primary qualities. From this period we inherited a world: “Made up of miniature billiard balls that are colorless and odorless, but whose position and movements can be mapped on exhaustive mathematical description” (Chirimuuta 2015, 25).

As it often happens when we speak of color, here lies a controversy: where is it? Is it a property of the object? Or is a product of our mind? Our understanding of color has been developing and changed deeply throughout the centuries in relation to big changes in human consciousness and our ways of seeing the world.

In antiquity there was a stronger connection between the *inner sight* and the *external sight*. Empedocles believed that Aphrodite built the human eye with the four elements, earth, fire, water and air, then she lit a fire that shone from the eyeball to the object of vision. The ray emanating from the eye, would allow us to see.

The *extramission* theory was sustained also by Plato who tried to explain the convergence of the rays from the eyes with the rays from the sun into a luminous medium. He tried to explain the variety of color as different sizes of the particles emitted by the object. A particle bigger than the particle of the visual ray would result in a black color while a very small into a white. The *extramission* theory was describing vision as an active action that we can compare to echolocation. Plato's student Aristotle did not agree with his mentor and sustained that perception comes from something external, a transparent medium representative of the object that enters in our eyes.

To explain color Aristotle individuates two possible ways in which it can be formed:

- black and white particles, light and darkness mixed in different proportions produce different colors.
- The second way that color can emerge is similar to what painters do when they want to recreate a specific atmosphere, like a water reflection or a foggy day. They overlap a color to the other and result is a color different from the two starting one.

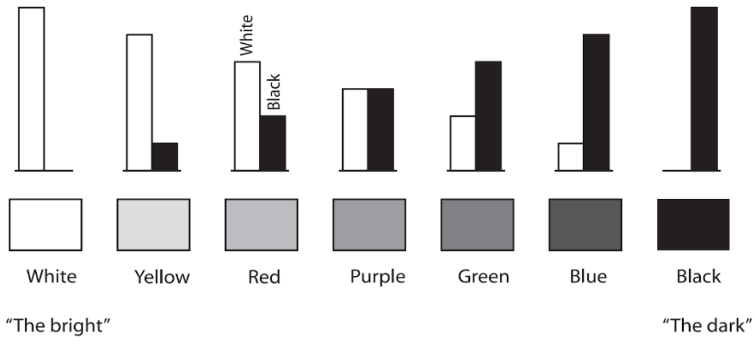


Fig. 12: color formation from black and white, from the treatise *On Senses*, Aristotle.

One of the most influential writings about color until Newton's theory is the treatise *On Colours.* Attributed to Aristotle, it has been recognized as written by another author due to the difference from his authentic works (Gottschalk 1964, 78-79).
Probably by Theophrastus, or Stratone di Lampasco, there is no way to establish with certainty the authorship. In the text the colors are associated with the four elements, and change in response to cold, dry, humid and heat. For example, earth is considered to be white, the ashes being proof of this fact. The dark color that we see in soil is due to the humidity and the cold present in it. Black is the color associated with transformation, and water and air are considered black when present in big quantities.

In the ancient mind black and white, light and darkness were favoured over the description of the hue.

We have to skip forward some centuries before finding the first examples of a color organizational system. The very first one, as far as we know, dates back to 1611 when the Finnish astronomer Aron Sigfrid Forsiu, published the first color system (Baumann, Silvestrini, and Fischer 2011). He organizes the color in a sphere where white and black are the poles and the five basic colors are on the meridians.

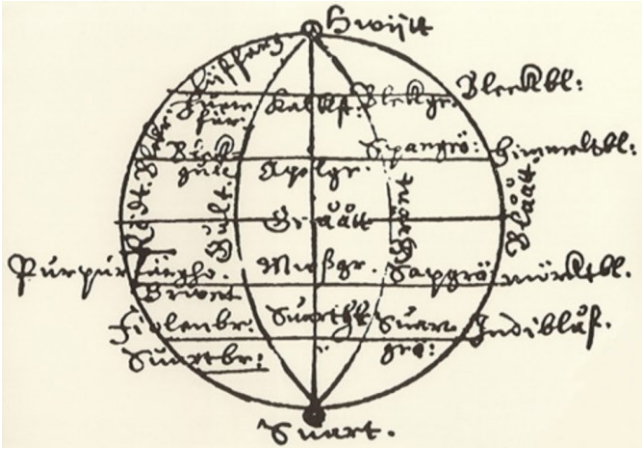


Fig. 13: Aron Sigrid Forsiu, color system

In his manuscript *Physics* he describes his color system:

"If, however, the origin and the relationship of the colours are to be correctly observed, then one must begin with the five basic median colours, which are red, blue, green and yellow, with grey from white and black, and one must heed their grading, and whether they move nearer to the white because of their paleness or nearer to the black because of their darkness" (Forsius 1611, 315-321).

Not so long after Richard Waller published an article called, *Catalogue of simple and mixed colours*, with a specimen to each color, a prefix to its proper name and a color chart with some mixed colors.

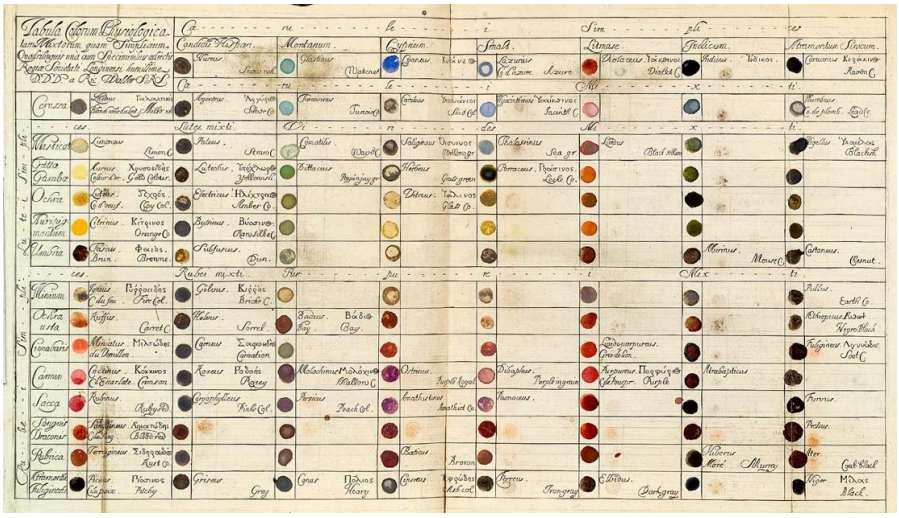


Fig. 14: Richard Waller, *Tabula Colorum Physiologica*,1686

Meanwhile Isaac Newton was developing his theory and in 1686, he created his color wheel after conducting the prism experiment and splitting a light beam into the colors of the spectrum. (Baumann, Silvestrini, and Fischer 2011)

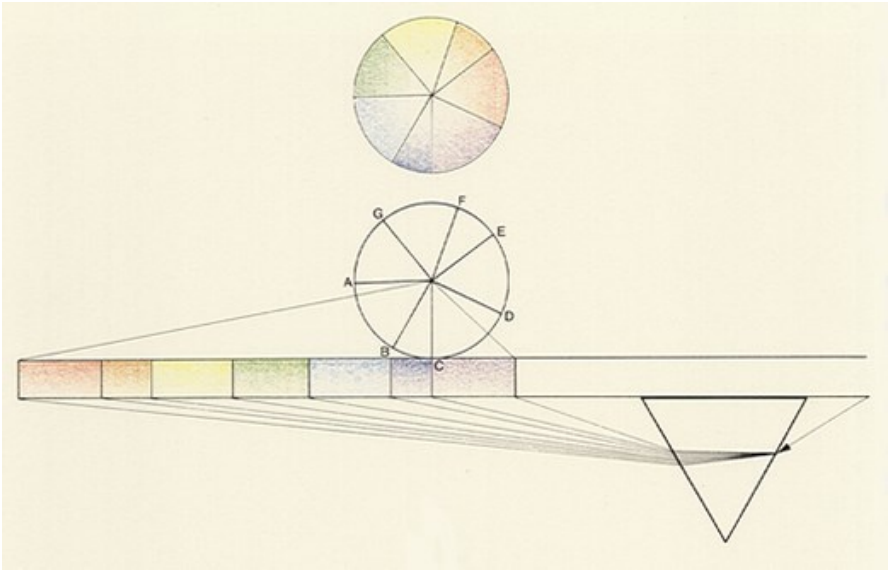


Fig. 15: Newton's color wheel study

Other versions and models of color organization followed. In 1775 Thobias Mayer did an organization of color in a triangle, and in 1800 Philipp Otto Runge created a three dimensional spherical organizational model.

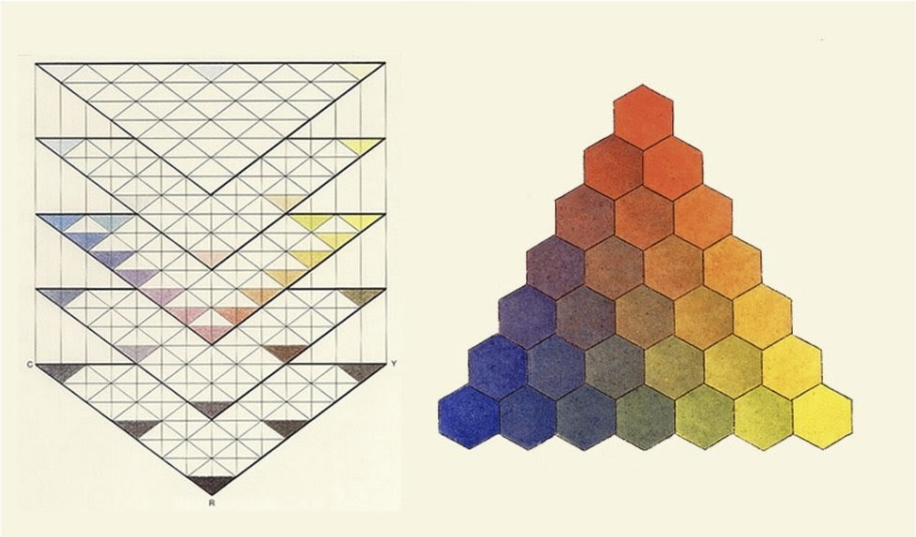


Fig. 16: Thobias Mayer, color chart

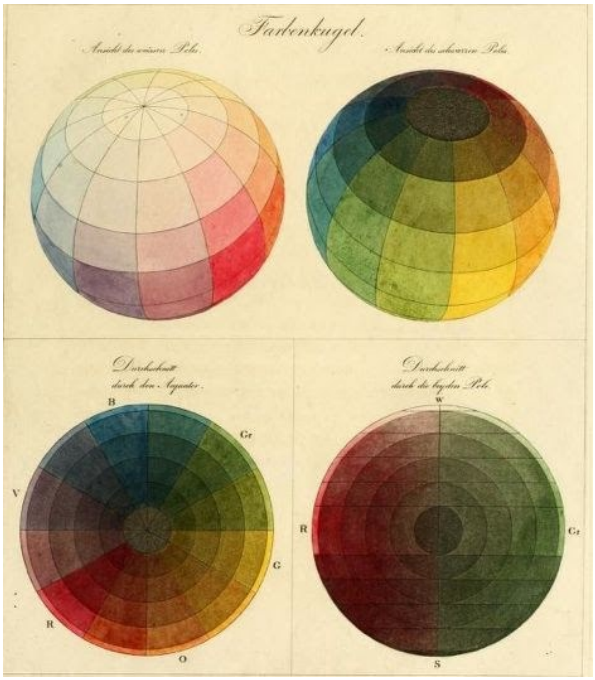


Fig. 17: Philipp Otto Runge, colour model

During the late XVIII century, J.W. Goethe realized the incompatibility of classical color theory with real life. He strongly disagreed with Newton and found his theories incomplete. Goethe was concerned with the way we see and perceive color and light in relation with reality and nature, more than how he was in destructuring it. Goethe was aware of phenomena such as the permanence of images in the retina, colored shadows, the effects of contiguity and illumination on color, as well as other visual illusions, all accurately described

in his book *Theory of Colour*. All these phenomena were not explicable by Newton's theory, but only by unknown rules of the brain, and he considered visual illusions to be the *neurological truth*. (Goethe 1840)

In his book *The Sky in a Bottle*, Peter Pesic summarizes the history and the huge scientific discoveries and inventions that brought us to our understanding of the color of the sky and why it is blue. Among them there is the work of the Swiss mountaineer and botanist Horace Benedict de Saussure. Saussure was an intrepid explorer in a period where mountains were looked upon with fear. During the XVIII century mountain exploration was rare, but Saussure probably walked all the Alps and became the founder of systemic alpine exploration. He integrated this passion for nature with his scientific passion and invented numerous scientific instruments that he would take to his exploration to make his observation more precise. His inventions were related to the weather, to humidity, wind and temperature. He was the first to set up a modern meteorological observatory in the mountains that gave him the possibility to observe the weather and the color of the sky. In 1788 he published the description of what he called a *Cyanometer* an instrument to measure the blueness of the sky. He created a blue scale arranged in a circle and with a hole in the middle, to make it easier to compare with the sky's color (Pesic 2005, 58-66).

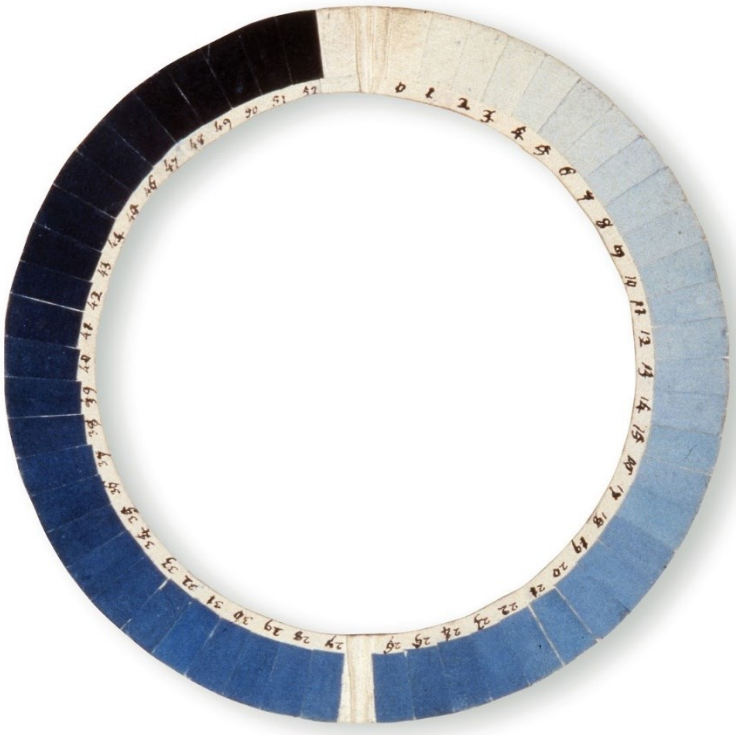


Fig. 18: Cyanometer

Inspired by Saussure, his exploration and passion for nature and inventions, I felt the necessity to create my own scale to better understand the color of the river Isonzo.

The *Isonzometer* is a scale to measure the color of the Isonzo. It has been created with some digitally extracted samples from Fig.2. Differently from the *Cyanometer* which is a monochromatic scale created by adding black and white to the hue, the *Isonzometer* also comprises different tonal value due to the fact that algae, bacteria and the river bed can change its hue by making it more green, more yellow or more brown.

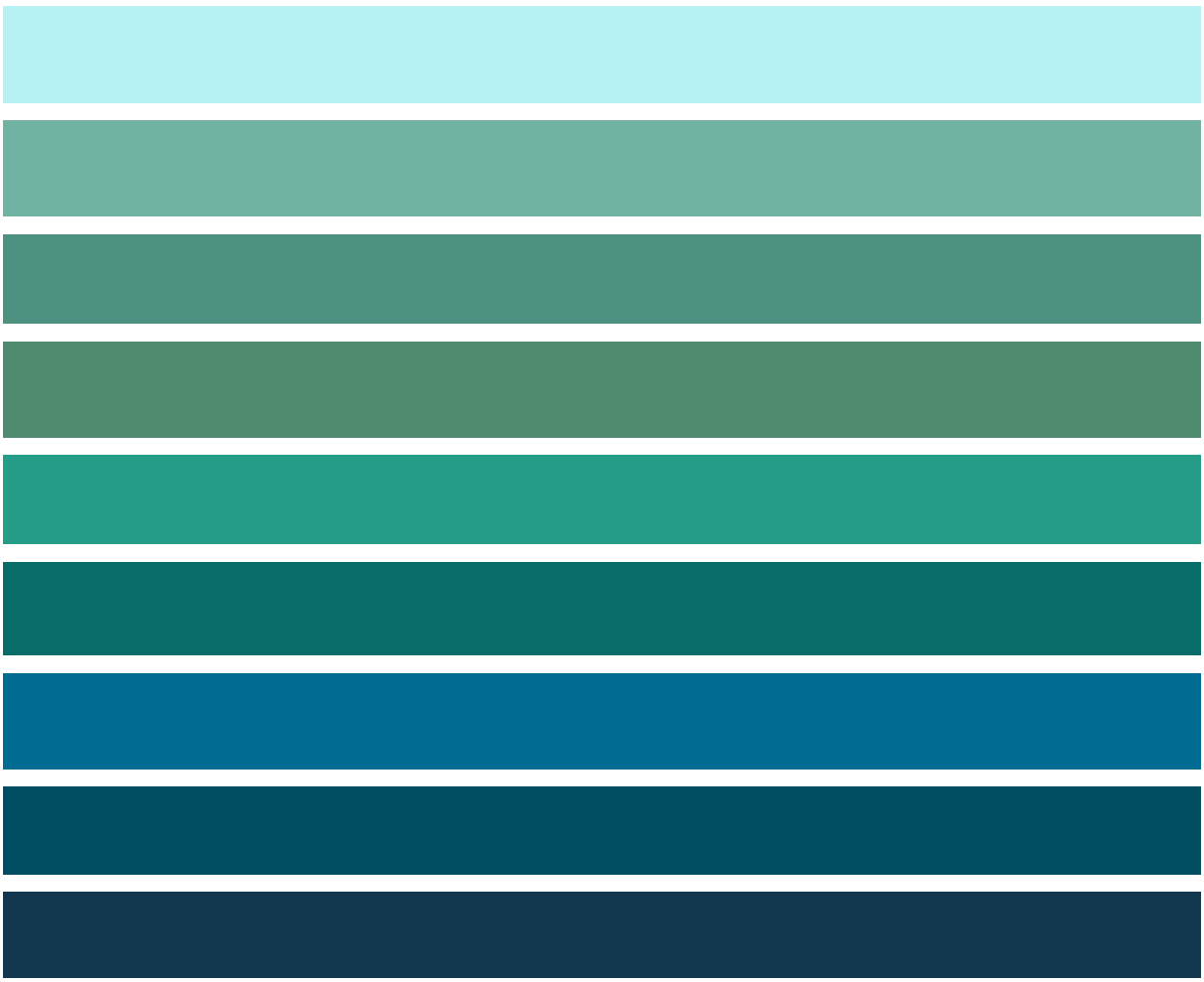


Fig. 19: *Isonzometer*, work by the artist, 2021

4. TAKE A PICTURE

> "'The matter with human beans', the BFG went on, 'is that they is absolutely refusing to believe in anything unless they is actually seeing it right in front of their own schnozzles.'" (Roal Dahl 1998, 68) [4]

It might not be that difficult after all to extract the color from the river, as in the *Isonzometer* I have done exactly that: I took a sample of the color of the water *from a picture*. It does sound reasonable, and ultimately it might be the closest way there is to taking home a piece of that aquamarine, and on the plus side it would definitely solve the problem of the transparency of the water. There it is, a fully saturated hue directly from the Isonzo.

Not to forget that a camera works very similarly to our human eye. So can that be the end of our quest?

Fig. 20: A Cyanotypie from Anna Atkins' book *British Algae: Cyanotype Impressions*, 1843

[4] BFG stands for Big Friendly Giant, a character from Roal Dahl that doesn't know too much about the grammar of human *beans.*

In the 1830s William Henry Fox Talbot, discovered a technique that allowed him to transport on paper negative images, just by using light. In the following decade he published his discovery in a book with original photographic plates. His publication was titled *The Pencil of Nature* and in the text Talbot writes the following disclaimer:

“The plates of the present work are impressed by the agency of Light alone, without any aid whatever from the artist's pencil. They are the sun-pictures themselves, and not, as some persons have imagined, engravings in imitation”
(Talbot 1845, 202-203).

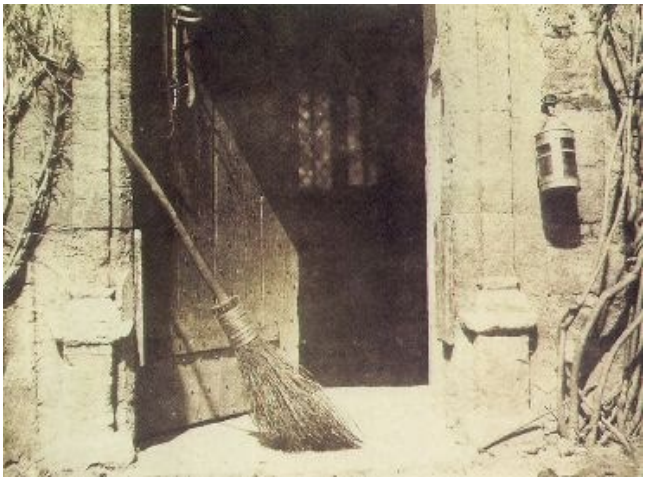


Fig. 21: A Photograph from WilliamTalbot’s book *The Pencil of Nature: open door*, 1844

This technology was the *medium of nature*, the most faithful way of image creation. No painter could reproduce an image in such detail and with the same speed of a camera. Photographs showed *the truth*.

In the series of lectures *Readings in Synthetic Media and New Media Art,* from the professor and media art theorist Ingeborg Reichle, she discussed the relationship between image reproduction and the concept of reality. Today we know that images can be easily manipulated with processing programs like Photoshop, but even before that photographic images could be manipulated. The first photographs were in black and white, and this fact distanciated them from reality, as we see with color. To remedy this imperfection it was a common practice to hand color them.

The medium of photography was far from being *the pencil of nature* also for the high amount of staging necessary to take a picture. Back then the exposition times were long and photographers had to use some tricks and technical equipment.

Fig. 22: Hand color photography

Fig. 23: structure to keep the head still for the photograph

Photography was mostly used for family portraits and it was a common practice to also include dead family members to pose in the picture. With the advent of color photography the problem of the color disappeared but this media remains abstract in some form, featuring just one very selected point of view. Today our society achieved a very high level of image manipulation, that also expanded to videos with the phenomenon of deep fake. Deep fake, form the union of the words deep learning and fake, are realistic media modified through AI. The fictional content looks *real*. Until not so long ago, video manipulation was a complex and time consuming practice reserved to professional movie makers. Today this tool is available on app and is becoming a global phenomena that changes the perception of *reality*, adding an extra level of complexity for us to distinguish between real and fake and increasing the fear and distrust in digital media. Although we are well aware that photographic images don't correspond with reality, there is an unconscious part of us that struggles not to consider them real. This happens due to the way in which our sight and brain are connected: vision is strongly related to our psyche. As a consequence of that, the behaviour of a person is an expression of his visual-perceptive state. An incredible example of the relationship between the phenomenon of vision and our brain is the *phantom limb syndrome*. In this disorder there is the persistence of discomfort or pain in a limb after its loss or amputation. The subject affected by this malfunction can even perceive movements as if the limb was still in place. In

our brain we have topographical representations of the entire body surface, and in the case of an amputation the area of the brain relative to the missing area becomes more and more greedy for stimuli, so the stimuli of the adjacent cortical area begin to invade the space left empty by the missing limb. To mitigate this dysregulation it is necessary to provide the patient with a visual response. It must be shown that the phantom limb responds to the brain commands to give him the opportunity to *unlearn* the paralysis. To do that it is necessary to use a mirror and position it in such a way to give the patient the impression of seeing his limb move. To convince the logical part of the brain we have to show irrefutable evidence to it. (Ramachandran 2004)

In optical illusion such as the one below we can see both a young woman and an old lady. We can never see them at the same time because our brain is able to process the information of one meaning at the time. Our brain struggles between the double visual stimuli, both of them valid. With a bit of practice we can learn how to switch the perception from one to the other and decide which one of the two to see.

Fig. 24: *My Wife and My Mother-in-Law,* William Ely Hill 1915

“With every act of perception, we participate unawares in making a meaningful world” (Zajonc 1995, 23).

There are different kinds of optical illusion that trick our brain in different ways. In Fig. 25, the square A and B have exactly the same color, but we fail to see them as such. We know that the pattern is continuous and the shadow makes it appear brighter than how it actually is.

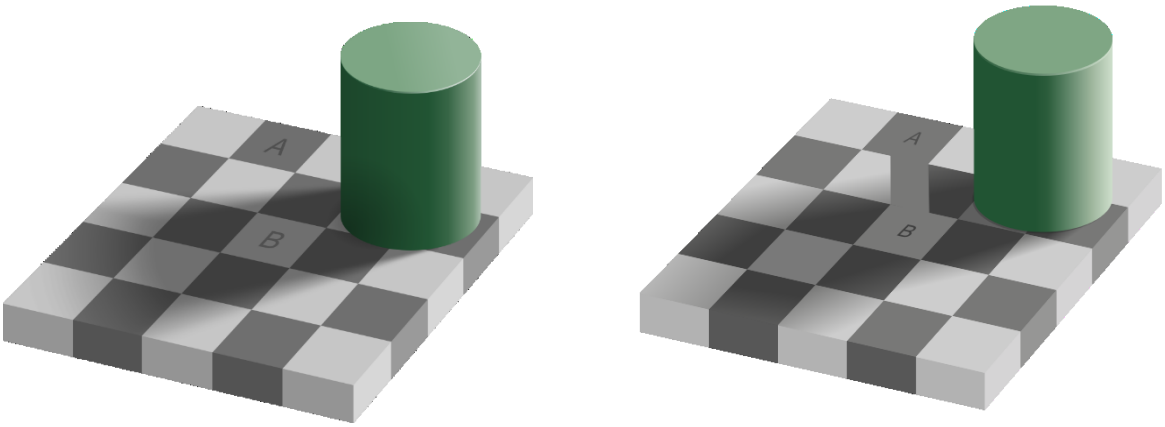


Fig. 25 and 26: *Checker shadow illusion*, by Edward H. Adelson, 1995

What would happen if we suddenly stopped seeing color?

An interesting answer to that question can be found in the non-fictional work of Oliver Sacks: *The Case of the Colorblind Painter.* Mr. I, after a minor car accident, lost the capacity to see color and the whole world turned black and white for him. Mr. I spent most of his life working as a painter, and it was a very serious loss that drove him into depression. He struggled to accept his new monochrome reality and kept on painting with color, sure of the fact that he could still use colors and remember their hue. Life was almost unbearable during the daytime so he started to be awake at night, to feel more *even* with the rest of the people, as then color is not so important or recognizable. For Mr. I the turning point happened a few years after the accident, when he witnessed a beautiful sunrise and saw it as an explosion. He never thought that a sunrise could look as such, and for the first time the uniqueness of his point of view made him accept his condition. At the beginning he was trying very hard to remember the colors, after a few years he was not sure anymore of what they looked like. (Sacks 1995, 15-49)

Color fades away from our memory and from our eyes if we are not constantly under ist influence.

“when a colorful object is reflected in a mirror, it imparts its color to the surface temporarily, without permanently altering its constitution. An object's color seems to have the same effect on the eye as when it is reflected in the mirror” (Clark 2007, 18-19).

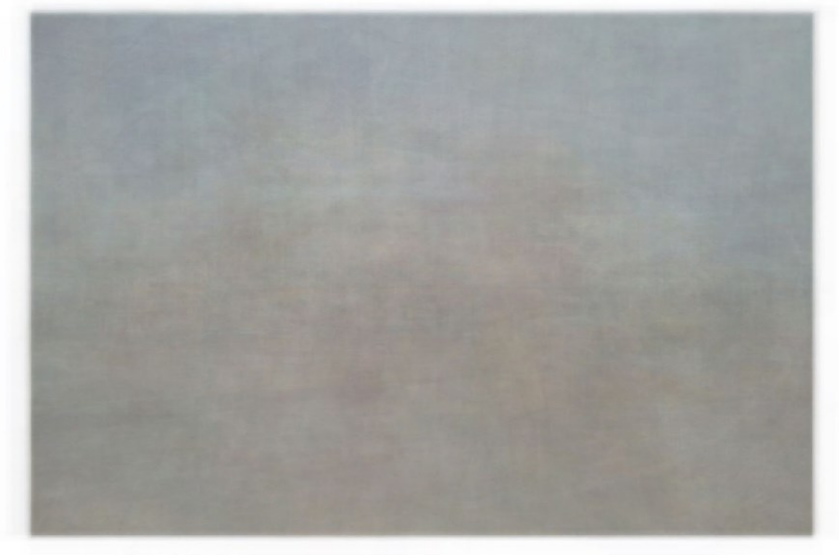


Fig. 27: *Memories*, 2016, digital overlapping of 100 memories with 1% visibility. Artwork from the author

I consider color as a practice, my practice. There is always something to learn, every time is different, and you discover it on the way. You can't force it, you have to wait for it to happen, and it does not have an end. Whenever you paint you put attention to colors, and one colored pencil is never boring, with each interaction and juxtaposition creating another meaning. I would like to bring the careful attention of a painter into our everyday life.

5. LOOK AT IT FROM ABOVE

It is very easy to picture an image of our globe, since the high diffusion of satellite images and instruments such as Google Earth made us familiar with the surface of our planet, its coloration and texture. It comes with no surprise that blue is the most extensively present color on our planet, due to the composition of the atmosphere and the presence of the ocean. However, the technology necessary to produce this kind of images is pretty recent and in fact the very first full disk colored picture of our planet was taken in 1967 from the satellite DODGE. To this very first testimony of the Earth's appearance many others followed, but one picture in particular accompanied a *revolution of thought*. It was 1972 when one of the Apollo 17 crew members, on their way to the moon, took a fleeting picture of the Earth.[5]

Fig. 28: *Blue Marble*,1972, NASA, AS17-148-22727[6]

[5] The picture was probably taken by Harrison H. Schmitt, (scientist-astronaut). The crew included Eugene A. Cernan (commander) and Ronald E.Evans (module pilot).

[6] The original picture was a bit different from the picture we see above, the space shuttle was traveling rotated with respect to the Earth's position so the image was taken upside down. The image was later turned, cut and the contrast values adjusted to make it more recognizable and better fitting to our perspective.

The *Blue Marble* was taken with an analogue 70-millimeter Hasselbad camera and it stays until today as the last picture of the whole planet taken by a human hand.
In the *Atlas der Weltbilder* Horst Bredekamp explains how our planet looks astonishing but also fragile and vulnerable in the immensity of space. During the 1970s *Blue Marble* became a symbol of growing environmental activism. The image was giving a new point of view, a new awareness about our size and position in space, a new sense of dimension that made our society's failure to recognize the finiteness of the resources on our planet more evident. It is exactly in those years that Lovelock and Margulis elaborate the theory of Gaia. The picture was at the same time the embodiment of achieving one of humanity's biggest dreams, to overcome the Earth's borders. This image inspired people to care and it became one of the most reproduced images of all times. Peter Sloterdijk described it as a "Copernican revolution of the gaze". (Sloterdijk 1990, 57) (Bredekamp 2011, 366-375)

There is a sense of identification in the color blue, which in those years probably became stronger and more evident. Blue is the color associated with water and water is the fundamental condition for life, it is the first factor in the planetarian exploration that is looked for to determine the possible existence of life forms. Although the use of the word blue in relation with water is in some sense an approximation, due to different factors such as the changing of meteorological conditions, in the case of the ocean, blue can be considered a *constant color*: the same hue present everywhere on Earth. The open ocean acts like a filter and absorbs different wavelengths at different depths. A part of the light gets scattered from the water surface like in the sky, but in a smaller quantity and for this reason the hue of the ocean is darker than the hue of the sky. The way in which color gets absorbed is consistent in the open ocean also due to a very low presence of color dissolved organic matter, that makes the physics aspect of the interactions more visible.

The oceanic color *constant* is used to monitor the state of health of our planet. Unfortunately, due to the climate emergency as reported in the study *Computing the Ocean's True Colors* led by Sthephanie Dutkiewicz, the color of the ocean is changing, and it will change dramatically until 2100. It is foreseen that the ocean will become darker and the coastal areas will become greener due to a higher proliferation of phytoplankton. (MIT, Joint Program on the Science and Politics of Global Change 2016) This change in color represents a massive change in the ocean equilibrium and marine life. Now more than ever I feel it is fundamental to care about the color blue, to find a way to document it and preserve it.

Fig. 29: che shade of the ocean

When a light beam passes the water's surface, it is refracted and absorbed at different depths. The wavelength that travels to the deepest distance is the blue light. Most of the visible spectrum is absorbed in the first 10 meters of water and after 150m there is almost no light.[7]

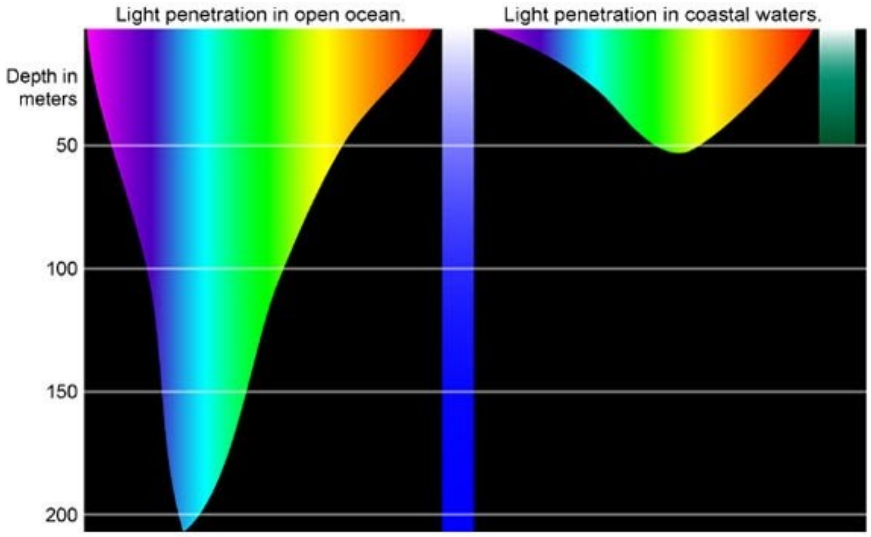
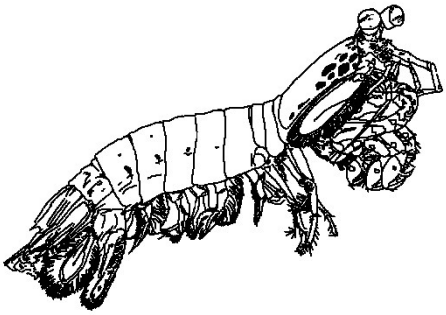


Fig. 30: Absorption of light in water

[7] Under 1000m of depth there is no light at all, it is estimated that 90%of the ocean is deeper than 1000m.

These special conditions make our ocean:
the biggest monochromatic environment on our planet.

Very different ways of perceiving and using light apply in this very unique environment. Most of marine life is concentrated in the more luminous upper layer of the water, the Euphotic zone[8]. The red wavelength is the fastest to get absorbed and in response to this condition most of the fishes are blind to red, as it is visible just very near to the water surface.



The *Mantis shrimp* for example, a little prawn with the fastest punch in the world, possesses between 12 to 16 different kinds of cones where humans have just three. Surprisingly, this animal is very bad at distinguishing colors, and while it can detect UV and Polarized light it is still a mystery why it has so many cones.

The octopuses use color to mimicry in the environment, to do that they have specific cells in their skin called *chromatophores*. These cells are full of differently colored pigments, contained into a sac surrounded by a muscle, and can be *tuned* by the octopus. Each of these cells is connected to a nerve, therefore the nervous system is responsible for this color change. Octopuses have a decentralized nervous system that allows them to control color and texture change in an extremely efficient and impressively rapid way.

Fig. 32: Octopus

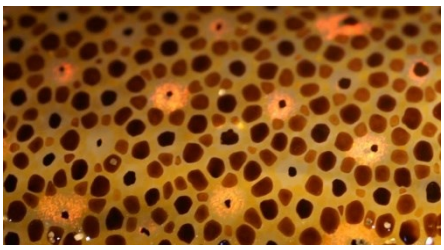


Fig. 33: Skin detail of an octopus

[8] The upper layer of water that goes from 0 to 100 meters

Cuttlefishes are also amazing at color changing, with males known to be very smart at deceiving. In the presence of a female, they change the pattern of their skin, but only on the half that is opposite the female's position. On this side, they mimic a female pattern, in order to trick other male cuttlefish into thinking that those are just two females and there are no rivals. They can switch very rapidly the *cover pattern* if the female decides to swim on the other side.

In the ocean, light is precious and some critters evolved the ability to produce their own light. It is mostly produced in two ways, by chemical reactions or by developing a symbiotic relationship with bacteria that can produce it. Bioluminescence involves an enzyme called *luciferina* or *luciferase* and the light produced is generally blue to travel the longest distance possible. These lights systems are used by the fishes to hunt, to communicate and as a defence. For example the deep sea Stoplight loosejaw, is the only known fish able to produce a red colored light beam, that he uses to hunt without being seen from its prey and from bigger fishes.

Another interesting deep sea semi transparent little creature is the Cardinal fish.
When it feels threatened, it can spit out *ostracods*, tiny little creatures that produce bioluminescence that he throws at his aggressor to blind them for a second and have the time to swim away.

6. CALL IT BY A NEW NAME

In the history and development of the color blue, as a pigment and as a concept, we can find clues about our way of perceiving and understanding color. Before starting with our history I would like to talk about the difference between pigments and structural colors. Pigments are substances that give color, the most common ones are chlorophyll (green) carotenoids (red-orange), and anthocyanin. This last one can appear in different colors depending on the pH, it can change from greenish-yellow when the solution is alkaline (pH>7), purple when the pH is neutral, and pink or red when the solution is acidic (pH<7). Bright saturated blue is a rare color in nature because blue pigments do not exist. The blue that we see in plants or flowers is the result of different variations of anthocyanin. Structural colors on the other hand are specific microstructures that interfere with light and create a drastic variation of the color, usually in the spectral range of the blue-green. Structural colors are more long-lasting than pigments, they don't fade. The exoskeleton of beetles, for example, doesn't lose its coloration, even after several years. Structural and pigment coloration can both be present in some colorations but differently from the pigments, structural colors cannot be mixed together.

Blue as a natural *pigment* is exceedingly rare. If we don't consider all of today's synthetic pigments, the only bright blue source that exists is the semi precious stone *lapis lazuli*[9]. Blue is profoundly incorporated in our visual culture, but it was not always like that, this color was rare and generated fear and respect. Ancient Britons used to dye their bodies in blue to scare the enemies, making them known as the *spectral army.* Romans Instead wore blue just in mourning and considered blue eyes as a symptom of bad character.
Blue was at the same time precious, a symbol of power and divinity. In many Egyptian temples it was used to depict gods, water and havens. The pharaohs wore blue crowns and jewels as a symbol of divinity on Earth and when they were represented in their afterlife they were depicted in blue, to reflect their completed process of deification.

[9] from the latin *lapis* pietra and the sanskrit *rājāvarta*, 'curl of the king'

The geological conditions necessary for the formation of lapis lazuli are as rare as the stone itself. That made it possible to identify its main extraction source in the Sar-i-Sang mine, located in the current Afghanistan. In antiquity the stone was all coming from there and was commercialized in predynastic Egypt where it was used for the manufacture of precious items and sculptures. Lapis lazuli was a very hard stone, difficult to break, and grounded it would result in a greyish color. For this reason it was almost never used as a pigment, so they needed to find another way to produce this color. Egyptians engineered the first blue. They developed the technology to produce glass and created a blue glaze that could be grinded into powder to produce a pigment. They called it *hsbd-iryt* the lapis lazuli from the kiln.[10]

During the roman period the recipe to produce the Egyptian blue was forgotten as the technology to produce it. In the VI century the interest for the stone lapis lazuli flourished again, but it still remained a very difficult color to use until the XIII century when a new method of pigment extraction came about. In the XV century, Cennino Cennini described this very efficient method, which was proved to successfully eliminate all the impurities from the stone and obtain a vibrant and intense blue: the ultramarine. Literally meaning beyond the sea, this pigment was very expensive and delicate because it was easily reacting with dilute acids and acid vapours. For this reason it was only reserved for the most important part of the paintings like the mantle of the holy Mary. Often it was also used on top of a cheaper blue, like azurite. A big revolution in the color market happened in 1704 with the first synthetic pigment. The accidental discovery took place in the alchemical laboratory of Johann Conrad Dippel, when he was trying to create an elixir of life and to do so he mixed bull's blood with potash. The printmaker Deisbach, who was working in Dippel's laboratory, needed to use some potash in order to produce red from cochineal insects. He did not know that the potash had already been contaminated. The iron present in the potash reacted with the mixture, which at first turned green and then changed into an intense blue. This color got commercialized as Prussian blue. In the 60's, synthetic organic chemistry developed greatly and took over the color production. Blue started to appear everywhere, including clothing like blue jeans. This color largely lost the connection with the divine and it is not rare anymore, although it still reminds us of the sky and inspires trust. Exactly for this reason, today it is the most used color for app logos.

[10] The stone Lapis lazuli was referred to as lapis lazuli from the mountain.

Fig. 35: Still from the video by Francis Alÿs, Watercolor, 2010

In his work *Watercolour,* the Belgian video and performing artist Francis Alÿs does a simple but powerful gesture. He pours a bucket of water from the Red sea into the Black sea. To complete this action he travels from Trabzon to Jordan. The two seas don't match the color that describes them, but this action opens a discussion about the meaning of color.
“Him I saved when he was bestriding the keel and all alone,
for Zeus had struck his swift ship with his bright thunderbolt
and had shattered it in the midst of the wine-dark sea”. (Homer, lines 1-4)
In this passage of the *Odyssey*, Homer uses the word wine-dark to describe the sea. Intrigued by this strange color association, William Gladstone in *Studies on Homer and the Homeric Age* conducted a study about color terms. He counted all the times that a color was mentioned throughout the Odyssey and found out that the color blue was never there. This fact led him to question the ability of ancient civilization to see the color blue. How was it possible that it was not mentioned anywhere? Could they see it? (Gladstone 1858)

Starting from the 1950s a lot of different studies have been conducted. It became the ground for a real *color controversy* in which the relationship between language and thought was at the centre of the discussion: could language determine how we perceive the world? All these studies involved anthropology, cognitive science, philosophy, physiology, and linguistics. Two formal sides arose in the debate, the *universalist* and the *relativist*. The universalist sustained that color terminology had universal characteristics due to our belonging to the human species. The relativists supported the theory that color naming was a culture-specific phenomenon. In 1969 the universalist Brent Berlin and Paul Kay published a theory linking color cognition to an innate physiological process. Their Publication *Basic Colour Terms: Their Universality and Evolution,* explains that basic color terms mature with the development of language itself and their order of appearance is predictable since we all share the same

structure of the visual system. White and Black always appear first to explain brightness and darkness. Red always comes second place followed by yellow or green. They identified eleven possible *Basic Colour Terms* (BCTs) categories: white, black, red, green, yellow, blue, brown, purple, pink, orange, and grey. They also created a seven-stage scale to describe the order in which they enter in the language:

Stage I: Dark and light
Stage II: Red
Stage III: Either green or yellow
Stage IV: Both green and yellow
Stage V: Blue
Stage VI: Brown
Stage VII: Purple, pink, orange, or grey

A level II language will have terms to describe black white and red, a level III will have words to describe black, white, red and yellow or green, and so on. They theorized that as a language evolves, new terms for color are acquired in a strict chronological order. (Berlin and Kay 1969) Today we also know that babies are already able to distinguish between light (white) and dark (black) before being born. A new born child needs a few weeks to learn how to see, and the first color they are able to recognize is red. Their eyes need to adjust a bit longer to the new world before they are able to use binocular vision and see all the other colors. The debate was definitively settled in 2006 with the study: *Colour categories and category acquisition in Himba and English.* The study was led by Jules Davidoff who conducted an experiment to finally understand the degree in which language and culture influence our way of thinking. He went to Namibia to study the Himba tribe, which has no word for blue or distinction between blue and green, but they have a lot more words to describe green shades than there are in English. He showed to the Himba 11 colored squares organized in a circle, 10 of them were green and one blue, he noticed that they had difficulties in identifying the color blue. He repeated the experiment this time with 11 squares of green of which one had a different shade. In this case the Himba had no difficulties distinguishing the different color, the same was not true for English speakers. He showed how much faster people are identifying colors that belong to a linguistic category of their language and proved that it is very difficult to describe a concept without the words for it. The experiment settled the issue: language influences, but does not determine our perception. (Davidoff et al. 2006, 159-172)

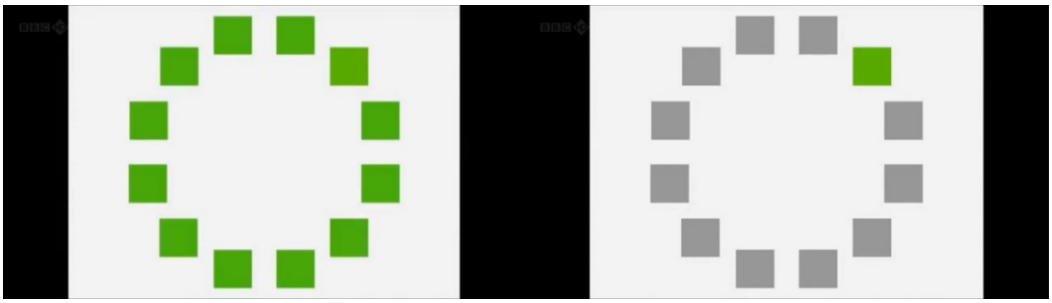


Fig. 36: colored tables used for the experiment, green squares

Blue has always been there, for ancient civilization as for us, and our visual system didn't change. They could see the sky as well as we do today, but it changed our way to identify its concept. Ancient Greeks used the word *kyanos* to indicate a very dark color, and it could indicate blue but also black. For them the difference between black and blue was not so crucial; the luminosity was much more important than the hue in the distinction of colors. Blue is at the border with black or dark (see Fig.12). With this in mind we can better understand also the value of other colors, in ancient cultures. such as the one of *chloros* "the term that later Greek color theorists call green, [...] In the *iliad*, honey is *chloros*; in the *Odyssey*, so is the nightingale; in Pindar, the dew is *chloros*, and with Euripides so are tears and blood! From its use, we can see it means not green but moist and fresh-alive." (Zajonc 1995, 15). Still today we can use the term green to refer to someone untrained, new to the field or young and energetic. The connection between the color and the way in which is used in ancient texts reflects their ways to see and consider color. They recognized in it more for its entanglement with nature and sensations than for its hue.

What happened with the color controversy study was a misinterpretation of the concept of color, not in relation with our visual system but relative to the value of the concept of color for ancient Greeks, and maybe they were not so wrong. Sky and sea always change color, and with our habit of defining and associating them to a fixed definition, we have lost a bit our ability to observe them and tune in with their hue.

From what emerged from Davidoff's study, color terms do not change our perception but they do make us faster at identifying them. It is very difficult to describe a concept without the words for it, so I would like to propose a new name for the aquamarine of the Isonzo, a new name that makes us able to identify it faster, able to comprehend not just its hue but the hole system of interconnection and relationships. This new name shall not be a common name, as general as the word river, because it is a specific and unique system that we are talking about. Neither shall it be the word Isonzo or Soča as those are geopolitical names that split

the river in propriety. I would like to invite you to think about a name that enhances its unity as a non-human living system and will help us to look at it from a new perspective.

7. CONCLUDING REMARKS

A river is an indivisible ecosystem, an organism that contains different living creatures, which participate all in the resultant final hue. None of its components separated from the context is able to provide a faithful representation of the whole, as the interactions would go missing and with them the core would slip away from our grasp. The experience with the Isonzo was for me a moment of awareness. I think it is fundamental to re-learn how to see, to restitute to color its dignity and integrity and start to move in a direction of transdisciplinarity that can, in an equal way, involve all its aspects. I think it is fair to talk about color in terms of a biodiversity that has to be protected. It is important to develop new careful terms to define color in a more transdisciplinary manner that does not take into account just wavelength and frequency but also considers where they are coming from. I want to propose a new form of Geography, a *Colorography*, that considers natural borders rather than geopolitical borders. In my work I want to make a paragon between the different layers of tulle and the identities of the river. By the simple addition and subtraction that happens between each layer I want to make the interactions more visible, to show that each color is not a singularity, but a collectivity, and that maybe, after all, the Isonzo is not aquamarine. I want to invite you to get closer to color as a way to see things, to appreciate it and become surrounded by it. If you ever happen to pass by this river I want to invite you to go for a swim, to get immersed in its hue, to let it blur your endings, and to lose the sense of yourself and all your limbs, for I know it is cold.

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