



'INDEXING WATER': A COLLABORATION BETWEEN AN OCEAN COLOUR SCIENTIST AND A VISUAL ARTIST.

by Marcel. R. Wernand – Senior scientist, Coastal Systems, Marine Optics & RS, NIOZ.

Working as a physical oceanographer at NIOZ (the Royal Netherlands Institute for Sea Research), my field of research is that of ocean colour, remote-sensing, and marine optics, which includes the study of colour of natural waters. These studies are based on multi- and hyper-spectral measurements of the water column, also from space. There is also a simpler way to determine the colour of natural waters, using the Forel-Ule colour comparator scale, which has been applied globally and extensively by oceanographers and limnologists since the end of the 19th century. It has been rediscovered by oceanographers today as a useful tool to index water on its true colour.

In 2016 I received an email from Irene Kopelman, a visual artist from Argentina living in the Netherlands. She told me she was interested in scientific methods of colour observation and asked if I had time to talk with her. We first met on September 30, 2016 and, again, a couple of days later in my office at the Royal Netherlands Institute for Sea Research (on the island of Texel). Irene had expressed interest in working together and, not knowing exactly what to expect from a collaboration with a visual artist, Irene showed me the outcome of her work from previous collaborations with other scientists, such as her renderings of crab movements on shore at low tide, with marine biologists, and drawings of microscopic organisms in the maritime lab of the Smithsonian Tropical Research Institute in Panama.

We started our collaborative project in the beginning of October 2016, under Irene's working title, 'Indexing an intangible material', which changed during our project to the simpler 'Indexing Water'. In my understanding Irene wanted to take this specific research – the search for the mechanisms behind the arcane colouring of natural waters, despite, and in addition to its supposed transparency – as inspiration for her artwork. Even though her work is conceptual, abstracting elements of the natural world, such as colour, it has its ties to concrete matters. You have to realise that climate change can have its influence on the colour of the sea.

Shortly after our coming together I offered her my time and a place to work at NIOZ, Dept. Coastal Systems – Marine Optics and Remote Sensing. During this period she got the status of Guest Scientist. Irene's art project started in the beginning of 2017 – a time of new and challenging marine optical research, as it coincided with the launching of the four-year Coastal Ocean Darkening project (COD). The main topic of this project consists of the scientific study of the so-called 'darkening issue' – the issue of the North and Baltic seas becoming less clear (mentioned in scientific publications).

Collaborating with an artist like Irene was new to me. To acquaint her with my work and research in Marine optics, I first took her to a COD workshop meeting at the TRIOS company near Oldenburg. The TRIOS company would manufacture the hyperspectral radiometers used in this project. As the meeting was organized between all project partners, for each to clarify their specific input, it was a great introduction to the project for someone like Irene. Accordingly, Irene interviewed me at our Institute on all kinds of issues related to Marine optics and remote-sensing. Our 'method': she came into the office, sat down with a coffee and started firing questions at me on differently coloured

waters. We had animated discussions all the way through our meetings in 2017.

These sessions consisted of two-hour interviews, more or less. We spoke about why seas had a certain colour and about the mechanisms responsible for the colouring of natural waters. Topics and waters discussed were: the blue and green grotto at the island of Capri, Naples, Italy; the blue and green lakes at the Azores, Portugal; the Kayzers tube; Count Luigi Ferdinando Marsili, the first oceanographer who in the 17th century measured colour; historic publications on oceanography in general; and we spoke more than once about the Secchi disk and Forel-Ule scale. As part of my research, I'm interested in bringing back this colour comparator scale into today's science. In addition to our in-person meetings, later on I Irene also consulted me through long Face Time meetings. Over the year we built up a very good and personal relation. Irene was the artist, but I always tried to exercise some influence on her upcoming and new artistic ideas. I realized that of course she was the artist and I was the scientist. But this never stood between us.

When we started collaborating, I was simply curious about Irene's work, but over the course of the project this developed into a personal dialogue, which was interesting for both of us to explore. Along the way, Irene prepared ideas and showed me her first sketches, which were drawn from my colour observations and historical work, as well as from joining me during practical work in the lab and darkroom, on field trips, and workshops. In my research at NIOZ I have consulted many historic papers and books on the colour and clarity of the sea, another common interest and base for our conversations. As part of the Indexing Water project, an exhibition on the topic of the colour of sea is now emerging. Irene has been a very inspiring person to me, with a specific artistic goal to relate science to art by expressing its specific signs into drawings, paintings, and sculpture.

An example to end with: as mentioned before, one of the recurring topics of our conversations was the Secchi disk. The Secchi disk is a white disk, 30cm in diameter, used to establish the water clarity by measuring the depth at which the disc ceases to be visible from the surface. Oceanographers around the world perform these measurements, and the NIOZ holds the world's record on a Secchi disk depth of 78.5 m, observed in the very clear waters of the Weddell Sea near the Antarctic. To be clear: at 78.5 m under the water's surface, the disk can still be seen.

For her exhibition in Lisbon, Irene decided she wanted to translate the above into a glass column, 30 cm in diameter, 78.5 m in height, to be placed at the entrance of the Kunsthalle. However, after some deep thinking she came to the conclusion that this kind of sculpture would of course be extremely heavy, tall, and massive. She decided to divide all measures by a factor of 10, so that the column would instead be 7.8 m in height and 3 cm in diameter. In fact, two columns have now been produced: one bluish in colour – the one representing the Wendell Sea Secchi disk depth – and another depicting the most turbid, brownish coloured, natural waters on our planet, in which the Secchi disk ceases to be visible 10 cm below the water's surface. This can be observed for instance in the Madura Strait in Indonesia or at the outlet of the Yangtze River in China, where it flows into the Yellow Sea. Following the scaling of its counterpart, this 'column' will be 1 cm in height and 3 cm in diameter. And brown in colour.

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A Kunsthalle Lissabon apresenta Indexing Water, a primeira exposição individual em Portugal de Irene Kopelman (Córdoba, Argentina, 1974, vive e trabalha em Amesterdão).

Há mais de um ano, quando o João Mourão e o Luís Silva me convidaram para desenvolver um projeto específico para a Kunsthalle Lissabon, pensei que era o momento e o contexto indicados para da início a um processo de investigação sobre uma ideia que me acompanha já há imenso tempo: trabalhar com as cores da água.

Há alguns séculos, arte e ciência não eram campos separados, como os conhecemos hoje. Existiam imensos pontos de correlação e coexistência. Como agentes com uma prática no campo das artes estamos bastante familiarizados com os estudos de cor no campo da história da arte, mas os dicionários de cor foram também desenvolvidos no campo das ciências naturais como meios para descrever e comunicar a investigação científica. Em 1831, Charles Darwin levou consigo, a bordo do HMS Beagle, um livro cujo nome era A Nomenclatura das Cores. Os cientistas usaram este e outros "dicionários de cor", antecedentes dos atuais livros de pantones, como referência comum, ao descreverem a aparência dos seus objetos de estudo. Os dicionários de cor foram desenvolvidos para criar um vocabulário comum, nos diferentes pontos do globo, para a descrição das cores de tudo, de rochas e flores a estrelas, de pássaros a selos de correio. Permitiram aos cientistas e naturalistas os meios para a descrição e precisão biológicas que podiam assim ser facilmente partilhadas, de modo a que naturalistas em Kalamazoo e na Alemanha pudessem efetivamente comunicar sobre uma família de pássaros encontrada em ambos os lugares. Tipicamente estes dicionários eram constituídos por um conjunto de amostras de cor, e a cada uma era atribuído um nome (usualmente escrito em diferentes línguas para facilitar o uso internacional), um número identificador e também uma descrição mais lírica sobre a cor ("a cor do sangue de um coelho acabado de matar" ou "castanho múmia").

Depois de decidirmos em conjunto avançar com esta pesquisa, contatei o Dr. Marcel Wernand, um oceanógrafo físico no NIOZ (Royal Netherlands Institute for Sea Research), onde é investigador sénior e cuja pesquisa combina o desenho e desenvolvimento de instrumentos multi-espectrais para medir as cores do oceano; a variabilidade bio-ótica dos estuários, mares e oceanos e uma monitorização continuada das cores costeiras;

Kunsthalle Lissabon presents Indexing Water, the first solo show in Portugal by Irene Kopelman (Córdoba, Argentina, 1974), inspired by a year long cooperation with Marcel Wernand, scientist of the Royal Netherlands Institute for Sea Research, and the German-Dutch Coastal Ocean Darkening research project.

More than a year ago, when I was invited by Luis Silva and João Mourão to do a site-specific work, especially developed for the Kunsthalle Lissabon I thought it was the right moment and context to start the process of following the thread of an idea I had for a long time: working with the colors of the water.

A few centuries ago, art and science were not such different and separate fields, as we know them today. They had many points of correlations and coexistence. As practitioners in the art field we are aware of the color studies in art history, but color dictionaries were also developed in the field of natural studies as a means of describing and communicating the examination of nature. In 1831, Charles Darwin carried a book called The Nomenclature of Colors aboard the HMS Beagle. Scientists used this book and other "color dictionaries", predecessors of today's Pantone swatch books, as a common reference when describing the appearance of whatever they were studying. Color Dictionaries were designed to give people around the world a common vocabulary to describe the colors of everything, from rocks and flowers to stars, birds and postage stamps. They afforded scientists and naturalists the means of descriptive biological precision that could be easily shared so naturalists in Kalamazoo and Germany could communicate effectively about a family of birds found in both places in related (but different) forms. They typically consisted of a set of color swatches; each assigned a name (usually rendered in several languages, to facilitate international use), an identifying number, and an often-lyrical description of the color ("the color of the blood of a freshly killed rabbit" or "mummy brown").

Once I had decided, by discussing the ideas with Luis and João, that we would go for it, I contacted Dr. Marcel Wernand, a physical oceanographer at NIOZ (Royal Netherlands Institute for Sea Research). Dr. Marcel R. Wernand is a senior research scientist whose main research interests combine the design and development of multi-spectral ocean color instrumentation; bio-optical variability of estuaries, seas and oceans, long-term

alterações da cor do oceano, a longo prazo, em relação às mudanças globais e à história da ciência ótica marítima. Esta particular combinação de linhas de investigação aliada a uma personalidade particular criaram, desde o início, um diálogo extremamente interessante e enriquecedor.

Marcel não era, afinal, apenas um investigador capacitado, mas também um ótimo contador de histórias. A sua pesquisa levou-o um pouco a todo o mundo, a ver muitas águas e a cruzar-se com muitas pessoas. O seu interesse pelo estudo da cor ligou-nos e trouxe vida a toda esta pesquisa.

As entrevistas com Marcel tornaram-se elementos centrais do projeto. Continuei a estudar, a ver livros, a ficar mais envolvida no tópico, ao ponto de participar no congresso do Ocean Darkening Project. A quantidade de informação rapidamente se tornou esmagadora e percebi que me constrangia em vez de me inspirar. Percebi então que o mais interessante que tinha em mãos eram as conversas com Marcel. As suas histórias, o espaço mental que toda esta informação criava nos nossos diálogos. Continuar a conversar, gravar as entrevistas, deixar a informação fluir e tirar notas de imagens que se materializavam durante estas conversas. A narrativa das conversas tornou-se o guião para a exposição bem como de um livro de artista que publicaremos depois.

Como as conversas eram demasiado abertas, propus a Marcel que usássemos como guia a escala de cores que ele usa nos seus estudos, a escala de Forel-Ule. François-Alphonse Forel (1841 –1912) desenvolveu o método, que três anos depois foi acrescentado pelo limnologista alemão Wilhelm Ule (1861 – 1940). A escala possui 21 cores. Propus a Marcel falar cor a cor. Ele sugeriu agrupá-las. Um dia sobre azuis, um dia sobre verdes, amarelos e castanhos. Dissecar a escala de cores ajudou-me a entender os fatores que afetam a cor da água.

Irene Kopelman (1974) é uma artista Argentina a viver e trabalhar em Amesterdão. Estudou Pintura na Escola de Artes da Universidade Nacional de Cordoba (1994-2002). Em 2002, Kopelman inicia o programa de residências internacional na Rijksakademie van beeldende Kunsten, em Amesterdão. Na Holanda, Kopelman inicia a sua investigação sobre representações da paisagem registadas no século XVIII e XIX por naturalistas. Este período exploratório, na era do Iluminismo, é profusamente presente em arquivos um pouco por todo o mundo. Inicia uma série de colaborações com coleções de museus como o Museu Geológico (Artis, Amesterdão), a Entomological Collection (Universidade de Amesterdão – UvA), o Teylers Museum (Haarlem), o Museu de História Natural, Londres e a Observatório Astronómico de Cordoba, Argentina que resultaram em projetos de exposição no Drawing Centre, Nova Iorque (2007), Apex Art, Nova Iorque (2008), Le Plateau, Paris (2009), Gasworks, Londres (2012) e La Verriere Fondation D'Entreprise Hermes, Bruxelas (2013).

A sua proximidade a estas instituições levou Kopelman a observar as metodologias científicas de trabalho neste campo e despoletou curiosidade sobre os modelos de organização de um assunto que é tão vasto, essencialmente disperso, extremamente dinâmico e simplesmente demasiado escondido para entender ou abordar de uma só vez.

Isto leva Kopelman a passar um período de tempo alargado no Manu Learning Centre, Madre de Dios, Peru em 2012 ao qual se seguiu a sua integração num grupo de 40 cientistas do Sabah Park na Malásia e do The Netherlands Centre for Biodiversity Naturalis (NCB) na Holanda numa expedição ao Monte Kinabalu, na Malásia.

monitoring of coastal color; long-term changes of ocean color in relation to global change and marine-optical science history. This very particular combination of approaches, summed with a very particular personality made the dialogue from the beginning extremely interesting and enriching. It turned that Marcel was not only a very knowledgeable researcher but also a great story teller. His research had taken him all across the globe, seen many waters and coming across many people. His interest in the history of color studies is what makes it come all alive to me.

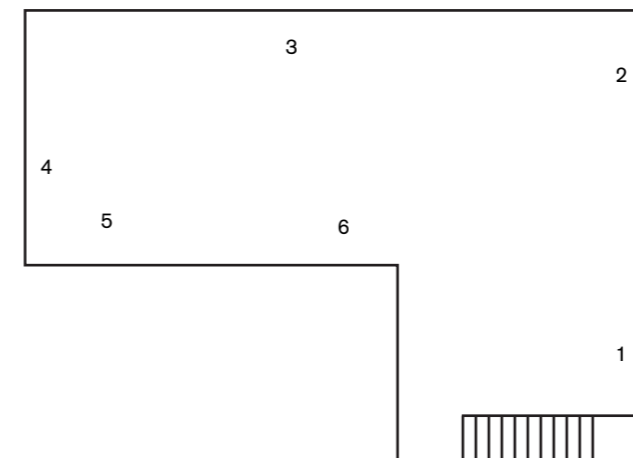
The interviews with Marcel become the very core of the project. I kept studying papers, looking at books, getting more involved in the topic to the extreme of joining and participating in a congress of the Ocean Darkening Project. The amount of information started becoming overwhelming and I realized that it had started being more constraining than inspiring. I then realized that the most interesting thing I had in my hands was the conversations with Marcel. His stories, the mental space that all that information was creating in the dialogue with him. I decided then that I would follow that quality. Keep talking to him, recording the interviews, letting the information float and taking notes of images that would materialize from the conversations. The narrative of the conversations became the script of the exhibition as well as the artist book we will publish.

As the conversations were too broad, I proposed Marcel to take the color scale he uses in his studies as a guideline. The scale he still uses is called a Forel-Ule scale. François-Alphonse Forel (1841 –1912) developed the method, and was three years later extended with greenish brown to cola brown colors by the German limnologist Wilhelm Ule (1861 – 1940). The scale has 21 colors. I proposed Marcel to talk color by color. He proposed to group them. One day about blues, one day about greens, yellows and browns. Dissecting the scale by colors helped me better understand the factors affecting the color of the water.

Irene Kopelman (1974) is an Argentinian artist based in Amsterdam. She studied at the School of Arts at the National University of Cordoba where she obtained her bachelor's and master's degree in painting (1994 - 2002). In 2002, Kopelman was accepted within the two-year international residency program at the Rijksakademie van beeldende Kunsten in Amsterdam. In the Netherlands, Kopelman began researching the representations of landscapes as recorded by 18th and 19th century naturalists. This period of exploration, during the age of the Enlightenment, is richly archived in museums across the world. A series of collaborations within museum collections such as the Geological Museum (Artis, Amsterdam), the Entomological Collection (University of Amsterdam-UvA), the Teylers Museum (Haarlem), the Natural History Museum in London and the Astronomical Observatory in Cordoba (Argentina) led towards various projects including exhibitions at The Drawing Centre, New York (2007), Apex Art, New York (2008), Le Plateau, Paris (2009), Gasworks, London (2012) and La Verriere Fondation D'Entreprise Hermes, Brussels (2013). Her proximity to institutions led Kopelman to begin observing the methodologies of scientists at work in the field and ignited curiosity as to how they framed and organized a subject that was vast, essentially dispersed, extremely dynamic and simply too hidden to grasp or approach all at once.

Também em 2012 inicia uma colaboração com o Smithsonian Tropical Research Institute (STRI), no Panamá, que continua ainda hoje. O STRI desenvolveu uma infraestrutura extensa para o estudo da biodiversidade nos Istmos Pananianos e, Kopelman, nesta parceria com o Instituto tem explorado assuntos como as lianas, espécies marinhas invasoras, manguezais e caranguejos violinistas. Associou-se igualmente ao World Glacier Monitoring Service (WGMS) e ao Swiss Federal Institute for Snow and Avalanche Research (SLF) que ajudaram a informar e impulsionar o seu estudo das paisagens glaciares e dos ecossistemas alpinos. Estes desenvolvimentos aconteceram durante um período de residência no Stiftung Laurenz-Haus, Basileia, em 2013.

This led Kopelman to spend a period of time at Manu Learning Centre, Madre de Dios, Peru in 2012, following which she joined a group of 40 scientists from Malaysia's Sabah Parks and The Netherlands Centre for Biodiversity Naturalis (NCB) on an expedition to Mount Kinabalu in Malaysia. A long-term collaboration with STRI (Smithsonian Tropical Research Institute) in Panama began in 2012 and continues. STRI has developed an extensive infrastructure for the study of biodiversity on the Panamanian Isthmus and Kopelman's partnership with this institution has enabled her to explore subjects such as lianas, marine invasive species, mangroves and fiddler crabs particular to the region. An association with the World Glacier Monitoring Service (WGMS) and the Swiss Federal Institute for Snow and Avalanche Research (SLF) have helped inform and propel her study of glacier landscapes and alpine ecosystems. This development occurred over a period of residency at the Stiftung Laurenz-Haus, Basel in 2013.



1. Stones mentioned by Liburnau in his 'mineral' sea colour scale (1898)
Rochas mencionadas por Liburnau na sua escala "mineral" da cor do mar (1898)

2. Snap of Blue Grotto
Instantâneo da Gruta Azul

3. Water column – scale 1:10
longer visibility record taken with the Secchi Disk
Coluna de água – escala 1:10
registo de visibilidade mais longo obtido com o Disco de Secchi

4. Phytoplankton drawings
Desenhos de Fitoplâncton

5. Water column – scale 1:10
shortest visibility record taken with the Secchi Disk
Coluna de água – escala 1:10
registo de visibilidade mais curto obtido com o Disco de Secchi

6. Enlarged version of Forel-Ule Scale
Versão aumentada da Escala de Forel-Ule



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