

9 Abstraction as Material Translation An Artistic Reflection of (Re)Presentation

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9.1 Scientific Representation Analysed by Artistic Means?

Abstraction is a central concept in many fields. In art, abstraction can mean different things, from non-figurativeness of works of art to “processes of image-making in which only some of the visual elements usually ascribed to ‘the natural world’ are extracted” (Goodman 2003). In current philosophy of science discussions, abstraction in science is frequently approached as omission¹—i.e., “abstracting away” from concrete details of the object or the system of interest. We are interested in the counterintuitive claim that abstraction in science involves concreteness, being not only *subtractive*, as the notion of abstraction as omission suggests, but also *enriching*. Instead of thinking about abstraction as a reductive operation doing away with concreteness, we study the translations, transformations, and displacements across different *material* realisations that facilitate abstraction.² Through the use of different representational and experimental artefacts, material translations enable scientists to arrive at abstractions. As such abstractions usually do not display the underlying material and semiotic work, they are prone to “epistemological horrors”, as Steve Woolgar has provocatively put it. Lacking access to the concealed scientific work, it becomes challenging to understand how abstract representations relate to the concrete realities they supposedly represent or derive from.

To examine and illustrate the displacements and translation that takes place in scientific abstraction, we juxtapose the artwork of Finnish artist Lauri Anttila, *Homage to Werner Holmberg* (1985–1986), to Bruno Latour and Michael Lynch’s work on scientific representation. *Homage to Werner Holmberg* provides a provocative reflection of scientific representation, in that the work appears to parody the scientific method in seeking to render the landscapes in the paintings of Werner Holmberg, a renowned Finnish landscape artist from the 19th century, with scientific instruments. Through its artistic use of scientific methods, this work addresses scientific representation in the very same spirit as constructivist science studies—even partly preceding the publication of these texts (e.g., Lynch & Woolgar 1990). Indeed, Anttila has said about his work:

I have intentionally wanted to submit the concept of scientific certainty to ironic scrutiny. To set the notions of exactness, of the purity of science, in the framework where coincidence, as part of the whole, imparts the spirit and exposes the method only as a method, not as the truth.

(Anttila 1989, 103)

Likewise, constructivist sociologists of science have explicitly challenged the idea of science as searching for *the* truth, whose products would correspond to real objects as accurately as possible. The parallels and affinities of Anttila's artistic analysis of scientific representation and Bruno Latour's (1995) philosophical report on his fieldwork in the Amazon are striking. Crucial for the processes of abstraction that both Anttila and Latour study are the technologies and media used to translate a local object through a series of displacements into an abstract object of knowledge. These translations render a tentative object into quite another kind of material realisation, which, through its more generic nature, is conducive to further conceptual and theoretical development.

9.2 Werner Holmberg and Lauri Anttila

Lauri Anttila (1938–2022) was interested in the differences and similarities between scientific and artistic perception, being also a lifelong member of The Finnish Astronomical Society. Many of Lauri Anttila's works point to scientific activities and make use of scientific instruments in diverse ways. An excellent example of such border crossings is *Homage to Werner Holmberg* (Kunnianosoitus Holmbergille), which is regarded as one of his main works. *Homage to Werner Holmberg* is a showcase that embarks on a dialogue with the natural sciences. It combines themes, methods, and media familiar to Anttila. As the title of the work indicates, it is simultaneously a tribute to the Finnish painter, Werner Holmberg (1830–1860). Anttila has said that Holmberg led him to “look at painting with totally different eyes” (Anttila 2002, 30). Travelling in Holmbergian landscapes in Finland led him to an understanding that Holmberg's paintings are not “products of pure imagination and tradition”, but that there was something concrete behind them (ibid).

Werner Holmberg has been regarded as a romantic landscape painter, but, in his production, idealistic landscapes started to give way to more realistic features that become more and more recognisable therein. It has been claimed that Holmberg, in his last paintings and sketches, anticipated the aims of painting outdoors like Constable in England and Corot in France (see, e.g., Reitala 1986, 83–84, 95; Thomas 2002). Holmberg



Figure 9.1 Lauri Anttila, *Homage to Werner Holmberg (Kunnianosoitus Werner Holmbergille)*, 1985–86, installation, black-and-white photograph, colour photograph, drawing, text, books, dried plants, diary, 114.0 × 441.0 cm, Finnish National Gallery/Ateneum Art Museum. Photo: Finnish National Gallery/Jukka Romu. Reuse not permitted.

never totally gave up composing a painting from various landscape elements; his oil paintings were made indoors using sketches, and they have features from German, Norwegian, and Finnish landscapes. In the works he painted in his last years, however, one can note a clear attempt to communicate an “authentic” experience in nature. In addition to conveying the sense of “place”, works such as *Mail Road in Häme (Postitie Hämeessä, 1860, Figure 9.2)* or *Cottage in Kuru (Talonpoikaistalo Kurussa, 1860, Figure 9.3)* impart feelings about nature, such as air full of dust or humidity from the rain. Such sensory perceptions are prominent in Holmberg’s sketches and especially in the watercolours he painted while out in nature. They give more direct glimpses into the paths and places where Holmberg hiked as well as into their weather and vegetation than do his oil paintings. In his sketches, we can see Holmberg’s attempt to depict nature based on observation and experience.³

The showcase, *Homage to Werner Holmberg (1985–1986)*, is based on the material Anttila collected on his treks in Finland from 1985 to 1986. The main impetus for these treks was to use Holmberg’s diaries and follow along the routes he took in the central parts of Finland during his last

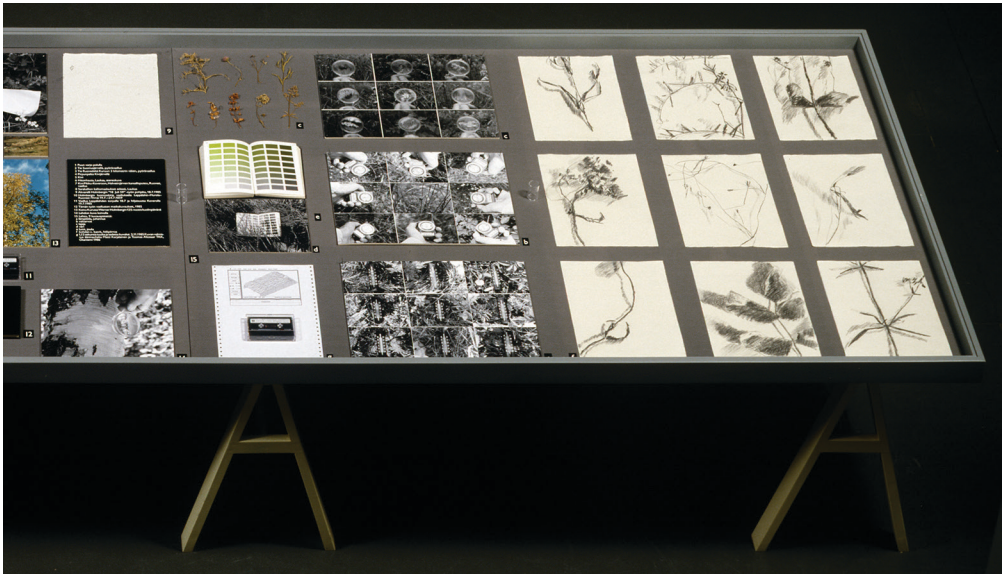


Figure 9.1 (continued)

summer. In a piece of writing that is part of the work and sheds light on its background, Anttila writes,

Werner Holmberg was the first real Finnish landscape artist [...]. I have tried to find out about the factors, the so-called structure of the land, where those works were born. I have explored the places where the sketches were made by walking there and attempted to follow the dates of the sketches. This I have done so as to find out what concrete things the works entail—how one could experience those landscapes today, what sets Holmberg’s “pictures” apart from what I experience.

Anttila’s reference to how one would experience Holmbergian landscapes today targets the connections between arts and science. Writing about this work over 15 years later, Anttila mentions, “To me, that scientific point of view was important. When I understood the time Holmberg had lived in, I wanted to show how the Holmbergian experience in nature could be expressed using the means at our disposal today” (Anttila 2002, 30). For Anttila, scientific instruments and the scientific method provided a contemporary way of reviving Holmberg’s landscapes. In addition to (often serialised) photos, he makes use of other recording and reproduction technologies ranging from a tape recorder to keeping a diary to collecting plants and rocks. Additionally, the work makes use of different



Figure 9.2 Werner Holmberg, *Mail Road in Häme (Postitie Hämeessä)*, 1860, oil on canvas, 40.0 × 58.0 cm, Victoria Laurell Bequest, Finnish National Gallery/Ateneum Art Museum. Photo: Finnish National Gallery/Jenni Nurminen.

kinds of technological devices to measure and convey the phenomena in the surroundings: a thermometer, a watch, and a compass.⁴

The work refers at multiple levels to Werner Holmberg's works. Fragmentation is one of those features. Just as is the case with Holmberg's seemingly vivid and integrated landscapes, Anttila's work, too, is composed of parts found at sundry places, referring to the Holmbergian landscapes. In the middle of the showcase, we can see the actual *Homage to Werner Holmberg* section (see Figure 9.4). The fragments in that section were collected on the excursions where Anttila walked following Holmberg's footsteps in Kuru, Ruovesi, and Leppälahti 126 years after Holmberg had been there. These sections of the work include a three-part "watercolour" that was completed by Anttila on 18 July 1985, and which was based on Holmberg's work *18 July 59*.

Below Anttila's watercolour are two pictures showing its origin, namely the watercolour Holmberg painted in Leppälahti. On the left we see the entire work, whereas the picture on the right is a detail depicting the



Figure 9.3 Werner Holmberg, *Cottage in Kuru (Talonpoikaistalo Kurussa)*, 1859, oil on canvas, 71.7 × 116.0 cm, Finnish National Gallery/Ateneum Art Museum. Photo: Finnish National Gallery/Antti Kuivalainen.

vegetation on the shore. The close-up draws our attention to the plants around Anttila’s “watercolour”; this parallel shows that the same species of vegetation are still there. Below these is a photo of the inventory slip from Holmberg’s sketchbook for the 19–24 July 1859 expedition, and, next to it, we see Anttila’s journal from his *Homage to Werner Holmberg* expeditions. Included in the work is also a cassette tape, which has a recording of the expedition to the Leppälahti croft on 18 of July, and “silence” in Kovero on 19 July 1985, as well as a description of the work written by Anttila. In the middle of the showcase, as if in the place where Jesus would be in Christian iconography, Anttila has placed a colour photo, which was taken in Kuru just as the birch was dropping its leaves on the 125th anniversary of Holmberg’s untimely death on 24 September 1985.

The *Grove (Lehto)* section on the right-hand side (and the lower middle part) of the work was made from materials and photos of a grove in Hangonkylä in December 1985 (Figures 9.4 and 9.5). In addition to the series of photographs depicting a compass and a thermometer in nature, we also see desiccated plant samples, drawings of them, as well as photos of the plants as seen through a magnifying glass. Below the plant samples, there is a

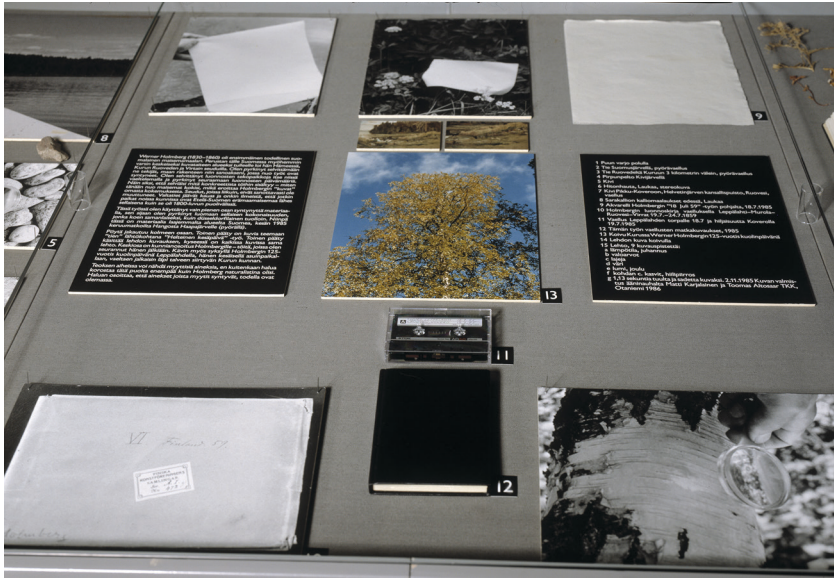


Figure 9.4 Lauri Anttila, *Homage to Werner Holmberg (Kunnianosoitus Werner Holmbergille)*, 1985–86, installation, black-and white photograph, colour photograph, drawing, text, books, dried plants, diary, 114.0 × 441.0 cm, Finnish National Gallery/Ateneum Art Museum. Photo: Finnish National Gallery/Jukka Romu. Reuse not permitted.

Munsell colour atlas opened to the green color chart, and below that a black and white photo of the same page of the colour chart placed in nature, in the middle of the plants. This section also includes the fragment, *Rain in the Grove on 2 November 1985 (Sade lehdossa 2.11.1985)*, which is made up of an audiogram produced by a computer and, above that, another cassette tape that contains the audio material the audiogram depicts. Additionally, the *Grove* section to the left of the diary includes a photo that shows the artist's hand holding a magnifying glass in front of the trunk of a birch tree, the magnifying glass reflecting the image of the grove (for a better rendition, see the lower righthand side of Figure 9.4).

Holmberg's painting, *Road in Häme (A Hot Summer Day) (Maantie Hämeessä [Helteinen kesäpäivä])*, has inspired the *Road (Tie)* section of the work on the left, although the painting draws from several places, viz., Kuru and Ruovesi as well as Suomensjärvi and Laukaa (Figure 9.6). In this *Road* section, Anttila has depicted the terrain he covered during his expedition: its inclines and declines with photos of a clock at different intervals along the span of three kilometres displayed side-by-side with



Figure 9.5 Lauri Anttila, *Homage to Werner Holmberg (Kunnianosoitus Werner Holmbergille)*, 1985–86, installation, black-and-white photograph, colour photograph, drawing, text, books, dried plants, diary, 114.0 × 441.0 cm, Finnish National Gallery/Ateneum Art Museum. Photo: Finnish National Gallery/Jukka Romu. Reuse not permitted.

the photos of the surface of the Kuru–Ruovesi road, also at intervals over three kilometres. Holmberg painted *Road in Häme (Maantie Hämeessä)* and *Mail Road in Häme (Postitie Hämeessä)* right after his last trip to Finland (he lived in Düsseldorf at the time). Next to the photos, we see pebbles that Anttila brought from his journey, which he placed next to the photos in the showcase. On the left in the *Road* section, there is, furthermore, a collage of five photos *The Shadow of a Tree (Puun varjo)* which, too, refers to the Holmbergian paintings; in particular, to the painting *Mail Road in Häme (Postitie Hämeessä)* (Figure 9.2), in which the trees cast their dark shadows onto the road.

We should note that Anttila’s work has two chronological references. On one hand, the work follows Holmberg’s routes and the places he visited in the Kuru and Ruovesi regions in the summer of 1859, which he depicted during his journey. Anttila sought to use various instruments to reproduce features typical of Holmbergian “outdoor” depictions: their sensitiveness to colours, the brightness of light, the humidity of the air and rain, and the material characteristics of the landscape. As Anttila put it himself, the work attempts to find contact with the concrete landscapes of Holmberg’s paintings. “How did it feel to move in them; how did it sound?” (Anttila 2002, 31). On the other hand, Anttila recorded or traced his own experiences, observations, and impressions of the very landscape and nature where he walked during his journey—and tried to communicate them to the beholder the way they were, through various instruments



Figure 9.6 Lauri Anttila, *Homage to Werner Holmberg (Kunnianosoitus Werner Holmbergille)*, 1985–86, installation, black-and-white photograph, colour photograph, drawing, text, books, dried plants, diary, 114.0 × 441.0 cm, Finnish National Gallery/Ateneum Art Museum. Photo: Finnish National Gallery/Jukka Romu. Reuse not permitted.

and measurements. Thus, these sections in Anttila’s work refer also to his own personal journey: the weather he experienced, the route that he travelled, and the changes in nature he witnessed during the journey.

These two chronological “levels” become conflated and carry on a constant dialogue in the various sections of the work. Regardless of which chronological “origin” we pay attention to, we, as beholders, are given one work: a showcase, which as an object in and of itself, concretely conveys both a scientific and an artistic approach. On one hand, it refers to the scientific collections and showcases in museums with their specimens and corresponding descriptive slips that explain what the specimens are.

On the other hand, it imitates—at a symbolic level—the table in Leonardo da Vinci's painting *The Last Supper*, which connects to Holmberg in an interesting way. A reproduction of Leonardo's painting was already on display in the Kuru church in the days when Holmberg lived; we can assume that Holmberg saw the painting as many of his works depict the Kuru church (see Anttila 2002, 31).

Thus, *Homage to Werner Holmberg* simultaneously attempts to depict the reality of both Holmberg's paintings and the reality of Holmberg and Anttila's journeys by showing the "objects" using different instruments and media. However, the various recording devices and other instruments and renderings Anttila used translate the Holmbergian landscapes and their sensuous qualities into new and more fragmented and abstract forms, making them amenable to scientific observation.

9.3 In Pursuit of a Scientific "Picture"

Anttila's goal of exploring the assumed certainty of science through his art resonates in an interesting way with the discussions on scientific representation from the last decades. These discussions, both within the fields of philosophy of science and science and technology studies, have challenged the assumption that science should represent its objects truthfully, casting doubt on the very idea of accurate representation. This questioning of representation has either radically forsaken the whole notion of representation or embraced a new, heretofore more pragmatic notion of representation. What has been typical of the representational legacy of philosophy of science is the assumption that knowledge consists of a collection of representations that more or less truthfully depict their outside reality. This requirement for truthfulness has often been understood in terms of a correspondence that raises the problem of how external representations in science (e.g., mathematical models, diagrams and pictures produced through the use of different instruments) can be compared to external states of affairs, beings, and processes—in other words, to reality.

As the title of Richard Rorty's famous criticism of representation, *Philosophy and the Mirror of Nature* (1980) insinuates, the idea of internal or external representations standing for and accurately depicting their real objects taps into phenomena like seeing and mirroring. John Dewey wrote about such "spectator theory" of knowledge as follows:

The theory of knowing is modelled after what was supposed to take place in the act of vision. The object refracts light to the eye and is seen; it makes a difference to the eye and to the person having an optical apparatus, but none to the thing seen.

(Dewey 1984, 19)

Such representationalist realism assumes that scientific representations could somehow reach the external world in the same way as our vision catches the objects in our field of vision, which means that our vision offers a model for knowledge. No wonder scientific representation is often approached through the metaphors of picturing, or mapping, that is, through various kinds of iconic signs, as well as the assumed structural or other kinds of similarities between scientific representations and real-world objects and systems (for critique, see Suárez 2003; Frigg 2006; Knuuttila 2005, 2011). The visual metaphors through which knowledge has been approached make a realistic (or, seemingly realistic) landscape painting an apt case for the study of scientific representation through artistic means.

The first thing to note when viewing Anttila's work, *Homage to Werner Holmberg*, as a study of scientific representation is the way it approaches the production of knowledge through the use of fragments and various media. The work dissolves a unified realistic picture or, rather, an illusion of it, into various renderings produced through different media. As we view Holmberg's works which serve as the starting point for Anttila's work, we see a uniform landscape that seems to reproduce an identifiable place at a certain time. Strictly speaking, no such landscape exists. As pointed out above, a great majority of Holmberg's paintings were put together from fragments following the conventions of the landscape painting of his times. For instance, a particular tree appears in many of his works, although the paintings appear to depict a certain identifiable landscape (and are named accordingly).

On the other hand, the individual fragments in Anttila's work, such as sketches of desiccated plants, directly refer to this process of assembly. The plants are detached from their habitat, drawn, and photographed, after which they are positioned as parts of the total work (Figure 9.5). Our attention is also drawn to the way Anttila's work employs the photograph; despite being a tribute to the *landscape painter*, the work refers to *scientific representation* through its fragments. Moreover, while the work displays technological instruments used in scientific research, it also comments on the scientific method by grouping, picturing, and serialising specimens, pictures, and drawings in different ways (Figures 9.5 and 9.6). The extensive use of the photograph in the work would seem to refer not only to the new media that arts increasingly employ, but also to the aims of science. A photo as an index-like sign, produced by a machine, is supposed to be in more direct contact with reality than a painting in its icon-like form created by an artist. Consequently, a photograph appears to refer to the ability of a scientific representation to depict reality in a more objective fashion than a painting.

It is fascinating to compare Anttila's work with constructivist science studies on scientific representation, which coincided with Anttila's work.

Constructivist science studies have attempted to show how scientific representations and results should be related to their social surroundings and technological media, being rich repositories of social actions. In doing so, it has challenged the traditional view of science as an endeavour that seeks to depict the world truthfully, or accurately. In what follows, we will put Anttila's work in dialogue with Bruno Latour's anthropological-philosophical essay, *The Pédofil of Boa Vista: A Photo-Philosophical Montage* (1995), with particular attention on the material processes of abstraction through which scientific representations are achieved.⁵

9.4 Latour in the Amazon

The French anthropologist and philosopher Bruno Latour has made expeditions to the sites of scientific work, both to laboratories and the "field"—comparable to the way that Anttila followed Holmberg's paths. Latour's article, *The Pédofil of Boa Vista: A Photo-Philosophical Montage* (1995), describes Latour's journey to the outskirts of the Amazonian rainforest with an interdisciplinary team of scientists. The trip led the scientists to write an article addressing the phenomenon of rainforest being turned into a savannah. Where Anttila follows Holmberg's alleged footsteps, Latour travels along with the scientists whose work he is studying. Like Anttila, Latour gives his own description of his objects' work and "origin", attending to the different media used.

Latour's explicit target is the representationalist idea that scientific illustrations in journal articles would be reproductions of some real objects through some relation of similarity. Latour had attacked this notion already in his earlier writings claiming that, in reading a scientific article, one easily forgets that their illustrations and diagrams are, in fact, the result of complex material and instrumental processes (e.g., Latour & Woolgar 1986 [1979]). Latour's photos of the group's work, which the text (philosophically) comments on, describe this very process: the natural object is turned, through a series of material and instrumental translations, into a successively more abstract phenomenon. In seeking to grasp the process through which scientific representations refer to their alleged objects, the real world, Latour uses the concept of *inscription*.

An inscription is any sign, for instance, a picture, a diagram, or a mathematical symbol, and an *inscription device* is any device or instrument that can transform material substances into signs. Prior to the start of the scientific exploration Latour joined in, complex inscriptions were already required. Among those inscriptions were maps of different kinds, through which the scientists can acquaint themselves with the place to be explored and even find their way there. The purpose of inscriptions is to mould the object, in this case, the outskirts of the rainforest, into a form more

susceptible to knowing. Such processes of translation, utilising different inscription systems and instruments, have been analysed by ethnomethodologist Michael Lynch as mathematisation (e.g., Lynch 1985b, 1988). Lynch's analysis is influenced by Husserl's notion of *mathematisation* (Husserl 1970), but while mathematisation for Husserl describes the historical movement through which experience and proto-science transform into science, Lynch approaches mathematisation as those everyday procedures whereby a specimen, creature, or process is carefully prepared into an object of scientific analysis. From the perspective of Latour and Lynch, mathematisation is essentially a process of *abstraction through material translation*. To even embark on an exploration of a rainforest, for example, scientists need to place a coordinate grid over it by placing markers in a delimited area at regular intervals. This artificial Euclidian space makes it possible to register phenomena using a series of numbers assigned to the markers. In these series of acts, scientists start to transform the forest into a kind of laboratory, Latour observes.

What we call material translation is not reducible to a (potentially reversible) symbol-to-property mapping. If we were to view it as such, we would fail to appreciate the cognitive grounding of such abstractions. Moreover, as cognitive scientist David Landy (2006) shows, the abstractions involved in the transformation of a problem into a different material realisation are not about the “stripping” of properties, but about the “replacing” of features. According to Landy, by finding a new way to express a situation, one attains a different roster of affordances with new features—these new features may be useful in identifying patterns that were previously occluded and can also trigger different cognitive perceptions that could be helpful. Consequently, “abstraction is not (as the myth would have it) about removing features to isolate relations; instead, it's about managing features to get relational work done” (Landy 2006). The material enrichment taking place in abstractive translation enables the exploitation of the affordances of different material realisations. The point is that distinct material translations enable different kinds of sensorimotor (concrete) engagements that support different reasoning processes. In contrast, structural mapping assumes that the relevant properties and symbols are already available for scientists simply to map onto each other. In our view, the various kinds of material translations can be taken to *constitute* the process of abstraction. As Landy succinctly put it: “every abstraction is a concreteness somewhere else”.

Science and technology studies have addressed the multitude of devices that configure, regulate, and institutionalise material translations that are crucial for abstraction. Scientific laboratories as habitats for the construction of facts and manifold representations have especially intrigued constructivist science studies (Latour and Woolgar 1986 [1979]). At the end of

the 1970s and in the early 1980s, a number of so-called laboratory studies⁶ appeared in science and technology studies with their published goal of “[d]irect observation of the *actual site of scientific work* (frequently the scientific laboratory) in order to examine how objects of knowledge are constituted in science” (Knorr-Cetina 1983, 117).⁷ Later on, *the laboratory* became extended into a general concept covering those manifold instrumental-theoretical practices typical of scientific work, through which heterogeneous materials and socio-cultural elements are worked into fixed and stable facts and phenomena.⁸

Studying the process of rendering a field site into a laboratory, Latour traced the chain of inscriptions and instruments, which led from the rainforest to a diagram in the article published by the scientists. Plants were collected and dried, the soil was opened up to get soil samples, and the layers in the terrain were measured and analysed with different instruments. One of these instruments is Topofil Chaix, a device Brazilian scientists perversely call *pedofil*, which uses a running string to measure how far a scientist has walked. The same string can also bring a scientist who has perchance gone astray in the forest back to where he started from. This string provides Latour an apt metaphor for the chain of inscriptions that offers an answer to the traditional problem of representation: how is it possible that one entity (a diagram in a scientific publication) can represent a totally different entity (the Amazonian forest)? The diagram representing the forest is not similar to it, but the chain of inscriptions through which the diagram was created connects it with a particular part of the forest.

At one end of the chain is the forest; at the other end, the diagram on paper. In between are the measuring instruments and the different classifications through which the specimens and their properties are coded with different numbers and words. Inscriptions are created, arranged, and combined until the scientists finally arrive at a diagram, an abstract rendering of its object—the Amazonian terrain at the crossroads of the savannah and the rainforest—and are able to answer the question of which one is taking over the other.⁹

As can be observed from the two very different ends of the chain, it is the sequential translation of material realisations one unto another that best characterises the reference carried over. This chain of material translations can be understood as a process of abstraction in which the features of the object of interest (the ecological balance of the Amazonian rainforest) are literally re-presented in various material ways, each offering different affordances and enabling other translations. The soil samples are first analysed by rubbing them between palms and then describing their composition, after which they are coded using the Munsell colour chart. The Munsell code assigns the soil samples a number in accordance with their colour. After this, the soil samples are no longer needed, the soil has

turned into signs, which can be transported on a piece of paper, losing the dirty hands, the heavy containers, and the confounding elements around the soil like plants and animals. What is more, the Munsell code allows for a standard comparison with other terrains.

At each step in the inscription chain, something of the elements is lost, but at the same time, they become renewed. Such renovation enables generalisations and connections that were not available in the original material realisation. The chain of inscriptions is a continuum that makes an ostensibly complex and opaque object into one known by a certain branch of science. In the transformation of the soil into numbers and other signs, a transfer takes place from natural objects into different documents and representations through subscription, experimentation, sampling, and substitution. This abstraction process generated through various inscriptions leans on the heterogeneous historical strata of other scientific disciplines, different instruments, languages, and practices. In this way, any scientific, artistic, or technological object always refers to the different times and places where the technological and other innovations were made that enabled its invention.¹⁰

As we have argued, the process Latour describes can be approached as an abstraction process. However, abstraction as translation is not reducible to the common notions of abstraction as omission, nor is abstractness opposed to concreteness in any simple way. Even though only a translated portion of the original situation is kept, it allows us to literally hold the transfer of the forest and the savannah in our hands. This abstract concreteness, we maintain, is characteristic of scientific work. With the help of combinability and comparability facilitated by concrete chains of inscriptions, we can get an overview-like understanding of the situation and manage it. The affordances of the different inscriptions and material realisations endow scientists with different sets of abilities, enabling them to take advantage of different affordances. These translations are also easier to move to other locations and scientific contexts—for instance, taking along the coded forest from the Amazon to Paris.

In the case examined by Latour, something of the original remains in the form of samples. The botanist in the group of scientists collected plants which serve as evidence. In the plants, we can see two features typical of scientific reference: on the one hand, an economic shortcut whereby we allow one individual to (metonymically) represent the others and, on the other hand, a grounding for the claims made. We can return to these dried plants, and they can be studied to justify scientific claims. One typical place where these kinds of specimens end up is a showcase. Indeed, the showcase of *Homage to Werner Holmberg* contains a compilation of samples (rocks and desiccated plants) as well as documents that were produced using different instruments and which refer to both science and

the arts. This showcase is also like scientists' work-desks when it comes to its contents: it is full of specimens and inscriptions which bring the object, the landscape, to its beholders.

9.5 Material Translation in *Homage to Werner Holmberg*

Anttila's showcase demonstrates the common roots of representation in arts and science in their very mediality: in the inscriptions, media, and translations with which the scientific and artistic objects are created and displayed. As if visually anticipating Latour's observations in the Amazon, Anttila has juxtaposed several instruments or technologies used in scientific work, also superimposing them. In this work, which pays tribute to the landscape artist, the objects of depiction also seem significant. A great majority of the black-and-white photos are serial close-ups of the earth with no horizon, and they show practically nothing of the surrounding landscape. The technological and objective device, the lens of the camera, is focused on the ground or on another scientific or technological device placed on the ground, viz., a thermometer, a compass, a clock, a magnifying glass (Figures 9.5 and 9.6). These serial photos show the beholder the change in temperature, the passing of time, points of compass, and magnified details of the desiccated plants in the showcase. Whereas Holmberg created landscapes by combining spatiotemporally disjunct fragments of the world while still conveying a feeling of being in a particular place, Anttila dissolves the experience into seemingly random instrumentally mediated samples and slices. The fractured, recomposed, and translated nature of abstraction is present in both Holmberg and Anttila, though it is made visible by Anttila, quite like in Latour's analysis of the field expedition to the Amazon.

What *Homage to Werner Holmberg* makes evident is how instrumental and graphic paraphernalia have become rooted in our ways of seeing the world—and how their development can inevitably change what we are able to see. In this work, we can observe several chains of transformation where each change is accomplished by exploiting technological instruments. That corresponds to the way that science produces qualitatively new kinds of *visibility* through laboratory work and inscriptions. The *Grove* series provides perhaps the best example of scientific (or artistic) transformation of an object in Anttila's work. It depicts the many transformations and states of the grove in the form of different specimens and documents, executed through various media. The desiccated plants from the grove are placed in the showcase with a separate charcoal drawing of each, and they are photographed through a magnifying glass. In those photos, there are two media on top of each other: the photo and the magnifying glass, of which the magnifying glass both takes the beholder closer yet eventually also wipes out the object.

The *Grove* section also contains the Munsell colour chart book (Figure 9.5). Next to the book, is a black-and-white picture depicting plants and a colour chart book that is placed on top of the plants. This, too, represents various overlapping media and transformations. The photo refers to the possibility of comparing the colours of the vegetation with the colours in the book. Such comparisons enable classification, in giving codes, which *represent* the colours and maintain them in a symbolic form—only to do away with the sensual experience of the colours that is underscored by the black-and-whiteness of the photo depicting the Munsell chart on top of the vegetation.

The Munsell chart indeed provides a good example of a replacement in abstractive practices. While such an “inscription device,” as Latour would call it, offers a translation of some properties (i.e., colour) of the collection of soil samples, it also strips the soil from its sensorimotor dimensions. Each of the soil samples becomes associated with a number that corresponds to the colour in the Munsell colour chart. What has been lost or gained in such translation? First, most of the other dimensions of the soil—texture, smell, volume, etc.—have been lost. Why is this not then just a case of abstraction as omission? Because the device does not just strip away these properties and leave *colour* but instead assigns the sample a *colour code* that allows the scientists to place the soil sample within a new context, affording for the comparison and alignment of the soil sample to inventories of other (translated) objects. This gesture signifies a loss, but it also involves an enrichment. In its new material realisation, the soil sample can be compared with other translated soil samples as well as other substances of many sorts. Several of these new epistemic possibilities are only available after the translation.

Second, the transformation via the Munsell chart is, in turn, the product of a concrete exploration. Munsell relied on photometrically tested value scales of the psychological experience of colour that he embodied in physical samples (Cochrane 2014, 36). Thus, while the process of creation of the Munsell System is grounded in particular experiences and experiments, such concreteness is compressed and black-boxed in the practice of using it. It is then crucial to note that there is no way back to the soil from the Munsell code. Instead, we have entered the forest of “circulating references”.¹¹

Perhaps the most complex series of references in Anttila’s work is provided by the “picture of the grove on the birch”, i.e., the grove reflected on the surface of the birch through the magnifying glass (Figures 9.4 and 9.5). The surface of the birch acts as the screen through which the photo, technologically produced with the help of a magnifying glass, appears to return to nature and, for its part, speaks of the chain of transformations that offer a chance to travel in different directions, yet always to an already

transformed image. At the same time, this procedure bestows a metaphor for the mathematisation process whereby nature, changed technologically, is placed on top of nature proper.

Other parts of the *Grove* section are photos of instruments, i.e., the thermometer and the light meter, which are placed in the terrain, as well as the rain recorded on the cassette tape, the contents of which are visualised as an audiogram (Figure 9.5). In the audiogram, 1.16 seconds of the recording is transformed into a graphic picture of the wind and rain. These pictures are indubitably references to the gamut of sensations evoked by Holmberg's work. At the same time, they tell us how, in scientific terms, different sensations and observations are measured and transformed in visual form using technological instruments. The temperature and the amount of light are recorded with the measuring devices placed in the terrain. The sound of rain, on the other hand, has been turned into a diagram, which gives us information of an auditory phenomenon in visual form.

What is indeed typical of scientific representation are the machine-produced instrumental shifts from world to paper where "invisible" objects are graphically made visible. In studying the link between scientific visualisation and mathematisation, Michael Lynch has concentrated on this very process where transformations produced with different inscriptional instruments not only create but also mould the visibility of a scientific object (Lynch 1985b, 1988). Scientific representations do not just reproduce or simplify things, they also add visual features to the pictures and clarify, complete, expand, and identify different structures which are presumably latent in the original object. From this perspective, the process of abstraction does not just omit but also augments. For Lynch, visual displays in science supply an "externalised retina" where the natural object is transformed into a graphic one. The pictures in themselves, however, do not show the transformations on which the possibility of a picture to produce a sensual presence of a scientific object is based. Behind the pictures, there are different kinds of methodical practices, instruments, graphic inscriptions, and interactive processes that replace the mind as the traditional place where the object of knowledge is represented. For Lynch, vision is still a medium of knowledge, but it works in a different way from how the epistemological tradition conceives it. Scientific representations lay out the externalised retina, which is produced through the complex instrumental and inscriptive processes of linearisation, unification, and standardisation.

9.6 Objectivities Made and Lost

In following the work of scientists, Latour noticed that scientists trust their instruments and inscriptions much more than their cognitive

abilities. Overlapping and parallel inscriptions, produced in different and independent ways, increase their reliability. Philosophers of science talk about *triangulation*—a process whereby the results produced through various independent means are compared to each other (Wimsatt 2007). The select objects in Anttila’s work, the plants, the rocks, the scenery, the rain, and other atmospheric phenomena are all supposed to reinforce the natural experience created by the work. We must note, however, that the objectivity is created by the triangulation of different instrumentally produced inscriptions. In commenting on scientific objectivity, Anttila wrote in his article “Science in My Art”:

From the pursuit of scientific research, I have borrowed the method of making observations, its systematics, and the transformation of data into demonstrable reduced form. The object of study, which used to be a phenomenon in the starry sky, is now earthly. I have wanted to study the method itself and to find the concreteness in it. To set it against everyday life. I want to restore the connection between science and arts that was lost in the 1800s. I use the photo (now also the recorder) because it is granted “scientific” certainty, but the subject can be any ordinary phenomenon. To me, the camera is a measurement device. The whole picture comes into being only when the series is finished. What is unknown to me, behind the pictures, is exposed. Separate phenomena become parts of the whole.

(Anttila 1989, 103)

The question is to what extent such artefactual renderings and translations remain artificial, and the unified picture illusory, at least to some extent. The preface to the Munsell colour chart indeed warns: “Rarely will the colour of the sample be perfectly matched by any colour in the chart. The probability of having a perfect matching of the sample colour is less than one in one hundred” (Munsell Color 1990, iv). This difficulty of matching is demonstrated by Charles Goodwin’s ethnographic studies (1994, 2000) on the use of the Munsell colour chart. The colour chart is a cultural artefact, whose use must be learned with the help of trained scientists—alluding to the paradox of scientific objectivity. When we look at the various samples with the help of some coding system, the triangulation of mutually corresponding uniform observations becomes possible. The exactness of the coding system, nevertheless, conceals the preceding cognitive, and observation-bound uncertainties, and the situated and distributed scientific work. These uncertainties have, however, been bracketed in later documentation—through the coding—ingeniously commented by Anttila’s black-and-white photo, positioned in the work just under the actual Munsell atlas. This photo taken of the vegetation on the top of

which the atlas has been placed makes apparent how difficult it is to discern the plants' colours with the help of the colour chart, once the colours have been erased.

It is precisely the idea that such a loss of experiential qualities fosters objectivity that Anttila rightly parodies. In Anttila's reconstruction of the Holmbergian landscapes we have lost, via translational artefacts common in scientific practices, precisely what Holmberg wanted to produce: *an experience* of the landscape depicted. Holmberg was not interested in creating just a visual reconstruction of a landscape, but an experience of a landscape, despite its being one that as such did not exist (pace the names of geographical locations in the titles of his many landscape paintings). Anttila, in turn, is interested in giving us a scientifically translated experience of Holmbergian landscapes through the pieces, colours, and sounds of the environments that inspired Holmberg. Paradoxically, Anttila's work strips the specimens from the experiential dimension with the same gesture.

Homage to Werner Holmberg also casts an ironic light on the goal of science to create order. One of Anttila's salient ways of disturbing the production of objectivity is serialisation. The serialised photos of the road work in this manner. They suggest that their goal was to systematise the material, but at the same time, they seem to ask the beholder what this serialisation is based on. In the left-hand corner of the work, there is a series of five photos, which creates an "unbroken" picture of the shadow of the tree (Figure 9.6). The uniform picture is, first, accomplished with different pictures, but, second, instead of the tree, they piece together its *shadow*, so as to hint at the scientific method never reaching the tree itself. This series is followed by a series of photos of the road with a clock, where the pictures were taken at certain time intervals, underscored by the clock's different times. This series is in turn followed by a series of photos of the road which show a terrain of varied roughness. Next to each picture, there is a rock as a sample that functions also as a *guarantee* of the reference.

The serialised pictures and the overlapping and parallel fragments can be seen as an artistic expression of the chain of material references Latour refers to in his attempt to solve the problem of representation. The chain of inscriptions, along which one can move in different directions, substitutes and partly solves the problem of representation, viz., the question of the relationship between the picture and its object. What is essential in Latour's solution is, nevertheless, the fact that we, as beholders, must know how and why the transformations were made in order to effortlessly move along the referential chain back and forth. Both in science and art the specific knowledge and training, rooted in the tradition of a particular field, establish the ability to trace the chain of references through which it is possible to move from the representation to its source (though some spatiotemporal qualities of the source have been permanently lost).

Yet, *Homage to Werner Holmberg* appears to expose the fragility of these links. It offers us a series of references where the relationship of the signs with their objects is problematic. The work refers to Holmberg's paintings and work, but it does it through Anttila's own experiences, which, furthermore, are present in the work only in the form of fragmentary signs produced through various media. There is a disruption between all these references: series and specimens are apparently produced by random choice, with no ulterior motive. Moreover, a beholder who does not know that the work is a tribute to Holmberg is scarcely capable of determining this merely by looking at the work. In fact, the various parts of the work do not clearly, on their own accord, even refer to Anttila's own experience. These references cannot become evident merely by looking at the work, as the representational theory of knowledge presupposes. Although the work, in the tradition of natural history museums, displays numbered signs with "instructions" on how to read the work, they require not only knowledge of the arts and science but also of the intentions of the artist.

Irrespective of such knowledge, the work is nevertheless able to display its investigation of contemporary experience, which is increasingly scientifically and technologically mediated. The overall theme in *Homage to Werner Holmberg* does seem to be the twofold movement characteristic of representation that both makes present and distances. On one hand, Anttila's goal was to find something concrete, tangible, and permanent behind Holmberg's paintings. In order to do that, he returned to the same and similar landscapes and fetched—through the use of different media and materials, which crystallised those landscapes and conditions—that world. On the other hand, the work explores the act of distancing and losing the original experience through representation: what is present are only documents and samples left of the road or plants, and the multiple modalities of sensing, e.g., warmth, light, and sound, turned into numbers and diagrammatic displays. *Homage to Werner Holmberg* reveals, then, the paradox of mediality shared by both science and arts: science looks for the basic mechanisms and elements of reality, but to be able to do so, it is forced to invoke artificiality: complex devices and man-made classifications. Arts, on the other hand, typically look for an experience, which is basically subjective, but in order to supply this individual experience, is forced to resort to communal and shared representational means.

9.7 What Abstraction Leaves Behind

Artistic and scientific representations differ in how they work and what they aim at. If the traditional task of science has been that of depicting reality as exactly and as transparently as possible, especially modern art probes the inability of images to represent reality, or to reach that reality.

For this reason, the arts provide an excellent place to speculate on the materiality of images and representation, their lack of clarity as well as on the translations that mediate the relationship of the representation to external reality.¹² We have seen how both Anttila's and Latour's treks in the woods ironically led them to the space of artefactual displacements. Their humorous explorations in translation remind us of what is ignored in viewing abstraction simply as omission, or contrasting it to concreteness: the experiences, practices, and tools that enrich representations with new affordances, enabling novel insights, questions, and accomplishments.

There is still loss involved, of which Anttila is acutely aware. While Latour appears confident in scientists' ability to travel back and forth between the inscriptive chains, Anttila shows how abstraction does away with many, if not most qualities of experience, and going back might not be possible anymore. His is not the abstraction of many philosophers of science, who assume along with Jones (2005) that omission might still leave scientists with true, though partial representation. Anttila's serialisations, and overlapping and superimposed images, refer both to the production of objectivity, and the ambiguities and choices involved in it.

Another important lifelong goal of Anttila was to inquire into the deeper connections between arts and science. *Homage to Werner Holmberg* does that indirectly by commenting on scientific representation, which, in our culture, faces the requirement of clarity and truthfulness. Although the ostensible aim of Anttila's work is to depict external "reality", the passing of time, certain localities, and landscapes as accurately and exactly as possible, the work develops into a reflection of the inescapable mediality of representation—and experience. In employing both the forms of scientific depiction and artistic documentation, *Homage to Werner Holmberg* tears down the boundaries between science and the arts. It exposes the abstractive processes inherent in the material translations between different media, simultaneously pointing to the complex referential chains native to both scientific and artistic representation. At the same stroke, the work thematises the techno-scientific nature of our own sensual life-world that is increasingly mediated, measured, and curated: science and technology not only supply us with new and ever-refined observations and means to make our aims possible, they rather continually work on what we see, experience, and want.

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Notes

- 1 Some philosophers of science have resisted this reductive approach to abstraction (Radder 1996, 2006; Martínez and Huang 2011; Nersessian 2002; Gallegos Ordorica 2016; Jones 2018; Loettgers and Knuuttila 2022; Carrillo and Martínez 2023).
- 2 This is not the case in art that typically refers to its own material constitution.
- 3 *Homage to Werner Holmberg (Kunnianosoitus Holmbergille)* belongs to the collection of the Museum of Contemporary Art Kiasma, Helsinki.
- 4 Anttila’s methods connect him to early contemporary art genres such as conceptual and land art.
- 5 See also “Circulating reference” in Latour, B. (1999) *Pandora’s Hope. Essays on the Reality of the Science Studies*, Cambridge, MA; London, Harvard University Press, 24–79.
- 6 Three pioneering laboratory studies are Latour and Woolgar (1986[1979]), Knorr-Cetina (1981), Lynch (1985a). A good overview of them can be found from Knorr-Cetina (1995).
- 7 Italics of the original.
- 8 On the notion of a laboratory, see, e.g., Hacking (1992).
- 9 See also Lynch (1988).
- 10 See also Latour (1999, 174–215).
- 11 Latour’s *The Pédofil of Boa Vista* has been reprinted in his book *Pandora’s Hope* (1999) with a title “Circulating Reference”.
- 12 E.g., Groys (2002).

References

- Anttila, L. (1989) *Ajatus ja havainto. Kirjoituksia vuosilta 1976–1987*. Helsinki: Kuvataideakatemia.
- Anttila, L. (2002) Kunnianosoitus Werner Holmbergille. In: Sederholm H. (ed.) *Pinx. / Maalaustaide Suomessa*. Maalta kaupunkiin. Espoo: Weilin + Göös, pp. 30–31.
- Carrillo, N. & Martínez, S. (2023) Scientific inquiry: From metaphors to abstraction. *Perspectives on Science*. 31 (2), 233–261. https://doi.org/10.1162/posc_a_00571
- Cochrane, S. (2014) The Munsell color system: A scientific compromise from the world of art. *Studies in History and Philosophy of Science Part A*. 47, 26–41. <https://doi.org/10.1016/j.shpsa.2014.03.004>
- Dewey, J. (1984) *The Quest for Certainty, Later Works 1925–1953 vol. 4*. 1929, Jo Ann Boydston (ed.). Carbondale, IL: Southern Illinois University Press.
- Frigg, R. (2006) Scientific representation and the semantic view of theories. *Theoria-Revista de Teoría, Historia Y Fundamentos de la Ciencia*. 21 (1), 49–65. <https://doi.org/10.1387/THEORIA.553>

- Gallegos Ordorica, S. A. (2016) The explanatory role of abstraction processes in models: The case of aggregations. *Studies in History and Philosophy of Science Part A*. 56, 161–167.
- Goodman, N. (2003) Abstraction. Grove Art Online. <https://doi.org/10.1093/gao/9781884446054.article.T000257>
- Goodwin, C. (1994) Professional vision. *American Anthropologist*. 96 (3), 606–633.
- Goodwin, C. (2000) Practices of color classification. *Mind, Culture and Activity*. 1 (1 & 2), 19–36.
- Groys, B. (2002) Art in the age of biopolitics: From artwork to art documentation. In Documenta 11_Platform 5: Exhibition Catalogue.
- Hacking, I. (1992) The self- vindication of the laboratory sciences. In: Pickering, A. (ed.) *Science as Practice and Culture*. Chicago, IL: University of Chicago Press, pp. 29–64.
- Husserl, E. (1970) *The Crisis of European Sciences and Transcendental Phenomenology*, D. Carr (trans.). Evanston: Northwestern University Press.
- Jones, M. R. (2005) Idealization and abstraction: A framework. In: Jones, M. R. & Cartwright, N. (eds.) *Idealization XII: Correcting the Model. Idealization and Abstraction in the Sciences*. Poznan Studies in the Philosophy of the Sciences and the Humanities. 86 (12), pp. 59–115.
- Jones, N. (2018) Strategies of explanatory Abstraction in molecular systems biology. *Philosophy of Science*. 85 (5), 955–968.
- Knorr-Cetina, K. D. (1981) *The Manufacture of Knowledge: An Essay on the Constructivist and Contextual Nature of Science*. Oxford: Pergamon Press.
- Knorr-Cetina, K. D. (1983) The ethnographic study of scientific work: Towards a constructivist interpretation of science. In: Knorr-Cetina, K. D. & Mulkay, M. (eds.) *Science Observed: Perspectives on the Social Study of Science*. London: Sage, pp. 1–18.
- Knorr-Cetina, K. D. (1995) Laboratory studies: The cultural approach to the study of science. In: Jasanoff, S. et al. (eds.) *The Handbook of Science and Technology Studies*. Thousand Oaks, CA: Sage, pp. 140–167.
- Knuuttila, T. (2005) Models, representation, and mediation. *Philosophy of Science*. 72 (5), 1260–1271.
- Knuuttila, T. (2011) Modeling and representing: An artefactual approach. *Studies in the History and Philosophy of Science*. 42, 262–271.
- Landy, D. (2006) Every Abstraction Is a Concreteness, Somewhere Else. *Blog entry*. <https://davidlandy.net/every-abstraction-is-a-concreteness-somewhere-else/>
- Latour, B. (1995) The Pédofil of boa vista: A photo-philosophical montage. *Common Knowledge*. 4 (1), 144–187.
- Latour, B. (1999) *Pandora's Hope: Essays on the Reality of Science Studies*. Cambridge, MA & London: Harvard University Press.
- Latour, B. & Woolgar, S. (1986 [1979]) *Laboratory Life: The Construction of Scientific Facts*. Princeton, NJ: Princeton University Press.
- Loettgers, A. & Knuuttila, T. (2022) Abstraction is (Much) more than omission: alon's network motifs reconsidered. *A presentation at PSA 2020/2021 Conference*. Baltimore, November 11–14, 2021.

- Lynch, M. (1985a) *Art and Artifact in Laboratory Science: A Study of Shop Work and Shop Talk in a Research Laboratory*. London: Routledge and Kegan Paul.
- Lynch, M. (1985b) Discipline and the material form of image: An analysis of scientific visibility. *Social Studies of Science*. 15, 37–66.
- Lynch, M. (1988) The externalized retina: Selection and mathematization in the visual documentation of objects in life sciences. *Human Studies*. 11, 201–234.
- Lynch, M. & Woolgar, S. (eds.) (1990) *Representation in Scientific Practice*. Cambridge, MA & London: MIT Press.
- Martínez, Sergio F., & Huang, Xiang. 2011. Epistemic groundings of abstraction and their cognitive dimension. *Philosophy of Science*. 78 (3), 490–511.
- Munsell Color. (1990) *Munsell Soil Color Charts*. Baltimore, MD: Munsell Color.
- Nersessian, N. J. (2002) Abstraction via generic modeling in concept formation in science. *Mind & Society*. 5 (3), 129–154.
- Radder, H. (1996) *In and about the World: Philosophical Studies of Science and Technology*. Albany, NY: State University of New York Press.
- Radder, H. (2006) *The World Observed/the World Conceived*. Pittsburgh, PA: University of Pittsburgh Press.
- Reitala, A. (1986) *Werner Holmbergin taide*. Helsinki: Otava.
- Rorty, R. (1980) *Philosophy and the Mirror of Nature*. Oxford: Basil Blackwell.
- Suárez, M. (2003) Scientific representation: Against similarity and isomorphism. *International Studies in the Philosophy of Science*. 17 (3), 225–244. <https://doi.org/10.1080/0269859032000169442>
- Thomas, G. M. (2002) The topographical aesthetic in French tourism and landscape. In *Nineteenth Century Art Worldwide*. 1 (1). www.19thc-artworldwide.org/spring02/the-topographical-aesthetic-in-french-tourism-and-landscape (Accessed 21.3.2013).
- Wimsatt, W. C. (2007) *Re-Engineering Philosophy for Limited Beings: Piecewise Approximations to Reality*. Cambridge, MA: Harvard University Press.