THE ANATOMY OF OPTICS AND LIGHT

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I

What role does light play in the translation of flesh into image? Through a reflection on my art practice, this article positions light as an instigator rather than passive illuminator of knowledge. With the advent of new technologies which are able to emanate, record and capture light, our perception of the anatomical body alters and a new body is imagined. This phenomenon leads me to investigate not only how light affects what we see and experience in relation to the anatomical body, but also how these perceptions and experiences are articulated through images and engaged with outside of the medical context. I propose to examine these questions by exploring the relationship between the anatomist, the artist and the public audience in their shared observations of the anatomical body. Enacted within a notional space of an anatomy theatre – a space whose design and philosophy go back to the Renaissance – the questions and relations are addressed through a series of mediations and relocations of the anatomy theatre that I perform through my art practice.

This paper takes as its focal point my recent artwork, *Anatomy of Optics and Light* (2009),[1] where the theatre is translated from its medical incarnation into an art gallery installation. Readers can also visit the interactive screen space online), which is to serve as more than mere documentation of the earlier work. Instead, it becomes yet another act of translation, with the theatrical space of the gallery being transposed into the virtual realm.

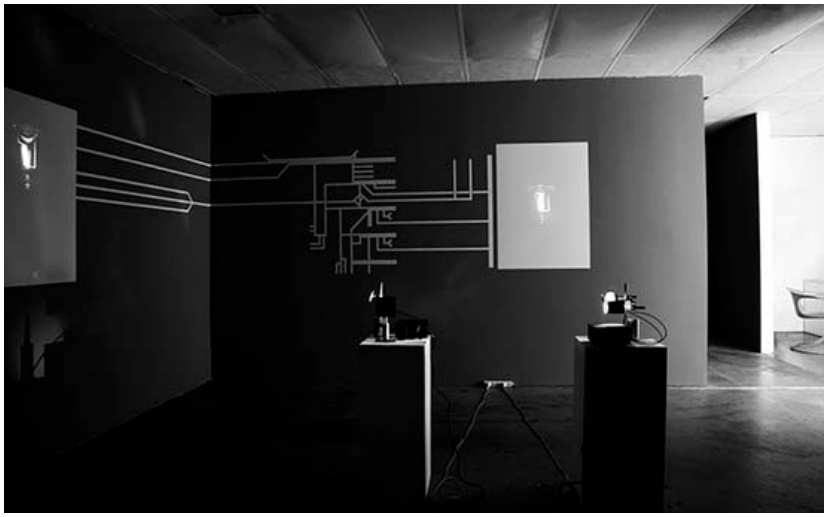


Fig. 1, Nina Sellars, *Anatomy of Optics and Light*, 2009. *View the installation by clicking on the image above, or by cutting and pasting the following link into your Internet browser: http://www.ninasellars.com/anatomy-of-light. You need to have QuickTime installed on your computer to view it correctly.*

This project has been devised as an investigation of the optical and technological dispelling of darkness in relation to bodily interiority. This process involves questioning the related representations and imaginings of the anatomical body which have been created by the interplay of technology and phenomenological experience. With the magnification of sight and the intensification of light, both enabled through various technological advancements, the viewer has been allowed to see what had previously lain invisible in the anatomical body. But just as importantly, if not more so, he or she will have been introduced to some new possible ways of thinking about human corporeality. As an artist who has experience of working within a medical context, I want to look at the production and representation of bodies in the realms of science and popular culture. We have to bear in mind here that, even in its scientific representation, the body remains embedded in culture and also that anatomising the body has always been a public – and not just scientific – concern.

II

The *Anatomy of Optics and Light* installation engages with multi-scale representations and imaginings of the body. It incorporates a diagram of a nervous system, which is visualised as a hybridisation of human tissue and light, and which exists as part of the technological environment. Magnified and extended across the gallery walls, it

escapes the usual diagrammatic confines of a page or screen and even eludes the artistic capture of framing. Instead, it gains its physical dimensions through the very act of installation. What is enacted here is not a body *within* a space; rather, a space is being defined *by* a body. In other words, viewers are presented with a spacious soma which invites a total sensory engagement with the abstracted corporeal structure. In a traditional anatomical theatre onlookers would gather in encircling stalls above a central stage where an anatomist would stand, opening a cadaver for display. However, in *Anatomy of Optics and Light* this schema is reversed. It is now the anatomical body intended for display that encircles the room, with the body that was to be viewed replaced by a viewing body. Viewers are thus not immersed in a representation of a visceral dissection room, nor are they invited to inspect a figurative wet body. Instead, they are surrounded by a diagram, with the discernable fleshy 'stuff' receding from sight and supplanted by a nervous system that has been translated into the diagrammatic language of electric circuit board design. It depicts the motor nerves that enable breathing and the movement of the arms, legs and head, showing the four main nerve plexuses – sacral, lumbar, brachial and cervical – that run from the spinal cord into the neck and limbs. Certain sections of the nervous system have been extended or stretched, but the linear order and connectivity within the individual plexuses have been maintained: the plexuses are stitched together to make a visually integrated whole, but not a whole coherent body. The term *diagrammatic language* signals that an abstract approach is being used here, which is produced through conceptualisation rather than an attempt to represent. The diagrams reveal a desire to understand and extrapolate ideas from appearances. *Appearing* and *thinking* are therefore not opposed to each other; rather, the former is the initial stage of the latter, with phenomenological engagement serving as an *a priori* to both.

The installation contains five devices, which I call *inverse camera obscuras*. They had been specially made for the exhibition. Each identical device is built from lathed brass. It houses a small light bulb and supports a ground glass lens with an adjustable diaphragm aperture. The usual working mechanism technique of the *camera obscura*, i.e. that of portraying an external scene onto an interior wall, has been inverted here, with an object contained within a small internal space being imaged and projected out. It is an interior that has been ousted for observation. The lens magnifies and projects the light emanating from a small bulb contained within the construction, so a 1-centimetre tall light bulb forms a 1-metre tall image on the

opposite gallery wall. The light here not only transmits the image but also becomes the image. The bulbs cannot be viewed or accessed directly; they are accessible to the viewer only as real time images (see fig. 2).

Fig. 2, Nina Sellars, *Anatomy of Optics and Light*, 2009, detail

Dust and small imperfections in the glass are magnified along with the glowing filaments, all in sharp focus, and offered up for close inspection, making visible what would have otherwise remained hidden. The multiple *inverse camera obscura* images link and illuminate the diagrammatic lines, but they also act to displace the central focus of the installation. The idea behind this set-up was to increase the impression of the installation forming a body/light environment, where one element does not dominate or act independently from the other. In other words, what we are presented with is a system or nexus of body and light. The body presented here is not only to be seen but also to be experienced via a process of all-sensory *listening*. It is a dispersed, abstracted body that exists, and surrounds the viewer, in the half-light of the gallery space. The externalised nervous system seemingly embraces the viewer both visually and aurally, with the power amps that provide the electricity to the *camera obscuras* creating an audible hum that permeates the room.

The combination of such simple technologies is aimed at exploring questions regarding how light affects what we see and experience in relation to the anatomical body and the ways in which these perceptions and experiences are articulated through images. These are questions that can be asked of the anatomical body's relation to light from the time of its inception as a science in the sixteenth century to its contemporary medical context. The proliferation of various anatomical images, both historical and modern, in medical science defines different approaches to the human body. These approaches are all a combination, in varying degrees, of theory, observation, culture and technology. We can compare, for example, a woodcut print from the first illustrated anatomy book *Commentaria* (1521) by Jacopo Berengarius da Carpi, figure 2, with a contemporary PET (i.e., positron emission tomography) scan, figure 3.[2]

Fig.2, *Commentaria*

Fig. 3, PET scan

Both images record light, which emanates out of an anatomical body, but they were made over four hundred years apart. PET scans are a record of a chemical reaction, brought about by an injection of radioactive materials into the body, which produces gamma rays that are emitted out from the body and then digitally imaged. The Berengarius woodcut also depicts light emanating out from the body, but here light symbolises 'philosophical and religious knowledge of the interior of the whole, or scripturally complete, individual' (Sawaday, 1995: 118), which is a reflection of the sacred beliefs of the era. Both images are laden with complex meanings and encoded with information. They may seem equally indecipherable and inaccessible to a lay person as they rely on being able to understand the context in which they were made and their intended use. It is also important to remember that anatomical images are never truly objective; they are created in the context of their time and are therefore subject to the technologies and beliefs of that time.

Anatomy of Optics and Light incorporates the use of contemporary technologies not only in the making of the *inverse camera obscuras* but also in the creation of the drawn images. There is a certain clinical precision to the schematic lines of the diagrams adhered onto the gallery wall, with the computer-generated graphics converted into laser-cut vinyl. The aim here was to uncouple the *line* from the *mark* of the artist and to emphasise instead the *cut* of technology. It is a visual analogy that refers to medical scans, with their precision, abstractness and absence of any *first-hand* mediatory mark of a human observer. As a comparison, in the Renaissance the process of manual dissection – guided by an observing, corporeal eye – was mirrored in the hand of the artist. The draw of the artist's blade equated the draw of the engraver's scribe, with both exploring and exposing the interior of the body. *Anatomy of Optics and Light* is purposefully devoid of the emotive direct interplay of the artist's body with a medium and is accompanied by the absence of an instantly recognisable image of the anatomical. Neither the corporeal body nor the mark of the maker are apparent in the installation. Instead, both have been visibly mediated by technology. The diagrams and the large rectangular sections that act as the *camera obscura* projection screens, as well as the exhibition wall text, were all produced by using the same method. The micro thin pearlescent-white vinyl, peeled from adhesive backing sheets in 4-metre long sections and pressed onto the dark walls of the gallery, creates a continuity in the work that links text, line and screen. At the end of the exhibition, when the power was turned off, the images and light patterns instantly disappeared. The elastic-like vinyl was then pulled and separated from the walls. It was in that moment that the diagrams appeared at their most corporeal, even fleshy, taking the form of sticky, knotted and visceral lines gathered on the gallery floor.

The installation was subsequently subject to another act of translation in the process of preparing this online article. It has been translated into compressed digital information to allow it to operate as an interactive panorama for the purposes of its publication in *Culture Machine*. This kind of visualisation offers an additional way of exploring and engaging with the space and takes the investigation of the body from the visceral 'cut and slice' to a virtual 'click and drag'. The eye of the viewer has been extended out from the body into the virtual room. Most importantly, it has become an eye that, to its greatest advantage, has been separated from a vestibular system. It is therefore not inhibited by dizziness or disorientation.

Speed and *spin* can thus be used as tools of investigation as it is now the room itself that is turning with the draw of a hand and not the viewer. The displacement of the audience and the dispersion of the body are also more apparent through the mediation of the Internet, where the viewer plays audience participant and is offered a certain anonymity and accessibility. The space is always available to the viewer to be entered, downloaded, transferred, sent, relocated, expanded, flattened and repositioned at will. It has been disconnected from its real world position and the volition of its maker.

III

One of the driving forces behind this project was a desire to explore how light illuminates, irradiates and exposes structures of an anatomical body to the receptive, ambivalent eye. Light alters our phenomenological engagement with the anatomical body and conditions our understanding of anatomical images. Engaging with images of the anatomical body created by penetrative light has become more than just an act of looking with the eye. It is now also an experience of listening *with the body*, in both senses of the term. In the *Anatomy of Optics and Light* installation the diagram, and the installation as a whole, are used as visual analogies for medical imaging technologies that in themselves can be elaborate to the point of distraction. The operational complexities of the equipment and the medium specificity of the images can promote a sense of wonder with 'scientific fact', which in turn can deflect attention away from the questions that I want to raise regarding ideological and phenomenological concerns. Therefore, the aim of the installation is to explore not so much the structures and technical processes involved in bodily imaging, but rather the network of relations and discourses around the anatomical body, both in culture and science, that have been initiated by these technologies. It is assumed that some preconceived ideas regarding what *anatomy* and *light* are – developed from their prior phenomenological experience of being embodied and embedded in the world – will be brought by the viewer into the art gallery as well as to the reading of this article. The project aims to raise questions about how far we can abstract an image of an anatomical structure before anxieties arise. How can we connect with a body that is not available to us as an easily defined and accessible object? We have to bear in mind that the anatomical body is always a construct, while anatomical images are abstractions of a certain *idea* of what a body is. The study of anatomy is therefore

also a study of contemporary ways of thinking, seeing and managing knowledge and information.

To proceed with this argument, we should perhaps clarify what anatomy *is*. The etymology of the term 'anatomy' can be traced back to the Greek *ana-*, meaning 'up', and *temnein*, meaning 'to cut'. In the medical sciences the term anatomy refers to the structures of the body, its organs and the systems. It is different from physiology, which describes the body's functions, and encompasses the movement and animation of those structures. Conceptualised in this way, the anatomical body can be understood as a still body, a non-moving body, and this remains equally true regardless of whether the body being considered is living or deceased. The anatomical body's condition of stillness relates directly to its intended use. It is a body to be investigated and recorded, whether by using modern medical imaging to capture images of the internal structures of the living body, or through the manual dissection and documentation of the deceased body. Anatomy can then be thought of not only as structures of the body but also as a method of questioning, an approach to the body that denotes, and was created by, scientific enquiry. However, by placing focus on the translation that happens when the *manual cut* of dissection – one which is guided by a corporeal eye – is replaced by the *virtual cut* of technology that is produced through the invisible penetration of light used in modern medical imaging, it becomes clear that this very method of questioning, that is to say *anatomy as a methodology*, has changed. With the cut, the spectacle and its visual realisation are now being performed as one instantaneous act. There is a sense of speed and immediacy that enters the discourse surrounding anatomy, but there is also an entirely different set of phenomenological engagements that are brought into play when light, from the extremes of the electromagnetic spectrum, is used as a medium to view and image the interior of a living body. In this discussion, I want to engage with the traditional meanings behind anatomy, with a view to redirecting them towards a more animated definition, one that will allow for a *quickening*[3] of the anatomical body through its active relationship with light.

When compared to the apparent stillness of the anatomical body, light can be described as an active, dynamic force – not only in a physical but also in an epistemological sense. Light itself is an unstable concept. It is difficult to define as it traverses various areas of knowledge in which it functions as both metaphor and physical agent. The philosopher Jacques Derrida refers to metaphors of light

as forming the basis of all philosophy when he states that 'the entire history of our philosophy is a photology' (1978: 27). Media theorist Marshall McLuhan conceptualises [electric] light as a pervasive medium that alters our sensory engagement with the world: for him light exists as 'pure information' (1964: 57). Identifying what light means in the context of my art practice has been an ongoing and context-dependent process. My study of light originally began in the realm of physics. As the area of knowledge that had constructed the anatomical body, science appeared a logical departure point for me, providing a methodology that placed light as part of a measurable, physical world. This is where I thought light would appear the clearest, the most stable and easiest to grasp. That departure point soon became a point of disappearance: the place of the last sighting of an elusive force. As 'light both reveals matter and ultimately retreats to a realm where it remains inaccessible to sight and to reason' (Miles, 2008: 37), light in itself cannot be seen and is accessible only through a combination of discourse, representation and affect.

In common usage, light is normally classed as a visible sub-section of the electromagnetic spectrum, but in the context of this article, and my wider art practice, I refer to light as comprising the entire spectrum, including its invisible parts.[4] (This definition was not arrived at arbitrarily: it was made in consultation with a quantum physicist.)[5] My intention is to remain faithful to the discipline of physics while suspending its historical classifications that divide the spectrum into separate sections. As different technologies were invented, their capabilities for measuring separate areas of the spectrum were recorded as new sections of the spectrum. The artificial boundaries document not so much the qualities of light, but rather the qualities and history of our measuring devices. This is reflected in a statement by the quantum physicist Werner Heisenberg: 'since the measuring device has been constructed by the observer… we have to remember that what we observe is not nature in itself but nature exposed to our method of questioning' (1958: 25). This revised approach to understanding what counts as light allows me to traverse the entire spectrum in my discussion of light and associated technologies used in the exploration and imaging of the body, i.e. X-rays, computed tomography scans (CT), magnetic resonance imaging (MRI) and positron emission tomography scans (PET).

Commenting on visualisations of the body in medicine, Catherine Waldby highlights 'the issue of medicine's medium specificity, the

extent to which its knowledge of bodies, and its abilities to work them, is conditioned by the medium of objectification, rather than through some direct encounter with the full presence of flesh' (2000: 7). Continuing with this line of enquiry, the anatomical body can also be seen as a spectrum that is divided by artificial boundaries and categories, and thus itself forms a record of the qualities and histories of our measuring devices. These dividing categories and units – such as, for example, cells, document both the quality of magnification at the time and the history of microscopy. But what happens when penetrative light is used as a method of questioning the fleshy body and how is this process of mediation perceived and recorded onto the anatomical body? These questions are not aimed at exploring the technical aspects of making and recording medical images by means of penetrative light. Rather, the focus here is on how this visual penetration through light influences our phenomenological engagement with the anatomical body and how we see ourselves after being exposed to the anatomical interior.

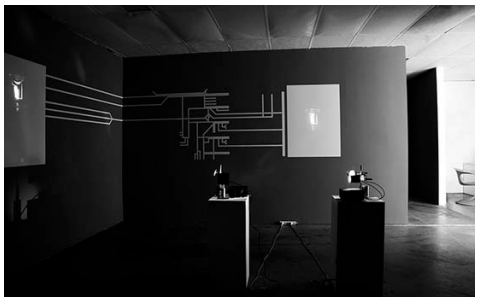
Arguably, light that penetrates the body also animates the body. I stated earlier on in my definition of anatomy that, as our ability to visually access the living body developed with the introduction of modern medical imaging, *anatomy as a methodology* itself changed. A sense of speed and an 'ocular' immediacy entered the discourse surrounding anatomy. When light from the extremes of the electromagnetic spectrum is used to image the interior of the living body, it culminates in the *virtual* cut, the spectacle and the visual realisation being performed in one instantaneous act. In the radiography room, which is an anatomy theatre of sorts, the relations and positions of the traditional protagonists are altered. The observed body is no longer necessarily a dead body, i.e. the ultimate still body, but it has become a *patient* body, still, ill and waiting. Witness the transformation of the role of anatomical images that has taken place in the process - from those of the Renaissance period, professing the illumination of God's perfect design to those of the contemporary medical scan, exposing the pathologies of the individual. The *patient* body of modern radiography is sensorially unaware of the light that is unveiling its interior, as its effect cannot be directly seen or felt. Yet, because of the light's intensity and potential harmfulness, the spectators have now become removed from direct viewing. With the audience dispersed and the anatomist displaced, the *patient* body must remain alone. This alienation of observation is nothing new, as the anatomical body has always been positioned as a liminal, but unlike the Renaissance cadaver, the radiographer's *patient* is alive and conscious.

We should ask here whether the interior of the living body is ever really unveiled to us, or whether what we see is only a mutually constructed compromise, where 'a body is brought into line with the potentialities of the technology and vice versa' (Pasveer, 2006: 44). A planar cross-sectional scan of the body appears as an abstract image. It seems dislocated not only from a fleshy and thus representational body, but also when viewed outside of the medical context, from the body of knowledge which is required for its understanding. What is being seen and not seen by an untrained eye when it views this unfamiliar representation of the body? The answers to these questions lie, in part, with the latent animation that is embedded in scans, which evokes a living body that is visualized as part of a diagnosis. In other words, to decode a scan one must understand the initial process of its encoding. The latter is not exclusively based on technological operations but is rather combined with an accumulation of information and understanding gained from the auscultation, palpation and percussion of a living body, i.e., the diagnostic *listening to the patient*'s body. Therefore, to encode and decode meanings in medical images involves not only total sensory engagement with a living anatomical body but also a need for these observations to be combined with theoretical medical knowledge. To an untrained eye, a seemingly abstract medical scan only announces the presence of a body, with the scan accepted in its role as a signifier of the body, which has been mediated by technology.

The abstraction of the body in medical imaging is further accelerated through its magnification, while minute forms become intangible and lie outside our reach. The sense of sight can no longer be verified by the touch of the hand, as a result of which the bodily microcosms being produced are accessible only by way of analogy. Magnification also dissolves discernable boundaries, or it multiplies them exponentially, depending on one's focus. Viewing an organ such as a heart at a cellular level negates, in that particular moment, the ability of being able to see it as a whole, let alone being able to perceive it as part of a system. On the other hand, such micro-perception can add millions of newly constructed boundaries such as divisions between individual cells. The limits of individual structures where an organ begins and ends become less clear and less relevant if questions about function, relations and communication are raised. How our body interacts in the world, where it begins and ends and even where *thinking* takes place becomes less discernable as the boundaries of the body contract and expand depending on social, cultural and technological influences

and perceptions. In this sense, the study of anatomy of optics and light is also, inevitably, a study of our ontology and epistemology – it is a study of who we are and how we construct knowledge.

To access the interactive panorama from the *Anatomy of Optics and Light* installation, please click on one of the images below or scan the QR code:



Notes

[1] *Anatomy of Optics and Light* was shown at Shifted Gallery in Melbourne, Australia, as part of a joint exhibition with Joanna Zylinska, titled *Solid States/Liquid Objects* and was accompanied by an exhibition catalogue essay written by Dr Melissa Miles. The exhibition was held in conjunction with the international symposium *Solid States/Liquid Objects: Discourses of Mediation*, which was hosted by the Faculty of Art & Design, Monash University, Melbourne. Dr Matthew Sellars, senior research fellow at the Laser Physics Centre, Research School of Physical Science and Engineering, Australian National University, assisted with the technical realisation of this project.

[2] Figure 2 and figure 3 are QR (Quick Response) codes. QR codes are matrix codes that function as physical hyperlinks, i.e. they normally appear as 'real' images that, when scanned by using the appropriate technology and software, provide access to the Internet and form a direct link to a selected online site. The QR codes contained in this paper have been given two functions. When an online reader accesses the article, the QR codes operate simply as clickable hyperlink images that will connect the reader directly to the website links. Alternatively, if the text is read from a printed hardcopy, the reader can use a mobile phone, uploaded with the scanner software, to scan the QR codes in order to gain access to the Internet and thus the links. Free QR scanner software (suitable for

most phones) and additional information about QR codes are available from <http://reader.kaywa.com>. Please note: QR codes cannot be scanned directly from a screen.

[3] quicken, *v.*[1] – To give or restore life to; to make alive; to vivify or revive; to animate. *The Oxford English Dictionary*. 2nd ed. 1989. OED Online. Oxford University Press. Sept. 2009. <http://dictionary.oed.com/cgi/entry/50194991>.

[4] The electromagnetic spectrum is continuous. 'An electromagnetic wave (light) consists of time-varying electric and magnetic fields that propagate at a speed of c (3.00×10^8 m/s) in a vacuum. The different types of electromagnetic radiation (such as UV, radio waves, and visible light) differ in frequency and wavelength' (Wilson, 2007: 679).

[5] Dr Matthew Sellars is a senior research fellow in the Laser Physics Centre, Research School of Physical Sciences and Engineering, Australian National University. His research interests centre on quantum measurement and quantum information processing using optically active ions in crystals. He has published in numerous journals, including *Physical Review Letters* and *Journal of the Optical Society of America*. His work on 'stopping light' for over a second was voted by the Chinese Academy of Science as one of the top ten international scientific achievements in 2005.

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