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Phasmagraphy: A potential future for artistic imaging

ABSTRACT

In recent years, a rising interest in scientific imaging has become apparent, in art production and in thematic exhibitions, as well as in popular media and advertising. Images captured by, and supposedly read through, machines open up a new era – not only for an as-yet-undefined aesthetic journey, but also to reveal insight into a normally invisible layer of reality. A wide range of techniques is already well established – not only in science, but also in an artistic context. Based on an overview of different media and their applications, the term phasmagraphy is introduced to be applied to the expanded boundaries of the visible photographic spectrum to the adjacent wavelengths beyond full-spectrum photography.

KEYWORDS

expanded photography
phasmagraphy
beyond the visible spectrum
scientific imaging in media art
artistic research

1. INTRODUCTION

Many species can see more than humans: possibly faster, in different light ranges or with wider angles, in higher resolution or in more colours. But even if they are able to sense through the skin and other boundaries, they rarely see bones, heat or volume and, naturally, cannot keep those images. Homo sapiens, nonetheless, has found methods not only to explore but also to capture and preserve what is not visible to the eye without amplification tools. Only the machine can compete with fauna's range of vision, having surpassed it already in most respects.

Media artists have tended to push the boundaries of what is possible since the days the electrical current was discovered, and have ventured to collaborate

with scientists, applying scientific tools in an expanded context – and also popularizing those developed in labs for specific purposes. But technological advances in image acquisition have spread from science labs and medical institutions not only through artists: they have become accessible for wider groups of users at competitive prices. For instance, an attachment to capture thermographic images is available for mobile phone cameras – mainly for technical inspections. Also the popular game sensor Kinect™ was equipped with infrared and depth-sensing capabilities, techniques initially developed for military purposes. Panoramic cameras for the price of a point-and-shoot camera expand our vision to a full sphere. I propose that it is only a question of time until not only scientists and artists will apply expanded image acquisition tools in the same way as colour superseded black and white photography. To emphasize my proposition, I will introduce several examples of well-established artists, who visualize what is not perceptible for the naked human eye. Furthermore, I will provide a brief insight into my artistic practice with imaging technologies, and also propose an expansion of the term photography to *phasmagraphy*, in order to encompass the spectrum of electromagnetic wavelengths. Finally, I pose the question of whether the images are at all comprehensible, and the possible repercussions for our view of the world.

2. CAPTURING THE INVISIBLE – A BRIEF OVERVIEW

The spectrum of electromagnetic radiation contains only a small range of wavelengths visible to the human eye; a much larger range can be recorded by optical means. Representation of light in painting and reproduction in photography concentrates on a band between roughly 390 and 700 nanometres (nm=one billionth of a metre). Most scientific imaging techniques of interest for my research utilize a scope beyond this spectrum and distinct techniques other than the established lens-based recording.

Since the photo-camera has become a highly developed feature among many models of the ubiquitous smartphone, since pictures disappear as fast as they are shot in the noise of the never ending stream of imagery, and since contemporary photography does not have anymore the limitations of traditional analogue photography – it has become difficult to still take pictures that are memorable and unique. But the challenge of exploring invisible areas and unknown territories, of working with inconvenient materials and complicated machinery, is a field worth to explore.

I propose that the different manifestations of image acquisition could be subsumed under the term phasmagraphy, as it includes more than the visible light used in photography (from Greek phōs=light expanded to φάσμα

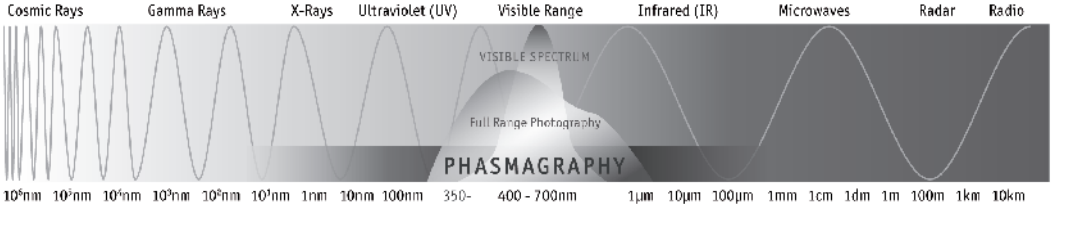

Figure 1: Electromagnetic spectrum: the visible and the phasmagraphic range, diagram by the author. © 2017 Elke Reinhuber/VG Bild-Kunst, Bonn.

phasma=spectrum and γραφή graphé=drawing/writing), but can be explored with related methods.

I will provide an overview of the different technologies, which artists (in particular photographers and filmmakers) have adopted from laboratories, beyond exposing silver gelatine on celluloid or the digital chip with visible light through an optical lens, and which could be defined as *phasmagraphic images*.

2.1. Radiography

One technique that frequently appears outside the science lab and medical institutions is radiography. The wavelength of X-rays ranges from 0.01 to 10nm; in between are bands of ultraviolet and gamma rays, which provide visualizations of different densities of matter. They are widely applied in medical imaging and, more recently, in security and border controls. Energy-intensive X-rays can pass through objects and are captured in the back on sensitive film – or nowadays with a digital sensor.

Röntgen's first successful, though slightly blurred, image shows a hand, or rather the bones and joints of his wife's fingers, including her rings. Almost a century later, in 1979, German Australian photographer Helmut Newton carried nude photography to extremes with X-ray images of models wearing jewellery. In these images, the skull is visible, with the outline of a necklace below. He used the same technique in 1994 in a spread for French fashion

Figure 2: Hand mit Ringen. *The bones of a hand with a ring on one finger, viewed through X-ray. Photoprint from radiograph by W. K. von Röntgen, 1895. Source: Wellcome Library, London. Wellcome Images. Public Domain.*

magazine, *Vogue*®. These photographs were more detailed than their predecessors, though bracelets and ankle chains were visible only in contours on the skeletal images of female hands and feet. While the images did not reveal much detail of the jewellery, it was easy to understand what the photographer was after. The medical image was already well established and the unusual representation is, in my opinion, Newton's best and most creative photographic work by far; I understand the series as a self-ironic representation of his usual long-legged and high-heeled, almost nude females. Instead of looking just through the covering layer of the models' clothes, the voyeuristic desire only ends at the bones. The images also reveal the shocking anatomic deformation of the models' feet (cf. Ahmady et al. 2014).

Another reference to the first X-ray image, with similar details, is *X-Ray of M.O.'s Skull* from 1964, a self-portrait by surrealist artist Méret Oppenheim. The silhouette of her skull, the hinted outline of her face and hand with finger- and ear-rings suggested a new era of portraiture – although it remained very nearly unique.

Though even earlier, the use of electromagnetic waves of high energy and short wavelength were not limited to still images. American artist Barbara Hammer discovered a curious treasure, which she incorporated in her video *Sanctus* in 1990. In the 1940s, Dr James Sibley Watson developed a method of shooting movies on X-ray-film, the so-called *cinefluorography*, which he employed more than 10,000 times for his radiology examinations. Besides those medical surveys, he investigated human movements: the films show individuals in the process of drinking, swallowing or digesting (Ramsey et al. 1959).

One of the more recent projects, which caused a small sensation, appears to be a 'medical pin-up calendar' by the LCD-screen manufacturer Eizo®, showing X-ray images of models in typical pin-up poses. Although the radiation doses for capturing an X-ray image for medical purposes is usually

Figure 3: Technician taking an X-ray fluoroscope of a patient, 1940. Source: National Cancer Institute, AV Number: AV-4000-3979, author unknown. Public Domain.

no worse than that experienced on a long-haul flight, the public learned with relief that the graphics were merely computed renderings. Oddly, the images suggest a reference to the pin-up girl that was unofficially and anonymously rendered with huge effort in 1956 and recognized as the first piece of computer art (Lee 2014). Different, though, is the process of creating pictures, which has been used by an increasing number of artists, among them Nick Veasey. For almost 30 years, he has used X-ray as his artistic tool. His purpose-built studio provides protection against the radiation produced by his equipment, usually more intense than that used in medical environments. Big objects, such as buses or even planes, surprise the viewer by providing insight into the objects' normally invisible structures. They are scanned in small sections with cargo slice-scanners, equipment usually used at border controls to search for illegal immigrants, then digitized and montaged to create the final image (Veasey 2008: 73). Human beings scanned for Veasey's image compositions, however, do not suffer from radiation: he works with dead bodies arranged in different poses (2009).

Distinctive densities of material deliver insight into human bodies, animals, plants – all kind of objects. Solid materials, such as bones or metal, show up clearly; soft tissue or fabric seems almost transparent. Though achieved through different transparencies rather than densities, I observe an aesthetic similarity to the lens-less photograms, specifically Man Ray's *rayographs* with their opaque, semi-opaque and translucent sections.

The aesthetically appealing images grew in popularity through their use in advertising campaigns. However the recognition lies not only in the visual attraction of radiography in its graphical simplicity and reduction, but also in our curiosity about what lies just below the surface. After the early approaches to applying short wavelengths for plane and stereoscopic stills and moving images beyond their medical purpose, X-ray has become popular among certain artists (such as the life-size self-portraits of the artist group Tromarama, *More We, Less Me*, 2011) and has conquered billboards, magazines and some packaging on the supermarket shelves.

2.2. Thermography (far infrared) and IR (near infrared)

With thermographic cameras, it is possible to detect radiation in the far-infrared range (FIR) on the other side of the spectrum and display the amount of energy emitted, transmitted and reflected by an object. A retrospectively added colour scale applied to the data helps distinguish the range of temperatures. Near-infrared (NIR) lies closest towards the visible range. With infrared-sensitized film or thoroughgoing digital sensors (actually cameras without the IR filter), life itself can be transfixed onto the medium. Trees, forests – all living beings – are easily discernible in this part of the spectrum and surfaces, which look alike in the visible light show their distinct qualities.

Visualization with thermographic imaging is different to X-ray. Instead of simplifying the image by ignoring colours and focusing on the contours and the often-unexpected insight showing what lies below the surface, a wider and mostly unfamiliar spectrum is added. It displays that which is not visible with our eyes at all: a map of the heat reflected by the examined body.

The Japanese fashion brand Uniqlo™ launched a marketing campaign for their Heattech™ fabric with models in chill-defeating shirts, apparently captured with thermography.[1] The colourful pictures seized the public's attention, although there is some question as to whether they were

1. Though some images state in small print: Computer-generated illustration, not actual product photography – as it might be valid for many product-shots today.

immediately comprehended by a broad audience. By disregarding a temperature scale next to the thermographic representation, usually displayed in scientific contexts, the image might even be read as a colourful printed pattern on the shirt. I suggest that due to a growing awareness regarding ecological matters in energy efficiency they were readable, at least in cold countries, where the detection of heat leaks in buildings through thermography already seems to be a widely popularized visualization. Also objects covered with heat-sensitive lacquer (cups for hot or cold drinks are most popular) provide some idea of the changes that may occur due to temperature. In addition to the advertisements, a thermography photo-booth was proposed. But one needs to be careful not to overstate the concept, translating it for example into ridiculous campaigns. An advertisement for Pizza Hut® in Mexico shows the perils of over-using this graphic vocabulary: a couple sits in a cold room enjoying a hot pizza, its red and yellow colours contrasting the otherwise blue environment. But why does the crotch of the male also glow in warm colours? Did the heat just reflect under the table, did the art-director try to add a joke by suggesting the meal as aphrodisiac – or perhaps that the pizza might cause diarrhoea?

If a more subdued colour spectrum is applied, the images can lead to an interesting artistic approach that represents what is not immediately recognizable with our eyes. The music video clip *Midnight* is a fine example: it was filmed in 2014 for the band Coldplay, directed by Mary Wigmore. All of the scenes are black and white or monochrome, and it is obvious that their easily recognizable content was not captured with an ordinary camera. The actual readout of the temperature seems in this case secondary: the unfamiliar thermal imagery was chosen for its aesthetic value.

Even in the days before digital imaging technologies took over, infrared film was capable of capturing wavelengths in the near infrared range (NIR) between 700 and 900nm. This technique gained great attention after Richard Mosse's work *The Enclave* was presented at the Irish pavilion of the *Venice Biennial* in 2013. The analogue false-colour film, Kodak® Aerochrome™, with which Mosse captured his large-format photographs, was initially applied to visualize the invisible, in particular in military research and aerial surveys. However, his photographs and multi-channel video-installation of Congo's war zone appear surreal, as the usually dark green of the vegetation was reflected in a vibrant pink.

To underline my argument for the rising popularity of the desire to expand the photographic spectrum, the Internet offers in abundance how-to guides on manipulating digital cameras for what is currently called full-spectrum photography or VNIR (visible and near infrared) which can capture the range from UV to IR, about 350–1000nm, with any common sensor.

2.3. Ultraviolet (UV)

Also achievable with manipulated cameras and filters lies ultraviolet light (UV),, at the other end of the visible range. Beyond the lilac light band, ultraviolet waves (between 10 and 400nm) can interact with certain materials, generating fluorescence or phosphorescence, which radiates back into the humanly perceptible spectrum.

Although her field is not predominantly photography, the renowned artist Yayoi Kusama provided a fine example of how to employ visible UV light in installations such as *I'm Here, but Nothing* (2000/12) for the otherworldly glow of her interiors. Fluorescent sticker dots fill an ordinary room. Their

reflection appears under UV-illumination like a hallucinatory veil in front of the furnishings.

Thomas Leveritt applies UV filtering to visualize the ultraviolet power of sunlight – or rather pictures its effects. Based on an earlier series of portraits which he captured in this particular spectrum, he ran a popular ad campaign for a brand of sunscreen. The images and videos compared faces under UV filter and how they are usually seen. The effective protection once sunblocker is applied looks as obvious as the damaged skin.

Both approaches to capturing the wavelengths at the edge of the visible spectrum for IR and UV are commonly executed with lens-based techniques with specific equipment, different to laser scanners, which will be described hereafter.

2.4. Data clouds

Lidar technology measures distance by illuminating a target with a laser and analyzing the reflected light, a technique which produces data rather than images. If a visible image is desired, the point model needs to be mapped onto a texture or a photographic image.

In 2008, the band Radiohead explored point clouds for their extraordinary music video *House of Cards*, a technique commonly applied for scanning cultural heritage sites and reproductions for 3D data. No classical camera was used throughout the production, only a Lidar laser scanner and, unlike the usual practice, the film was not mesh-mapped with photography. Therefore, the final result consists only of point clouds which represent the contours of faces, bodies and even environments. As in the video by Coldplay, the appeal of Radiohead's clip lies in the reduced optical sensation. To focus as spectator on the unusual technique seems effortless, since the visual content is easy to read. The video was directed by James Frost with the technical direction overseen by Aaron Koblin, who in 2005 devised visualizations of flight paths over

Figure 4: Depthmap of man sitting at a table, captured with Kinect by Elke Reinhuber. © 2013 Elke Reinhuber/VG Bild-Kunst, Bonn.

North America. His work was widely published, but despite being a visualization of eye-catching coloured lines, additional information about their actual meaning was required to understand the abstract network.

Although providing only a low resolution, with the appearance of the X-Box™ Kinect™, scanning data clouds became widely accessible for a consumer-level budget and the technique was comprehensively applied for artistic projects beyond gaming, as for instance interfaces with gesture control or 3D scans. Additionally, the device featured, next to an ordinary camera, a simple near-infrared camera. Nowadays, photogrammetry almost superseded laser-scanning as it became more accessible through affordable wide-angle action cameras, multi-camera arrays and drones as well as improved software solutions. Based on this technique, advanced 3D full body scanners are increasingly popular in professional gyms or at tailors' shops and might some time soon be part of every household,[2] as ordinary scales to measure weight currently are. But how they might be utilized as a creative tool – apart from the trivial 3D-printed 'selfie' figurine – is still a field to explore.

2. See for instance solutions such as Fit3D, Styku or Naked 3D Fitness Tracker.

2.5. Electron microscopy

Another technique to mention is microscopy – not only because of the expanded range of applied wavelengths, but in particular due to the scale, which is almost beyond visibility. Optical microscopy magnifies objects by using reflected light passing through multiple lenses, whereas electron

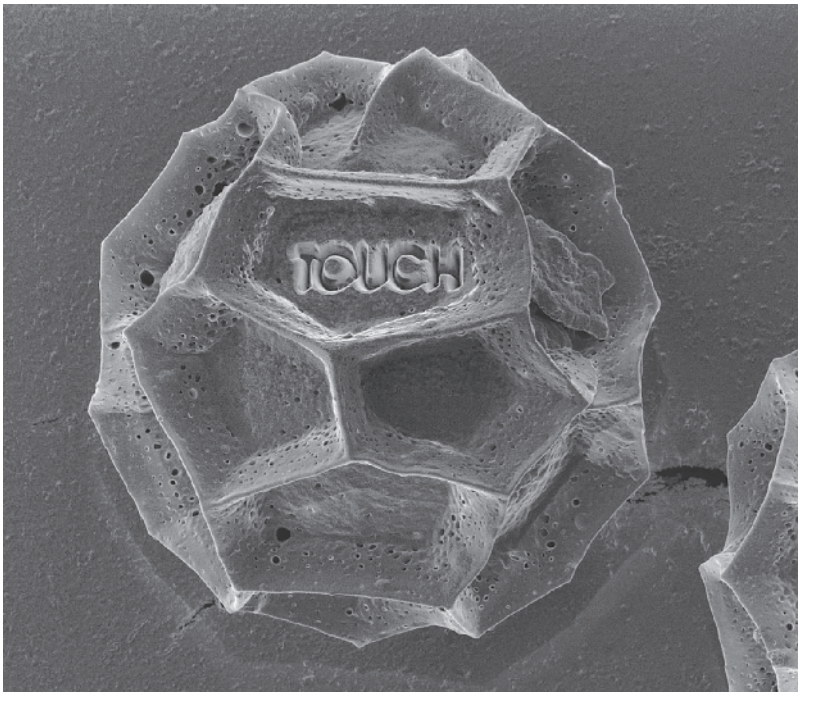

Figure 5: Stephanie Valentin 2002, arctotis 1*, 2002 from Pollinate, etched pollen grain – magnification 6500x, gelatine silver print 18×21cm. With kind permission of Stephanie Valentin.*

microscopy uses the smaller wavelengths of electron beams to create a higher resolution and magnify objects almost to the level of single molecules.

To see hugely magnified images of our natural surroundings, which take our breath away with their sublime beauty are what we expect in glossy magazines or in the enormous enlargements found in natural science museums. They provide the general public with an astonishing insight into some details of our 'blue planet'. Structures too tiny to be perceived by our eyes, or surprising mechanisms, make these images special. Most are visible thanks to microscopy at different levels of detail. Proof that interest in this technique is not limited to the realm of science lies in the work of many artists. Among them is Australian artist and photographer Stephanie Valentin: besides capturing pictures since 2002 of living organisms such as pollen, plants and insects with microscopes in scientific institutions, she has also magnified the objects into visualizations of hugely enlarged details. In some images, Valentin intervenes with ion-beam technology at the University of New South Wales' Electron Microscope Facility, to etch microscopic words, symbols and patterns on the surface and could be seen as a reference to the human imprint on nature.

2.6. Functional Magnetic Resonance Imaging (fMRI)

FMRI opens up a wide range of possibilities still to explore. Hydrogen atoms are induced to oscillate by powerful magnetic fields, generating a detectable radio-frequency signal that is received by antennas and computed into visual data. Providing the artist with a new toolset and a different vocabulary, current and emerging scientific image technologies nurture the artistic approach to develop their distinctive aesthetics. This is clearly illustrated by the example of Angela Palmer, who uses the fMRI image as a basis for her drawings and creates portraits of her own. Or Jane Prophet, who looks at the imaging process in the scanner quite performatively, by meditating on death while watching *Memento Mori* depictions, then using these images as a basis for 3D printing. The resulting life-size sculpture serves as the screen for the video portrait of herself, superimposing the MRI projection maps with real photography.

It is certainly too soon to articulate a conclusive theory about the future of this technique in an artistic context. So far, the bare generated image alone does not contribute significantly to the visual repertoire. Here, the additional data and time-based observations might provide sources for conceptual work or new forms of data visualization as in the example of the above-mentioned artists but also on the scientific cartography of prior unknown terrain. For the moment, I agree that 'the scientific image has no aesthetic, and only acquires aesthetic value when it is relocated in the art world' (Cazeaux 2016: 192), and perhaps never will, but those seized phenomena beyond the eyes' spectrum are worthwhile to survey.

3. ARTISTIC EXPLORATION

The above-mentioned examples can provide only a glimpse into the constantly expanding universe of visual vocabularies – there is more to see every day, for me as well. At the same time, platforms for scientists to expose images captured for scientific purposes are also growing although, as seen in competitions, their criteria differ from the conceptual and aesthetic approach of the fine arts. The image as evidence for a hypothetical assumption bears most value.

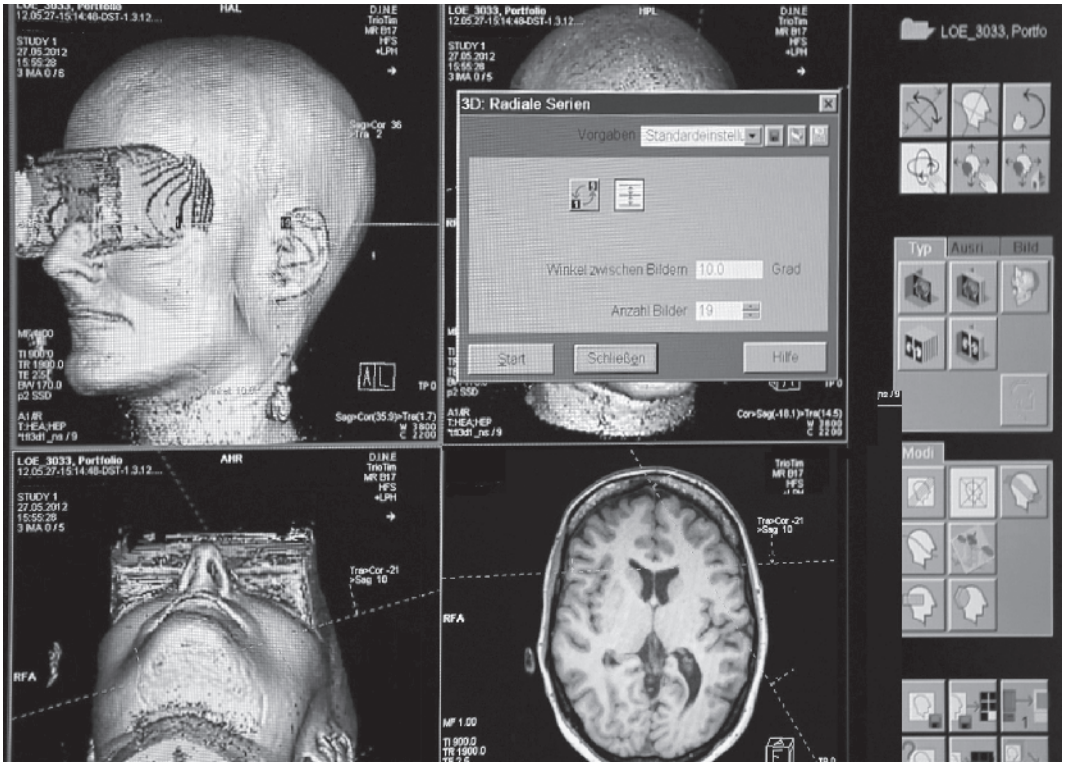

Figure 6: Elke Reinhuber, 2013, Decisions with 3 Tesla, *videostill. © 2013 Elke Reinhuber/VG Bild-Kunst, Bonn.*

As an artist myself, I keep exploring the possibilities of what lies beyond our visible spectrum, and not just in theory. Trained as an industrial photographer, I was always interested in film materials sensitive to different – in particular for the human eye invisible – wavelengths, although at this point I did not consider artistic or aesthetic possibilities, and was focused on the transfer of information.

During my Ph.D. research, in which I explored visualizing the difficulty of decision making in our choices-satiated society, as well as the next step – counterfactual considerations – I became interested in recent scientific imaging technologies such as fMRI. In this context, I joined the Machine Vision collective, a study project at HFG Karlsruhe. We had the opportunity to visit several institutions in the region, whose research on image acquisition, done mainly by machines, was to be read and analyzed through machines. The translation into visibility – in numbers or colour patches – could often be just a vehicle to facilitate explanations and discussions among humans.

My personal research resulted in an artistic video documentation of the application of fMRI to visualizing decision-making processes. It contained several interviews with specialists in the field, while the camera followed the experiment in which I took part myself (*Decisions with 3 Tesla*, 2012/13). Later, I employed thermography in a video projection for a ballet based on the mythological hero Orpheus. The state in-between life and death was visualized to perfection with heat sensing: living, breathing subjects are warm, whereas dead bodies cool down. The inspiration for the piece resulted from a lab visit

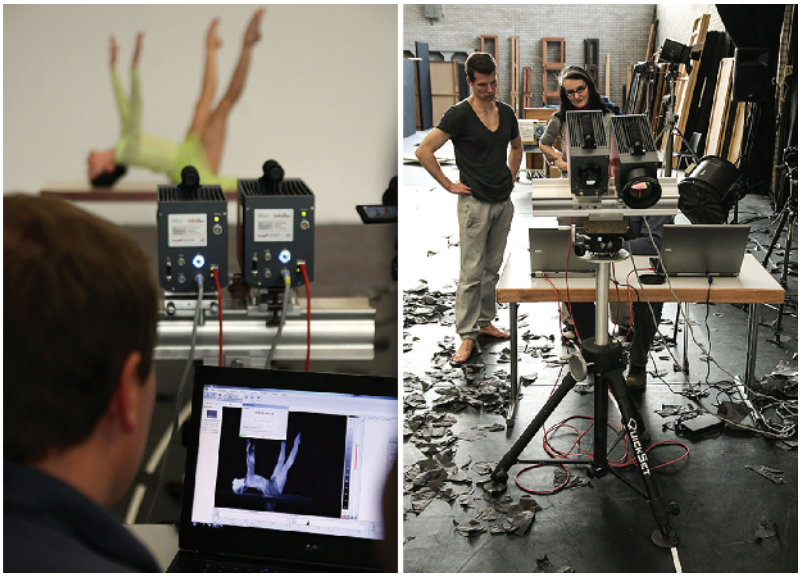

Figure 7: Capturing the thermographic video projection for the Ballet Orpheus. *Choreography Tim Plegge with music by Philip Glass and video by the author, Staatstheater Karlsruhe, 2014. © 2014 Elke Reinhuber/VG Bild-Kunst, Bonn.*

to the Fraunhofer Institute in Ettlingen, where thermography is a major field of research. For supporting me with the recording, my thanks go to Dr. Max Winkelmann and his special cameras, featuring high-quality Germanium lenses.

4. CONSIDERATIONS

As a media artist, I appreciate the privilege of crossing boundaries between disciplines, exploring new technologies and observing emerging tendencies in aesthetic concepts. In proposing the use of the term 'phasmagraphy', I aim to open the scope of photography to a wider range of the electromagnetic spectrum, for a new era of artistic imaging techniques.

With the partial overview provided above, I have introduced my point regarding the popularity of the expansion of photography beyond the visible. Furthermore, I suggest it has become obvious that the longer-established media, such as X-ray has already developed an aesthetic and conceptual significance with a range of artistic positions in the field, in particular when we look at specialists such as Mr Veasey, who works in a dedicated, lead-insulated studio and does not rely on collaboration with scientists in their laboratories.

For technologies such as fMRI, which are still not easy to access outside of specialized labs and are subject to high expenses and great effort, this application scope waits to be realized.

The technical research transferred into the artistic realm opens up new questions in an iconological field: even if the technology to capture a reality which is not visible to the human eye becomes commonplace, can the images be read by a wide and non-specialized audience? Do we need a new vocabulary to create, decipher and interpret these images? Only when the means to recognize this next step is widely understood in the photographic exploration

of the world, this time into the invisible, future generations will develop criteria to enquire into the distinctive layers of meaning, illuminating the hidden qualities of yet-unseen phenomena.

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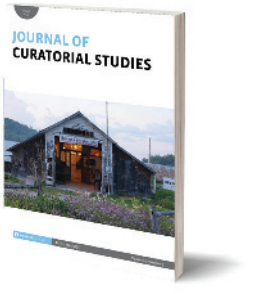

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The *Journal of Curatorial Studies* is an international, peer-reviewed publication that explores the cultural functioning of curating and its relation to exhibitions, institutions, audiences, aesthetics and display culture. As a critical and responsive forum for debate in the emerging field of curatorial studies, the journal fosters scholarship in the theory, practice and history of curating, as well as that of exhibitions and display culture in general.

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