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Contents

Ecologies of Corporeal Space

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The human body should always be understood as an ecologically functioning corporeal space. The body is the geographical area wherein medical praxis acts in a specific manner. First there is the gaze of the doctor, which is observing, intruding and productive at the same time. This gaze, professionalised with the help of technical instruments, is one crucial aspect in the reciprocal relationship between corporeal space and diverse and changing systems of knowledge. In the last two hundred years medical tools and devices have been a determining factor in establishing the body as a site for the production of new images and new fields of meaning. As such, it is important to consider medical practices, as well as the various techniques and the knowledge production involved, in terms of their coeval development. The history of medical diagnostics and treatment, after all, is a history of its media.

In this paper I will first present several epistemological aspects of (clinical) medicine and its practice. Next, I introduce an ecological notion of corporeal space, understood as a multi-layered 'milieu'. This is followed by an investigation of the various technical implications within the medical context from the angle of the interconnectivity between the different milieus or environments formed by matter and meaningful signs. The human body is active but stable – an ecological state, in a sense, or, more specifically, a stasis based on constant change. My argument aims to demonstrate that the different medical techniques and instruments function as a membrane between various corporeal spaces within different milieus. These different fields or milieus are constituted by the combination of meaningful signs, which do not yet form a system of knowledge, but rather an arrangement of relevant but a-signifying signals.

Surface and Depth

Regarding the historical changes within medical science and in particular the development of the clinic, one has to acknowledge the significance of the epistemological analyses by Michel Foucault in his *The Birth of the Clinic*, first published in French in 1963. For Foucault this publication was not merely about the century of the clinic's birth, but also, as its subtitle put it, about an 'archaeology of medical perception'.[1] Key aspects of his analysis are space, language, death and the act of seeing.[2] His study presents the development and methods of medical observation in a period of crucial changes. It recalls the history of the clinic, with its techniques of mapping symptoms and anatomical spaces. The chief goal of nosology as part of theoretical medicine in the eighteenth century was a comprehensive classification of all diseases. This motivated medical actors to let a disease unfold itself in the most free and natural way, after which they could describe the changes of the symptoms in detail and classify the disease correctly. The natural space for being ill was people's home of course, the everyday environment of their life.[3] In the course of the eighteenth century, however, it became a common practice to take a person who was ill and who lacked a supportive family out of his home and into a publicly financed

hospital.[4] The clinic, serving as both a hospital and a place for education, evolved into the preferred and most neutral site for the observation and treatment of people suffering from a disease. This marked a shift towards an understanding of medicine as an objective science and practice.[5] In classical medicine it was common practice to observe the patient thoroughly; or, put more precisely, medical actors described and categorised medical symptoms. The 'tableau' of classical medicine basically involved a straightforward set of classifications and structured data on families, genera and species. The medical gaze was deployed to observe some illness, after which it would be arranged, structured and put into a specific 'order' with the help of language.[6] A tableau, including extensive descriptions and structured information, became part of the interplay between the spoken and perceived. The similarity between a phenomenon and the symptoms classified resulted in a further step, in the essential moment of recognition of the disease in the tableau. Once the particular manifestations of some illness were linked to specific coordinates on the tableau, it took over the space of the body. The information on the outer body and its symptoms made its way into the flat language tableau, after which it also became 'apparent' in corporeal space. Merely the act of classifying involved perceptions that led to a productive mode of thinking in terms of particular codes. By connecting the medical gaze and language, a new medical system of knowledge was produced.

In the middle of the eighteenth century, the opening of dead bodies on a regular basis resulted in a growing amount of anatomical knowledge. Anatomical-pathology developed quickly as a body of knowledge and clinical diagnostics underwent great changes. If in classical medicine the dead body, regarded as the opposite of a healthy body, was believed to be of no further use to medicine, in anatomical-pathology the dead body served as a great source of knowledge for all further diagnostics. Earlier, in nosology, a disease was merely a bundle of characteristics on the surface of the body, but now the body could be horizontally and vertically penetrated to uncover the layered depth of its bulk.[7] The simple gaze of the doctor expanded into a comprehensive anatomical-clinical apparatus, based on the senses of sight, touch and hearing, which allowed one to map the living body.[8] As a result of this exploration of the inner space of the dead body, the living body turned into corporeal space as well. As Foucault states: 'For us, the human body defines, by natural right, the space of origin and of distribution of disease: a space whose lines, volumes, surfaces, and routes are laid down, in accordance with a now familiar geometry, by the anatomical atlas.'[9] A disease was no longer defined as a virtual ideal scheme, thus a theoretical tableau placed on the body. Rather, a disease was now embodied and locatable in corporeal space.

Efforts aimed at opening up the living body were not so much motivated by a desire for knowledge, but by the need to act within the corporeal space and treat malfunctions. In the early eighteenth century, most surgical procedures were amputations, which had to be done very quickly to prevent the patient from dying from excessive pain or loss of blood. With the discovery of anaesthetics around 1845 surgery in the modern sense became possible.[10] A patient under narcosis could be operated without pain, thus time was less of an issue and more complicated surgery became possible. The living body was silenced and the patient became merely a physical object. The living and fleshy organism, suspended in unconsciousness, could now be opened and entered without interferences. In surgery the patient is cut open wide, wide enough to see, to access, and touch the organs. In combination, anaesthetics and scalpels make it possible for the hands of the surgeon to enter the corporeal space and operate within it. Drawbacks of this invasive procedure include the damage resulting from the incision, the risk of infections and the time needed for recovery.

Although surgery has become a widely established and successful medical discipline today, it is not yet possible to operate and navigate entirely safely within the living human body. Ongoing research concerned with medical techniques has been driven by the aspiration to find enhanced methods which would guarantee secure navigation within the anatomical area, avoiding all unnecessary penetration. One example is the endoscopic technique which emerged in a primitive form already in the eighteen hundreds.[11] Using tools similar to binoculars or telescopes, which were based on the reflection on light from the outside, they entered the natural openings of the body. One way to reach the stomach, for instance, was by passing a straight, static tube through the oesophagus.[12] These endoscopic instruments were further developed, and the invention of the Edison lamp made it possible to bring light into the body. Regardless of whether we are dealing with the outside or the inside of the body, the question of visibility was – and still is – the most crucial aspect in diagnostics and treatment within medical practice.

The ground-breaking and fascinating discovery of the x-ray technique in 1895 made it possible for the first time to show details of the inside of a living body and also record images of it. For decades the photographs were exploited in popular culture, and since one of the first bone images showed Bertha Röntgen's hand, the x-ray of the female hand became a fetish object.[13] [fig. 1] It has always been common to apply technical apparatuses in unconventional ways, linked to the world of magic and occultism. The x-ray technique, for instance, has also been used in attempts to capture ghostly apparitions.[14] In this sense it is also possible to interpret media in a wider context than the one proposed by the cybernetic diagram.[15] The model of communication which assumes an information source sending a message to a transmitter, which is subsequently conveyed in an unaltered fashion to the receiver and its destination, is perhaps all too familiar. A medium is an agent between different areas of meaning; it submits, produces and/or shows new combinations of signs, which are to be understood as new information.

Regardless of the countless metaphorical interpretations and beliefs which came along with the sudden fact that it was possible to see the most intimate inner self, the x-ray technique was soon mainly understood as an objective, diagnostic tool. When in the late 1920s the x-ray technique made its way from the artistic studios of photographers into clinics, technologically produced medical images began to serve as an important tool for diagnosing illnesses at an early stage.[16] If the exploration of the dead body made it possible to establish a map of the living corporeal space, the x-ray produced an additional, new space, separated from the patient's body: patients could now be diagnosed without being present. Increasingly, the personal experience of the patient was rated as subjective and unreliable. As it became possible to show indications of a medical disorder within the space of the x-ray image, one no longer needed the corporeal space of an actual patient who was present. Furthermore, the doctor's gaze, including its various sensorial impressions, was increasingly replaced by visual evidence.[17] The perception, in other words, shifted 'from the subjective observer of the body to the intersubjective observer of mechanical induced representations of the body.'[18] With the help of a machine, and based on the patient's body, a new corporeal space had been produced. These new kinds of images correlate directly with the production of knowledge: they 'mold as well as reflect visual reality.'[19] More and more, the medical system of knowledge became pervaded by power, and to this day it is difficult to gain access to this system. Whoever has had the experience of having his body x-rayed will remember the 'moment of truth', when the doctor puts up the x-ray photo, looks at it and formulates a diagnosis. Even if the physician explains the image, or even if there is a clear fracture

of a bone which is easy to spot, it is still mystical and exciting to see a representation of one's own internal body. At the same time, many of these images are less transparent than they may seem to be. They need to be carefully interpreted by trained specialists before becoming a reliable source for medical diagnostics. Similar to the tableau with its tables, x-ray is '[…] a representative technology creating an illusion of unmediated, objective reality.'[20] At this point in medical history, the question of mediation began to present itself much more clearly. As indicated, to *mediate* means not merely to transmit, but to convert through diverse channels, and between different milieus. The media are always reshaping information and forms of information, even if one does not recognise the impact of the media's productive force. In this respect it is hardly surprising that the doctor who looks and listens had to give way to the specialist who relies on technology to see and intervene. Despite the fact that a technical image of the body such as an x-ray is strongly mediated, it is commonly seen to be superior to any subjective form of perception.

Parallel to the rise of this kind of technologically mediated diagnostics, the endoscopic procedure swiftly developed as well. By having more sophisticated optical equipment, a safe and reliable internal light source, and a flexible cable which could be passed between organs, the technique would prove to be more than just an extension of the eye of the doctor: it was also an extension of the hand of the surgeon. To have to make an incision to be able to enter the body with an instrument was a highly intrusive step. Anaesthesia was needed as well, which is why the procedure did not become common before the beginning of the twentieth century. At that same time the seeing device became a real instrument which functioned as an extension of the hand of the surgeon. Nowadays the technique is in many ways applied as a routine procedure. The entrance hole for the surgical device is small, and the instrument is able to show video images. As of the 1980s the recorded images of the internal body proliferated not only within the medical world; they also made their way into study colloquiums, art exhibitions, private homes and on the internet.[21] During the actual surgical procedure the camera feed is shown on a monitor, and it requires great skill and a lot of concentration on the part of the surgeon to work with these images. An additional source of information has to be monitored and interpreted, after which all the data have to be mentally transposed onto the patient's body.[22]

The general map of the physical space of the human body is no secret anymore, and with the evolving of technical media, highly detailed information can be gathered. Each measuring machine produces its own characteristic image and particular encryption. This in turn has prompted a need for specialists with diverse technical and visual skills. Digital augmented reality is a recently developed technique of image-guided and interactive training exercises and image-supported surgery. Due to a high digital image quality and interactivity, virtual training software can be of great benefit to students. But also during surgery it can be an advantage to be led by a virtual body. During endoscopic operations, the gaze of the surgeon is directed away from the body because the camera feed is shown on a monitor. This cognitive performance demands great discipline and extensive training. The projections of the augmented reality on the other hand make it possible to merge this additional information and help to reduce the workload or even shorten the time of narcosis. Already before the surgical procedure, many different data about the patient's physical condition has been gathered and can be used. Computer tomographic images or x-ray images are visually prepared and then projected directly onto the relevant body part. Tracking devices attached to the skin are connected to a wireless mouse, and they allow one to switch between different visualisations of the internal corporeal space.[23] Even if this method may extend the anatomical overview, it

does not give any sense of depth. Next, this was followed by the development of a system which produced an overlaying image with transparency and spatial presentation. When showing occluded objects, it was very effective to preserve the context of occluding structures by rendering just the edges. Very little of the occluded object is obscured by the thin edges, but there are enough visual cues to give a compelling sense of depth. The *Edge Overlay* visualization aims to provide depth cues when viewing sealed objects.[24] A perception of depth is achieved through including a 'window' without determined frames. In a certain area around the central image, the tissue becomes more transparent and therefore produces a spatial appearance. The clinical information is processed and prepared in order to be turned into a new image, making it possible to perceive a three-dimensional space. This field of the optical dimension is a field of mixed realties, and functions as membrane between the internal corporeal space and its cognitive and digital correlation. Based on the physical body of the patient, a much less encrypted internal image appeals to the gaze 'immediately' and instantly.

Homeostasis and Allostasis

To analyse the specificity of the entanglement between medical practice, its media and corporeal space, I will now introduce the notion of 'milieu'. Claude Bernard, the founder of modern physiology, scorned classic nosology and wanted to establish an 'experimental medicine'. His research of animal physiology was based on vivisection, surgery on living organisms conducted for experimental purposes. Bernard's work has been recognized primarily for his concept of the constancy of the 'internal environment'. This *milieu intérieur* is geared to stabilizing and maintaining the uniformity of the organism's conditions, so that it can pursue a free and autonomous life.[25] For instance, the *milieu intérieur* ensures a steady body temperature, and helps the body to adjust to the oscillating climate changes of the external environment, the *milieu cosmique*.[26] This process, also called homeostasis, describes the sufficient regulation of the physiological adaptations necessary for internal stasis. The control of temperature, pH, glucose, protein, oxygen, sodium and calcium are important examples of these regulatory responses to the systemic physiological requirements. As argued in recent research in the field of neuroscience, however, Bernard misjudged the environmental context and overrated the separation of the internal milieu from the external world.[27] Every species has to balance the internal demands with external contexts, suggesting that the concept of homeostasis was defined too narrowly. Since it proved impossible to explain the observed adaptations by the homeostatic concept only, several different theories have been developed. Today's research emphasises that a viable stasis cannot be accounted for by physiological adjustments only, as behavioural ones are equally relevant. The concept of 'rheostasis', for instance, includes a wider range of biological systems, taking into account variations tied to context, season and surroundings. Considering reactive and predictive homeostasis, it does include physiological and behavioural regulations, giving rise to a notion of 'physiology of change'.[28] An alternative neuro-scientific concept, 'allostasis', was introduced to acknowledge the change of state as a prerequisite for viability. Allostasis comprises both the behavioural and physiological processes that maintain internal parameters for the essential requirements for life. The concept acknowledges the impact of an external (social) space, and it is considered a plausible hypothesis for connecting events which might seem to be unrelated at first glance.[29]

If we want to follow up on the notion of a connected internal and external milieu, we should turn to Jacob von Uexküll and his concept of *Umwelt* (surrounding world or environment). In his theoretical biology[30] and theory of meaning (*Bedeutungslehre*),[31] Uexküll emphasises the

importance of a subject-oriented epistemology, which he based on his biological research.[32] A significant aspect is the reciprocal relationship between an autonomous organism and its geographical environment, on which each unique milieu is based. Especially well known is Uexküll's example of the tick, which was enthusiastically taken up and propagated by Gilles Deleuze and Félix Guattari.[33] The sunlight, the smell and the temperature of the skin, as well as the resistance of the hair, are the few relevant signs composing the tick's *Umwelt*. A unique composition of preceptor and receptor signs within the body and the surrounding environment constitutes a particular *Umwelt*, and the reciprocal connection within it is the functional cycle of meaning.[34] To assign significance to elements in the environment is not a question of the developmental stage of the animal involved. All organisms – be it a human being or some microorganism – share the ability to distinguish between noise and signal, as well as the ability subsequently to respond to what biologically is relevant.[35] Based on many different examples, Uexküll demonstrates that the cycle is organised by perceptive and receptive signs.[36] The main point is that the organism does not respond to causal impulses, but to perceptual signs or meaning.[37] The subject's *Umwelt* is assembled as a reciprocal relationship within a shared field of meaning. One further aspect of Uexküll's concept is the already genetically related surroundings. In the 'internal front' one can find imprinted images of the external world.[38] The subject is surrounded by vital counterpoints with respect to active images. Uexküll elaborates this aspect when he describes the spider's net. The fly, never seen before by the spider, is present as a primal image. This *Urbild* is the form on which the spider is able to build the perfect net for the hunt.[39] The net is a well-made mould of the fly, so to speak, and it would not exist in this way without the fly's concrete characteristics.

In this context it might be helpful to note that milieu or environment should not been confused with a fixed geographical space which can be easily determined. Although the 'milieu' is part of the space, it is defined by being an assembled multi-layered realm of matter, signs and meaning. The cycles of meaning (signs) each have a certain mode or style and their own particular semiotics. In most cases they undergo slight changes all the time, and to identify its temporal state is an act of intervening already. But we need a further element to grasp the moment of ecological change with respect to processes of exchange. In the analyses of Francis Bacon's paintings, Gilles Deleuze identifies three core elements: structure, figure and contour. 'This contour, as a "place," is in fact the place of an exchange in two directions: between the material structure and the Figure, and between Figure and the field. The contour is like a membrane through which this double exchange flows.'[40] Deleuze does not talk about a fixed system with respect to form, with boundaries which stabilise a self-preserving and organised system against a hostile and fluctuating environment. His concept contradicts with recent system theories, which rely on the differences between a complex environment and an operated superior order.[41] The contour is not a boundary without processes of exchange between the different layers. In this respect, Deleuze refers to Gilbert Simondon when providing us with a concept of 'figure' and 'ground' within the same field. The form individuates in phases and Simondon connects this concept to processes of life. He leaves behind the classic notion of form and developed a concept of *in*formation, which allows him to couch a specific theory concerning becoming.

The three aspects identified by Deleuze – form, structure and contour – are layers which can establish a milieu. As Deleuze and Guattari write: '[t]he living thing has an exterior milieu of materials, an interior milieu of composing elements and composed substances, an intermediary milieu of membranes and limits, and an annexed milieu of energy sources and actions-perceptions.'[42] To

conceive of the human body as a milieu, a corporeal space which is changing its reciprocal relations, implies a shift in the angle of this investigation. We can now look at the inflictions concerning corporeal space, medical practice and the involved media.

Symptomatology

I will attempt to apply the ecological concept of milieu and revaluate the examples of medical techniques discussed above. In medical practice we deal with differently coded fields and one can recognise that the ecology of corporeal space concerns the gaze and the language of the doctor, the intruding scalpel and hands of the surgeon, as well as the mediated images of the body. In each case one can find a certain kind of porosity between diverse fields of meaning. Next to the act of cutting the skin and touching the organs, there are many other intersections between surface, internal space and environment. Tableaus, x-ray photographs, brain scan images or even the printed curve of an electrocardiography are highly induced new forms of information correlating between the physical body and the particular abilities of the measuring instrument. In each case one finds the corporeal space expanded into different milieus.

First there is the directed gaze of the doctor, near to the body, mapping the outside space and its symptomatic signs. The next crucial step is the act of converting the body's code, translating it and customising its signs. By translating symptoms into language they are being introduced into a different field of meaning, thus into a new milieu. During this process, certain recognisable collections of symptoms are identified and named. In so doing, diseases are being configured, and a new knowledge system, including a particular concept of illness, has been produced. Really fascinating is the reciprocal dimension found in this process. Identification of a set of symptoms on a patient gives rise to a diagnosis. The patient now has a disease, and this becomes evident in his corporeal space. The body, besides having its fleshy milieu with its own symptomatic signs, is now also part of a differently coded field of signs: the system of illnesses. Just as the fly is the counterpart for moulding the spiders net, the patient's body is being 'framed' by the system of medical knowledge. In most cases the subjective symptoms of the patient and the technical image are each other's counterparts. The x-ray photo, for instance, offers a two-dimensional image of the three-dimensional body. The photos are made with the help of non-visible radiation. The radiation actually has to cross the body to shape the image. In that sense, the body functions as a counterpart by definition. But the machine, or its particular technical functioning, is responsible for the characteristic shape of the image. There is a reciprocal relationship at work between the patient's body and the x-ray machine. The x-ray image shows its own productivity, due to the conditions of the machine. As a result there is a correlating technical body image, which is geographically separated from the physical space of the patient's body.

The actual cutting of the skin to open the body might be the most obvious act of crossing between milieus. We know that a certain stasis is necessary to keep the organism alive. This securing state, however, seems to be based on constant changes and adjustments. During the phase of a life an organism has to deal with diverse environmental situations, caused by changing seasons with many weather and climate variations. Furthermore, there is a strong influence by changing social and physical interactions with other organisms. Each situation is balanced by a combination of different means dependent on each unique person's abilities. During and after an open surgery, the body is reacting strongly but very often it is also able to cope with the situation and restore a 'healthy' stasis. Still, it is an understandable desire to want to enter the internal milieu of the organism without opening the skin (contour or membrane). In fictions one can find fantastic stories of travelling through

Fig. 1: Photographed by Wilhem Conrad Röntgen 1895, 129 x 178mm, Celloidpapier, Remscheid Sammlung Deutsches Röntgen-Museum © public

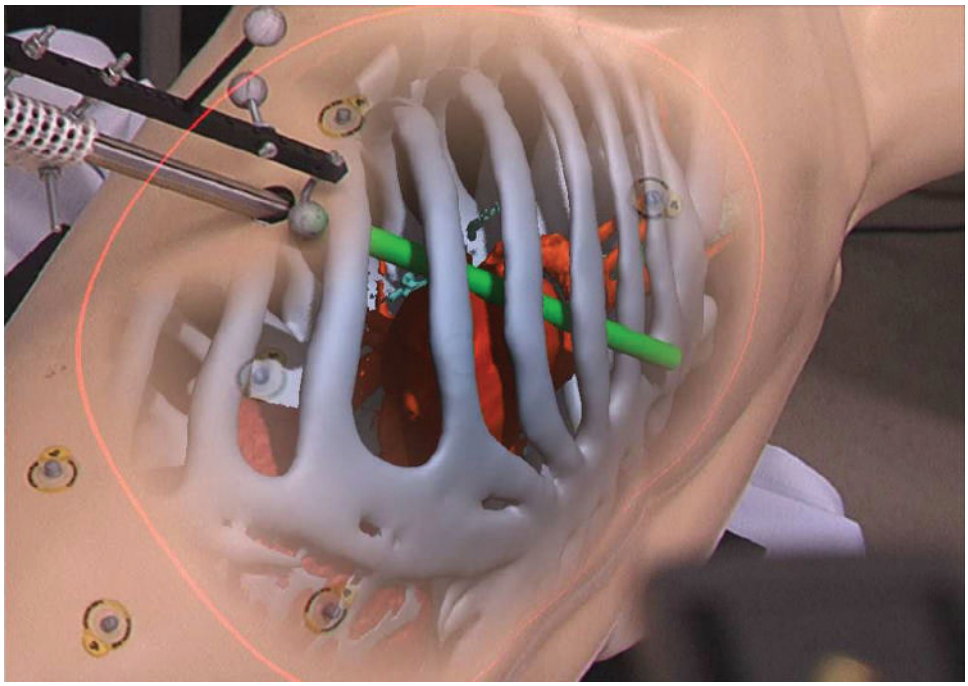

Fig. 2: Virtually extended instrument within a thorax phantom. In Christoph Bichlmeier et.al., 'Contextual Anatomic Mimesis, Hybrid In-Situ Visualization Method for Improving Multi-Sensory Depth Perception in Medical Augmented Reality' <http://campar.in.tum.de/Chair/PublicationDetail?pub=bichlmeier2007Mimesisismar> [accessed: 21 April 2014], Reprint with friendly permission by Christoph Bichlmeier.

the body: the internal milieu is turned into 'space', which can be entered for an adventurous trip. These kinds of stories are usually about a crew and a ship shrunken to a microscopic size, which enters the body through the mouth. Or the travellers will follow the blood circulation system through the organs, using a tear to exit the body again.[43] The internal organic space is presented as the unexplored and infinite outer space. This genre of fictions reflects on the scientific challenge of visiting the internal space of the body without even being noticed. The endoscopic technique in fact comes quite close to this ideal. If an incision is needed, it tends to be very small, while the instrument is sterile and flexible. To place the view of the doctor inside the body appears almost like a visit without leaving traces. The secret gaze inside is nevertheless a productive one, reflected in the parallel video feed on a monitor. The surgeon's gaze is not directed towards the patient's corporeal space, while he or she is guiding the endoscopic instrument with the help of the image displayed on the monitor. In that sense the surgeon operates within the corporeal space of the video feed. Based on the camera's mediation, the patient's body manifests itself in an additional geographical place, and becomes part of a different system of signs. Today's endoscopic surgery replaces images not only geographically; it also translates them into digital form. [fig. 2]

The patient's corporeal space does not only exist in its fleshy physical form, but also within the video feed of an endoscopic instrument, or a digital illustration. In the case of these new graphical images, all visual information is based on the digital system as a particular way of computation. The digital form is without further expression or flexible relationships and always formatted. It should be stressed that it is possible to directly address a particular pixel without having to traverse the precursor. The pixels, due to their continuous addressability, are more text than image and the computer graphics is therefore quite easy to manipulate.[44] In fact, it is not just possible to manipulate images, but also to produce entirely new images. Of course, these new images are an integral part of reality, and shall not be dismissed as a virtual and therefore less relevant part of the world. The complications between the digital and analogue domains reveal themselves in the area of the optical and the sensory realm.[45] One should give attention to the image as part of a mixed reality, since the sensory realm respectively optical field is the place where transcoding proceeds. Augmented reality is like a membrane between digital code and human perception. Even if the computer graphics is entirely based on digital information, by generating an image which can be interpreted, which can be seen and spatially perceived, the digital information provides analogue stimuli. The digital realm of coding basically produces actual corporeal spaces while at the same time maintaining their milieu constituted by digital structures.

The world of medical practice, with its intrusive instruments and diagnostic visualisation machines, is marked by an array of intersections between different milieus. There are plenty examples where the organic body is pervading its corporeal space into the technical milieu. Even without quoting Spinoza, or without quoting Deleuze quoting Spinoza, it is possible to argue that the body is capable of yet unknown ecological events. But one should be wary to claim completeness when investigating these ongoing ecological processes. To grasp the multiplicity and the infinite character we do not need to pursue exhaustive historical research, but merely point to observable intersections. This paper can be understood as a speculative but nevertheless practical and realistic approach towards an ecological understanding of the body. And yes, the ecology of corporeal space does not end with its own organic area and symptomatic signs. Next to the codes of the flesh, there is a field of meaning which is based on medical instruments and media, systems of language and the rhythm of the digital code. The body as an ecological form is able to expand its

range from a collection of subjective signs into the encrypted field of medical knowledge and digital formations.

Notes

1. Michel Foucault, *The Birth of the Clinic: An Archaeology of Medical Perception* (London: Routledge, 2002).
2. Ibid., p. ix.
3. Ibid., pp. 39,40.
4. Ibid., p. 40.
5. Ibid., p. 109 ff.
6. Ibid., pp. 60 ff.
7. Ibid., pp. 135 ff.
8. Ibid., p. 164.
9. Ibid., p. 3.
10. Ludwig Brandt, *Illustrierte Geschichte der Anästhesie* (Wissenschaftliche Verlagsgesellschaft, 1997).
11. José van Dijck, *The transparent body: a cultural analysis of medical imaging*, (Seattle: University of Washington Press, 2005), p. 66.
12. Ibid., p. 66.
13. Ibid., pp. 84,89.
14. Eugene Thacker, 'Vermittlung und Antivermittlung', in *Die technologische Bedingung: Beiträge zur Beschreibung der technischen Welt* (Berlin: Suhrkamp, 2011), pp. 306-32.
15. I refer to the diagram of the communication model by Claude Shannon and Warren Weavers. Ibid., p. 306.
16. Dijck, *The transparent body*, p. 84.
17. Ibid., p. 86.
18. Ibid., p. 98.
19. Ibid., p. 98.
20. Ibid., p. 98.
21. Ibid., p. 71.
22. Marcus Tönnis, *Augmented Reality: Einblicke in die Erweiterte Realität* (Berlin, Heidelberg: Springer, 2010), pp. 132-40.
23. Ibid., pp. 132-40.
24. Ibid., p. 133.
25. Claude Bernard, *Leçons sur les phénomènes de la vie communs aux animaux et aux végétaux* (Paris, J.-B. Baillière, 1878), pp. 112 ff.
26. Ibid., p. 117.
27. Jay Schulkin, *Rethinking homeostasis: allostatic regulation in physiology and pathophysiology* (Cambridge, Mass.: MIT Press, 2003), p. 2.
28. Ibid., p. 16.
29. Ibid., p. 21.
30. Jakob von Uexküll, *Theoretische Biologie* (Frankfurt: Suhrkamp, 1973).
31. Jakob von Uexküll and Georg Kriszat, *Streifzüge durch die Umwelten von Tieren und Menschen: ein Bilderbuch unsichtbarer Welten* (Frankfurt: S. Fischer, 1970), p. 107.
32. Torsten Rüting, 'History and significance of Jakob von Uexküll and of his institute in Hamburg', *Sign Systems Studies* 32.1/2 (2004), pp. 35-72 (p. 49).
33. Uexküll and Kriszat, *Streifzüge durch die Umwelten von Tieren und Menschen*, pp.6 ff. Cf. Gilles Deleuze and Félix Guattari, *A Thousand Plateaus: Capitalism and Schizophrenia* (Minneapolis: University of Minnesota Press, 1987), p. 51.
34. Uexküll and Kriszat, *Streifzüge durch die Umwelten von Tieren und Menschen*, p. 118.
35. Ibid., p. 15.
36. Ibid., p. 118.
37. Ibid., pp. 9,127. Cf. Paul Bains, *The Primacy of Semiosis: An Ontology of Relations* (Toronto: Toronto University Press, 2006).
38. Uexküll und Kriszat, pp. 133,158,167,171.
39. Ibid., pp. 126,159.
40. Gilles Deleuze, *Francis Bacon: The Logic of Sensation* (Minneapolis: University of Minnesota Press, 2005), p. 15.
41. Friedrich Balke, 'Auf dem Rundgang Bilder des Lebens bei Francis Bacon, Gilles Deleuze und Martin Heidegger' in *Struktur, Figur, Kontur: Abstraktion in Kunst und Lebenswissenschaften*, ed. by Claudia Blümle and Armin Schäfer (Zurich and Berlin: Diaphanes, 2007), pp. 317-8.
42. Deleuze and Guattari, *A Thousand Plateaus*, p. 313.
43. José van Dijck, *The transparent body: a cultural analysis of medical imaging*, pp. 64 ff.
44. Kittler, Friedrich: 'Computergraphik. Eine halbtechnische Einführung' in *Mimetische Differenzen: der*

Spielraum der Medien zwischen Abbildung und Nachbildung, (Kassel: Kassel University Press 2002), p. 221-40.

45. Colebrook, Claire: *Blake, Deleuzian Aesthetics, and the Digital*, (London, New York: Bloomsbury Academic 2012), p.vii.

Biography

Katharina D. Martin studied media art and aesthetics in Germany and The Netherlands. She is a PhD candidate in the Department of Aesthetics and Art Sciences at the Academy of Fine Art Münster, Germany. Martin is concerned with a new kind of trans-disciplinary philosophy and media studies. Her research gravitates around the concept of 'milieu' as a methodological instrument for analyses of digital technology.