Water Under Investigation: Artistic Photomicrography as an Alternative Approach to Understanding Issues Related to the Ecological Management of Urban Water Resources

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Abstract

Stormwater runoff from urban areas transporting sediments and nutrients is a big problem of the management of water in cities. Modern sewerage networks designed to move industrial and human waste away from urban areas are not always capable of transporting the tons of polluted stormwater which, in turn, causes serious flooding This is a challenging problem of science and technology. There is, therefore, an opportunity to explore some concerns related to the environmental impact of water pollution in an artistic context. The author proposes her artistic photomicrographs of micro-scale drops of water from urban waterways after evaporation fuses science and technology with art. She uses Scanning Electron Microscope as a medium and does so in an attempt to discover morphological features of the patterns related to water contamination. Scientific photography used as a creative art form has a potential to communicate issues related to the ecological management of water to the general public.

Keywords

Photomicrography, scanning electron microscope, art &science, ecological management of water.

Introduction

Cities face the problems caused by climate changes, demographic changes, more demands on open space and parklands, and aging infrastructure. [1] Today, it is an urgency to rethink the use, reuse and management of urban water and waterways in reflection to these problems.

This project aims to create a greater sense of awareness to our surroundings, in the sustainable management of water resources in urban environments, in particular, through photomicrography.

Scientific tools have brought new ways of seeing the world. Usually preserved for scientific use – now the artist will apply this technology to the purpose of art. Scientific photography made by the microscope can be considered non-aesthetic since its primary purpose is to convey accurate information rather than beauty. However, its ability to record material in addition to that which is merely informative allows it also to serve subjective and aesthetic purposes.

During my projects, I created images using Scanning Electron Microscope. They represent selected droplets of water collected from different urban water systems like rivers, ponds, creeks and even puddles. My studio research designed to deriving a combination of lab experiments and photomicrography that investigate the pattern formations in drying water droplets. The structure of the water impurities visually transforms and leads to a unique connection between evaporation and solidification. This natural process of drying reveals the inherent informative capacity of droplets which can be seen as the shapes, patterns, details and characteristics of water. Represented in photomicrographs, they can be used as a visual vocabulary for urban waterways which can be studied with image analysis. Samples of unknown chemical substances may be classified by using scientific techniques of image recognition.

To engage effectively with photomicrography as a social phenomenon, it is crucial for an artist to demonstrate an understanding of its ‘scientific’ protocols of representing. But will the viewer be familiar with what he or she sees in scientific images, what will he or she get from them? An artist using the scientific imaging device as a medium it is not a translator for all sort of purposes which every science has. I place (virtually and physically) scientific image in a ‘hostile’ artistic environment. In the gallery space, the significantly greater scale of photomicrographs, their impeccable details and photographic materials used lead to the disconnection between pure data and the form of this data. Artistic photomicrographs of water after evaporation refer to the viewer’s creative ability to perceive previously unseen as well as to observe natural phenomena over and beyond the directly visible. This may be a way to communicate ecological issues of water.

Background Study

Waterway pollution is recognized as putting urban ecosystems around the world at risk. A rainfall that washes oils, metals and nutrients directly from streets into rivers and seas is hard to treat. [2]

My current residence, Brisbane, Australia, occasionally experiences severe localized and regional flooding. While flooding is a major issue facing the City, Urban Stormwater[1] Management Strategy attention is

[1] Stormwater is rainwater or melted ice or snow running off elements of the built environment, e.g. hard surfaces like roofs or roads.

also focused on management quality of stormwater that can pollute waterways, cause erosion, sedimentation and increase flooding. [3]

"One of the most significant sources of such pollution in Brisbane is stormwater runoff from urban areas and, in particular, the sediment and nutrients in this runoff. For example, it has been calculated that, in Brisbane alone, stormwater from uncontrolled residential building sites has the potential to carry approximately 200 000 tons of sediment to the River and Bay per year. We now know that it takes only ten parts of fine sediment per million parts of water on a sustained basis to kill off seagrass meadows in the Bay. Loss of seagrass leads to adverse effects on commercially important fish species and endangered species such as dugong and green sea turtles". [4]

Minimizing the environmental impact of urban stormwater runoff is not an easy task, as the most of the City's drainage network was designed when it was considered that urban stormwater runoff was innocuous. It must be taken an approach relying upon community education, water sensitive urban plans, best practice construction and maintenance techniques, in addition to innovative stormwater treatment methods. [5]

The arts sector has a potential to communicate ecological issues to the general public through the art practices. [6] For instance, a collaboration of science and art might give much more potential for investigation and discovery. Photomicrography, in particular, has a potential to communicate to general public from both a scientific and a cultural perspective. This may be a way to analyze our surroundings more critically through numerous methods of seeing if combine science and art as a whole.

The Unseen Structure of Water

Both art and science have an experimental nature. There are some different ways of representing and perceiving an object that may be valuable for science but not all. Scientific approach appeals to me due to the amount of useful knowledge that can be gained through the study of water through scientific photomicrography which gives new facts, deepening understanding the harmful impact of stormwater runoff.

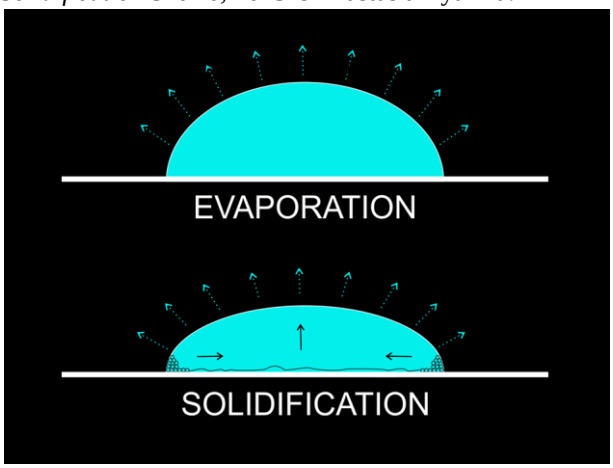
The evolution of the modern microscope has brought the study of microorganisms far from the age of Robert Hooke, who built his instruments and drew pictures of what he saw. Microscopes have been developed to use x-rays, sound waves and even electron clouds which surround all matter to form the image. However, the motive for using microscopes remains the same: being able to see and show the micro world invisible to the naked eye. [7]

The problem of visualizing internally inherent features of water: organic impurities, a chemical change in the structure (due to the inherent features), drying, crystallization, etc., is that these features are invisible to the naked eye and lay outside of the direct sensation such as touch. There is no way to see water impurities without the help of the microscope, sample preparation methods, modern technologies, and professional microscopist's work.

The composition of water, even that which is free from the mineral and organic impurities, is complex and diverse because water is constantly in contact with all sorts of substances. The variety and frequency of unusual properties of water are determined by the physical nature of its atoms and atoms association in the molecule and the group-formed molecules. Water behaves as a universal solvent. Different substances such as solids, liquids, and gasses can be dissolved in water.

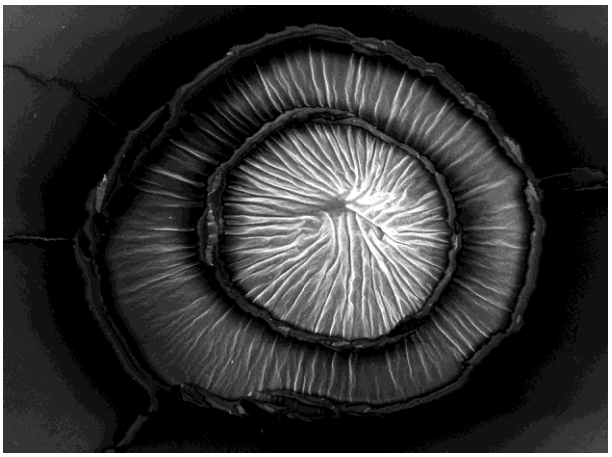
Evaporation droplets method has gained much interest during the last decade. In my research, I use the process of evaporating as an alternative and unusual way of visually presenting the composition of the water.

Figure 1. Anastasia Tyurina, *Drop Evaporation and Solidification Sheme*, 2015 ©Anastasia Tyurina.



"A phenomenon of self-organization of particles suspended in fluids into nano- and microstructures during droplet evaporation is studied by researchers working in different fields of science such as the deposition of DNA/RNA microarrays, protein microarrays, DNA molecule stretching, drug discovery, inkjet printing, and manufacture of novel electronic and optical materials, including thin films and coatings. There are also studies reporting the application of the droplet evaporation method as a diagnostic tool for medical purposes. It was possible to show that the droplets of biological fluids created different patterns depending on the patient's state of health and allowed the diagnosis of several disorders". [8]

Figure 2. Anastasia Tyurina, *Garden Pond*, Photomicrograph, 2015 ©Anastasia Tyurina.

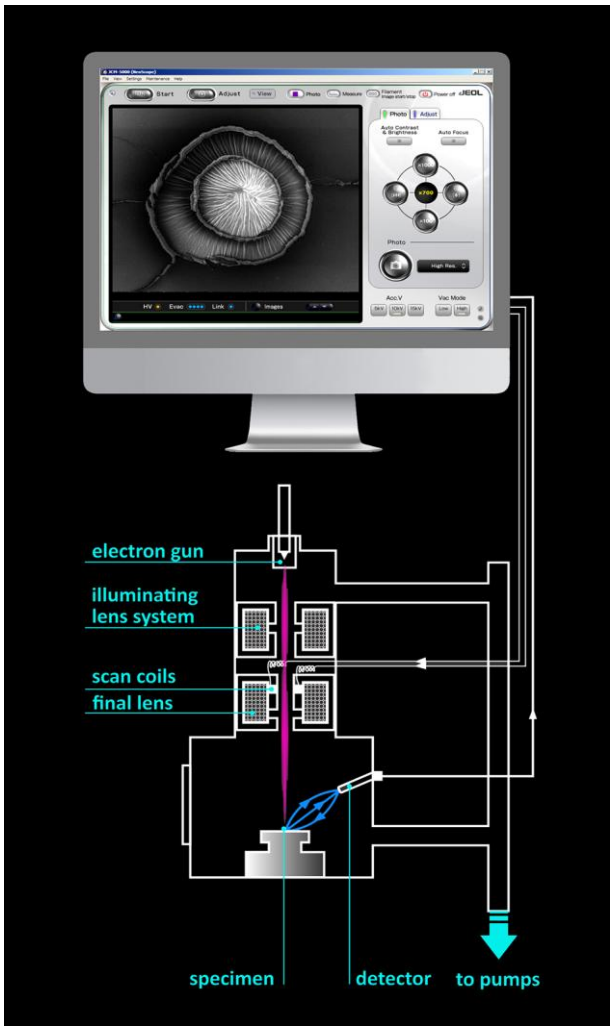


During experiments for my project, the structure of the water impurities visually transforms and leads to a unique connection between evaporation and solidification.

Scanning Electron Microscope and Artistic Use of Photomicrography

Image making using Scanning Electron Microscope (SEM) is a particular area of scientific photography. SEM work is based on very precise scanning of the surfaces of objects using an electron beam that provides a deep focus effect. [9] The process of producing a picture by using SEM is camera-less. There is no light although it seems to come from a particular illuminant; in fact, the contrast depends on the tilt of the plate with a sample positioned to the electron beam hitting it only. Additionally, the microscope cannot reproduce colours.

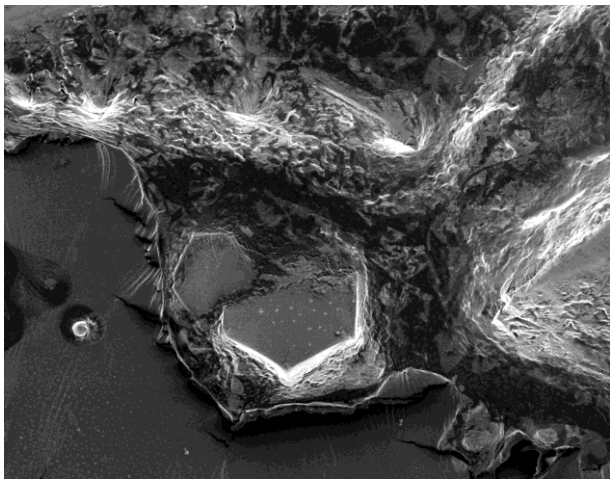
Figure 3. Anastasia Tyurina, *The principal sheme of SEM work*, 2015 ©Anastasia Tyurina.



Modern microscopy allows scientist not only see/observe the natural phenomenon in the greater magnification but make images of them. However, captured by a focused beam of electrons, images made by the SEM are not photographs. The apparatus tries to recreate a reality that is not a visual phenomenon. Interestingly, scientists try to analyze SEM images through their visual representations: photomicrographs.

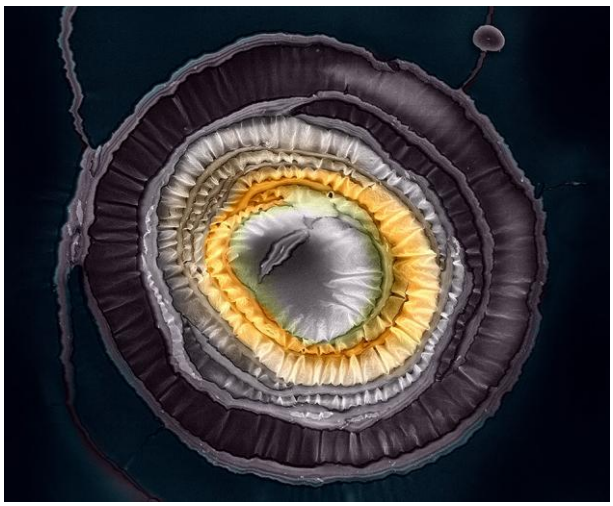
Technically, any object placed in the chamber of the SEM has to be dry. Supposing the evaporated water is no longer water in any sense, its dissociated drops contain traces of solids that represent what water composition used to be. The evaporation of droplets of different suspensions often leads to the formation of complex patterns, such as ring structures, rhythmic patterns, dendrite-like patterns, fractals, and hexagons [10].

Figure 4. Anastasia Tyurina, *Main Beach, The Gold Coast*, Photomicrograph, 2015 ©Anastasia Tyurina.



With the emergence of digital era advanced scientific technologies provided artists working with the SEM with new ways of representing subjectivity through images. Some manipulations can be carried out by adjusting the microscope settings and others through the interface of its supporting software. Additionally, artificial colorization can be made with the help of graphic software such as Adobe Photoshop.

Figure 5. Anastasia Tyurina, *Brisbane River*, Coloured Photomicrograph 2015 ©Anastasia Tyurina.



Artistic photomicrography does not deny the relationship between data and visual forms of data. However, it is not the primary focus of artistic photomicrography. Certain

visual forms are not only signifiers of water contamination but 'expressive' portraits of selected water reservoirs. As an artist, I am aiming to find a different meaning for the object of the scientific investigation (water sample) by exploring it visual features of such forms.

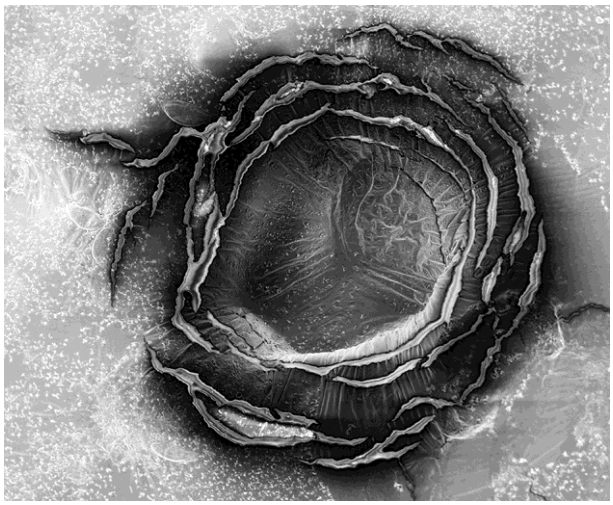
Artistic Photomicrography as a Communication Tool

Art and science are trying to use different languages to achieve their goals; nevertheless, the visual arts became a tool of science. Scientific photography aims to record and illustrate data and experiments with specific purposes that each science has. Particularly in photomicrography, the image is the investigation tool of the object and, at the same time, a communication tool for results of the investigation.

Dissolved hazardous chemicals do not always affect water visually; therefore, water contamination is often unseen. Artistic photomicrography of water drops aims to point out the effect of the careless attitude to the environment through 'expressive' visual signifiers of water pollution.

My artistic intervention of a scientific process through experimenting with the SEM is a way to transform the micro-world to a macro level. The captions for my photographs refer to the sites where water samples were collected. It is intriguing as they can resemble aerial photographs of topographic features of particular water reservoirs. This can create a sense of a special place for viewers and allows them to see the problem of reasonable management water from a different angle.

Figure 6. Anastasia Tyurina, *Mount Gravatt Pond*, Photomicrograph, 2015 ©Anastasia Tyurina.



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Author Biography

Anastasia Tyurina is an Associate Professor at the National Research University of Electronic Technology, Moscow, where she teaches Graphic Design and Photography. She is currently undertaking her PhD in the interdisciplinary field of Artistic Photomicrography at the Queensland College of Art, Griffith University. Throughout her academic and artistic career, Anastasia has been interested in obtaining new knowledge of the relationship between science and art. Her doctoral visual art project is concentrated in the specific area of scientific photography made by the Scanning Electron Microscope (SEM), a tool that has expanded the boundaries of observation and representation of the micro world since it was introduced to scientific research in the mid-1960s. By exploring the interplay between the indexical and iconic modalities in the process of evaluating scientific photomicrographs, Anastasia tries to imbue them with new meanings and thus turn scientific photography into a creative source of communication to the general public.