Abstracts from the Spectra 2018 Symposium Part 2

Visualization

**TOPIC: VISUALIZATION**

**CREATIVE USES OF REMOTE SENSING TECHNOLOGIES: LANDSAT DATA AND THE “OPEN AIR” PROJECT**

Grayson Cooke

For the past 40 years, Landsat satellites have been circling Earth. They orbit at around 700 km from the Earth's surface, completing a full orbit every 90 minutes and returning to the same location every 16 days. Equipped with sensors that record reflected electromagnetic radiation in the visible light and infrared wavelengths, they are used by scientists to track environmental change over time.

Since July 2017 I have been working with Landsat 8 satellite data from Geoscience Australia in Canberra and with their Digital Earth Australia platform [1]. In that time I have produced a series of still images that form montages of different environmental and atmospheric conditions in a single location over the span of a year [2]. I have also produced the feature film *Open Air*, which features time-lapse satellite images of Australia set against aerial macrophotography of the paintings and processes of Australian painter Emma Walker, accompanied by the music of Australian cult band The Necks [3].

This project uses the aesthetic frame of visual music and the combination of intimate and remote views to develop an artistic rendering of the forces that shape Earth. I am interested in what it is possible to think and feel when we release remote sensing from an instrumental purpose. For example, one of the great joys of the project was using “false color” mappings for cloud cover, which involves mapping the near and shortwave infrared bands of a satellite image to red, green and blue in an output image; the result is splashes of pink, red and orange clouds across a turquoise land. Ironically, this is one of the key factors that differentiates my approach from the more instrumental approach taken by geoscientists, who must use complex algorithms to filter clouds out of the data, because clouds block a clear view of Earth.

I am inspired here by Evelyn Fox Keller’s notion of “dynamic objectivity,” a rethinking of scientific objectivity that gives space to a sense of empathy and connectedness to the planet that gives rise to the phenomena we examine [4]. Empathy involves understanding between beings that are alike, and it requires closeness and intimacy to develop. The idea of bringing intimacy to remote sensing has a corollary in the Earth sciences, where “ground truthing” and “proximal sensing” modulate and validate remotely sensed data [5]. This is precisely what *Open Air* does in its crossbreeding of images sourced at two divergent scales: the macrophotographic view of Emma Walker’s paintings and satellite images gathered at low Earth orbit.

Mustering multiple pathways into thinking about and feeling the Earth is crucial today, as the force we exert on this planet becomes more and more evident. A dynamic objectivity does not discard the empirical framework of scientific imaging—rather, it builds upon this framework, inflecting it with extradisciplinary orientations, folding multiple perspectives, close and remote views, and emotional, sensual and conceptual apprehension into the imaging and understanding of Earth and our place upon it.

**References and notes**

2. See www.graysoncooke.com/12months.

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GALILEO’S HERITAGE:
ASTRONOMERS, ARTISTS AND DEEPER DARKER BRIGHTER

Pamela Bain, Carolyn Lewens, Christopher Fluke, James Josephides, Jeffrey Cooke, Igor Andreoni, Roger Alsop and Stephanie Sacco

Many great astronomers of the Renaissance were also great artists. Through drawing and illustration, astronomers could share, discuss and debate what was seen via the augmentation of lenses and mirrors. As telescopes grew in size, the increased level of detail revealed challenged the skills of many astronomers. The dawn of the photographic era in the nineteenth century—a move from subjective to objective image collection—signaled the end of the astronomer-artist. In a return to astronomy’s artistic roots, Pamela Bain and Carolyn Lewens led weekly workshops with research staff and postgraduate students from Swinburne’s Centre for Astrophysics & Supercomputing. Their creative outcomes were displayed alongside Bain and Lewens’s professional work in DEEPER DARKER BRIGHTER [1].

DEEPER DARKER BRIGHTER was a diverse, multidimensional exhibition comprising paintings, digital prints from cyanotype photograms, kinetic installations, animations and models of telescopes. Collectively, these works speak to themes of cosmic mystery and the search for meaning, life and death through light and darkness, color and the shadows of things. DEEPER DARKER BRIGHTER was envisioned as an artistic response to Deeper, Wider, Faster—a global, real-time astronomical observation program at Swinburne’s Centre for Astrophysics & Supercomputing that seeks short-lived, transient explosions in the universe. A strong collaborative partnership developed between the artists and astronomers, culminating in the exhibition at the Town Hall Gallery. In our paper, we introduce the science, the art and the potential engagement of art and science for innovation in this project and in the various art-science projects that flow from it.

An extensive program of public events supported the exhibition, offering new opportunities for the gallery to work with neighboring Swinburne University to provide new audiences for both organizations. While many art-science collaborations focus on providing artists access to technology, data or scientific methods, a meaningful development was the establishment of regular astronomy-themed art workshops that offered astronomers a chance to experience creativity and expression of science through art. Astronomers participated in workshops and experimented with art techniques and conceptual approaches to image-making. They speculated on the science of their own research by reimagining core issues through interdisciplinary collaboration, creating paintings and models of telescopes and galaxies, several of which were displayed as part of DEEPER DARKER BRIGHTER. Based on insight gained from semistructured interviews we conducted with astronomer-artists participating in the workshops, several themes emerged: (1) a new appreciation of the role of creativity in their own science, (2) opportunities to express themselves through art and (3) the important social aspects of meeting new people and being provided an outlet for relaxation and disconnection from the stress and mental health challenges of postgraduate research.

The project was a successful introduction of art about science into the Centre. Art-science dialogue between artists and astronomers continues, now focusing on specific research projects such as the visualization of dark matter, spectroscopy and sensory methods of detection, and visualizing key icons of science and space history. Plans for further art-science exhibitions are underway.

Reference

1 DEEPER DARKER BRIGHTER exhibition, Hawthorn Town Gallery, Melbourne, Australia, 12 May–1 July 2018.

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Molecules as Artists—Patterns in Nature Revealed with Laser Light

Ula Alexander, Jason Gascooke and Warren Lawrance

Molecules around us are in a constant state of motion as they vibrate and rotate. We cannot directly observe the vast majority of this activity as molecules are too small for us to see. However, we can monitor their motion and energy changes through their interaction with light in laboratory experiments. Usually, the information from these experiments is presented as individual line plots that, although invaluable to the experimenter, do not convey to a viewer that this information relates to a dynamic process involving changes in the shape and motion of the molecules being monitored. The authors used images derived from energy patterns directly observed from molecules studied in the Laser Spectroscopy and Molecular Dynamics Laboratory, Flinders University, to convey the concept of molecular motion. The observed dot and band patterning in the images is a physical manifestation of quantum mechanics. The patterns are a demonstration of the rules of quantum mechanics, where molecules can only have certain energies as they undergo dynamic motion. The apparatus used to generate the images was designed and built by the authors to gain detailed insight into the energy and motion of molecules.

Presenting the data in a two-dimensional format creates a different and more detailed way of associating information with the data. From a scientific perspective, this information can concern the dynamic motion and energy changes of the molecules as they tumble and vibrate in free space. The method of data collection and display is a new way for scientists to recognize signature patterns associated with molecular processes yet also lets others see that these data patterns result from dynamic processes. Through their visual aesthetic, the images suggest the underlying dynamic motion from the observed harmonious and flowing patterns. These patterns can be interpreted by the viewer as natural, familiar forms that suggest movement and energy. The quantum world, usually invisible to our eyes but underpinning our everyday world, is made visible in these images through the interaction of light with molecules. The two-dimensional display of the data in these images, as opposed to a one-dimensional line-plot, reveals the delicate and finely structured energy changes happening in molecules around us. This work has been included in exhibitions such as the South Australian Living Artists Festival (SALA) and in film for Labocine (an initiative of Imagine Science Films).

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CREATIVE INTERPRETATION OF IMAGES CREATED BY SCANNING ELECTRON MICROSCOPE AS A PREMISE WITHIN IMAGE-CENTERED SCIENCE

Anastasia Tyurina

Scientific images made by the scanning electron microscope (SEM) pose a challenge for aesthetics, because beauty appreciation in scientific images relies on traditional aesthetics theories. When scientific imagery documents a scientific discovery, its creation and interpretation are ruled by epistemological principles, and the role of aesthetics is still contested within scientific interpretation. It is also a matter of degree the extent to which aesthetics contributes to the value of an image for scientific or artistic purposes.

There is a risk of misinterpreting images created by the SEM in science. The interpretation of imagery made by the SEM is confusing because the microscopic sample seems as if it is illuminated by the detector and observed in the eye’s aperture. Images made by the SEM are beyond light because the process of producing a picture is cameraless; captured by a focused beam of electrons, they are not photographs. However, the most commonly used SEM electron detector, called the Everhart-Thornley (E-T), typically uses a material that produces light when an electron collides with it—a scintillator. Thus the SEM does use photons, but they are converted back into electrons that are accelerated onto the electrodes of the photomultiplier, producing an increasing stream of electrons until the final collector is reached [1].

The past few decades’ use of SEMs in creating scientific images has formed a well-established visual culture within a variety of scientific disciplines. As Klaus Hentschel explains, SEM imaging became “an image centered science in the sense of being even totally dependent on photographic images as basis of all further processes of inference” [2].

When using the SEM for scientific imaging purposes, scientists are aware of the occasional overinterpretation of photomicrographs, given the human brain’s tendencies to recognize patterns, find relationships and connect concepts when processing complex visuals. Taken as accurate and proven, such “misinterpreted” images are the product of “bad” or “false” data or documentation. However, when the audience is encouraged to evaluate the aesthetic criteria and the new meaning associated with it, rather than the scientific information such images contain, then the justification and proof of their scientifically rigorous content are no longer required: Images start to tell their own unique stories if they are conceived in an artistic context. Moreover, in some senses, “misinterpretation” is desirable for an artistic context. It encourages seeing a horizon of meaning of what was previously unseen as well as referring to the creative ability of the viewer to observe phenomena beyond the directly visible.

The paper abstracted here discusses the value of art within such “misinterpretation” and examines the function of the artistic manipulations through exploring the ambiguous nature of imagery produced by the scanning electron microscope. The paper also argues that SEM images, being meant to have value as objective scientific documentation, do indeed fulfill this expectation; at the same time, these images can also have aesthetic value. If they serve the purposes of art, images made by the SEM require new aesthetic criteria for their evaluation.

References and Notes


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