

# UNMAKING ABSTRACTIONS

-THE RELATIONSHIP BETWEEN THE DIGITAL AND PHYSICAL IN SCULPTURAL PRACTICE AND THE DUAL NATURE OF THE 3D MODEL

## INTRODUCTION AND RESEARCH QUESTIONS

My research investigates the dual nature of the 3D model as something abstract and particular, digital and physical. By giving a sculptural body to this field of enquiry, I aim to gain new insight into the relationship between the digital and physical in sculptural practice. I undertake this enquiry by means of sculpture, 3D modeling tools, Youtube instructional films and augmented virtuality works.

As a sculptor I am interested in abstraction, in how we translate phenomena into concepts, and furthermore how these abstractions affect our understanding and shaping of the world. This project departs from thinking about abstraction processes in the use of 3D modeling tools, from wondering if the 3D model is an abstraction or not. Through a process of making work in response to this question which turned out not to have a yes/no answer, I was pointed towards new ones. Can an object be translated into bodiless information? What is lost and gained in such an extraction? What are the answers to these questions when the procedures flip around and the 3D model on my screen materializes through processes of digital or manual fabrication?

By using sculptural approaches that I call *unmaking* and *giving body* I research how the 3D model is at once an abstraction and a particular construction. Articulated as triangles and nodes in a coordinate system, it can be perceived as disembodied zeros and ones. At the same time it not only has a digital materiality<sup>i</sup>, but it is a highly particular technology that has evolved in a particular technological context, co-developed through users and online communities, and it can be turned into new material objects through various kinds of digital fabrication techniques.

The way that these particularities - the tools, spaces, people, materials and something's situatedness - influence and co-create artistic work, ourselves and our surroundings are interests that naturally evolve from working with sculpture. To identify some of the questions and relevant discourses around sculpture, 3D modeling and relations between the abstract and the particular, and the physical and digital, I will invoke new materialist and posthumanist theories such as Donna Haraway's concept of *situated knowledge* and Kathrine Hayles *nonconscious cognition*. In "Situated Knowledges, The Science Question in Feminism and The Privilege of Partial Perspective"<sup>ii</sup> Haraway addresses how all of the world's particularities matter for knowledge creation, and how accountability for these must be established for an ethical epistemology, what she calls feminist objectivity. In *Unthought, The Power of The Cognitive Nonconscious*, N.Kathrine Hayles introduces the term nonconscious cognition as a kind of 'thinking without thinking' to explain how humans and technical systems process information from the environment and how conceptualizing interactions between them "can enable us to understand more clearly the political, cultural, and ethical stakes of living in contemporary developed societies"<sup>iii</sup>. This can be useful for my work in

reflecting over the embodied process of making work and experiencing art works, and also for understanding the interplay between humans and 3D-modeling tools.

## ARTISTIC BACKGROUND

When I first started making sculptures, I often used a space, some readymades, tools or materials as a point of departure for a playful experimentation with compositions of objects or installations. I soon became interested in how phenomena, these things that I experienced while working, are translated into abstract concepts, and how those concepts structure and shape our lives. Moreover, it made me think about how these abstractions are not created in a vacuum, that they are specific to the circumstances in which they were made and that those circumstances continue to shape what they come into contact with, our physical world and everyday life. Things such as numeral systems, measurement units, the spherical shape of the Earth, building blocks in 3D modeling software and other standards that simplify, categorize and structure a chaotic world. Making sculptures has since been a way for me to *unmake* some of these abstract concepts in an effort to understand them differently. Cutting up and assembling pieces of material, making compositions and experiencing these concepts in space and time has become a way to study the things that govern my world with my eyes, hands and feet. The result of this process, the work that I make, is not always intended to be read with a critical or analytical approach, but made to be accessible for the viewer, participant or co-creator through embodied interaction. 3D modeling is one of the sculptural tools I came across on my way and at first glance it seemed neutral, disembodied and body-disengaging while at the same time having particular influence on my own work, on architecture, product design and computer graphics. This made me interested in the tension between the abstractness and the particularity of the 3D model, and in the relation between the digital model and its physical counterparts.

In 2018, I co-founded Aldea, an open workshop in Bergen where digital fabrication has become an important component, and the use of 3D modeling tools, CNC machines and 3D printers became part of my daily working environment. Aldea is part of a large and growing movement of individually organized workshops, many of which are not mainly directed towards creative professionals, but towards a non-professional maker community. Rather than specializing in one particular skill following the assembly line logic of industrial production, makers can be involved in all parts of the lifecycle of a thing from material sourcing to design, fabrication, consumption and disposal. When not separated into different disciplines across different continents these processes are allowed to influence each other, shaping not only the thing being made and how the maker relates to it, but also the maker, and the process-based artist herself, who can combine head and hand<sup>iv</sup> in her work. Through online networks the maker shares her designs and information about how to make them<sup>v</sup>, allowing designs and the software systems used to create them to develop based on collective input, a process sometimes referred to as distributed cognition.<sup>vi</sup> Despite the maker movement's promise to democratize tools, empower people's individual creativity, challenge modes of industrial production, how we relate to consumer goods and ultimately create positive social change, it has according to its critics come short failing to reach diverse user base, address environmental impacts of production and reinforced hegemonic power relations for instance through opacity and secrecy around practices of user data collection.<sup>vii</sup>

## METHOD

The artistic research is carried out through making three different artworks and attending various workshops, in addition to participating in foras, seminars and other components of the national artistic research program.

### TWO ROCKS DO NOT MAKE A DUCK, STARTED 2018 AND ONGOING

The first artwork examines the blurred boundaries between the physical and the digital<sup>viii</sup> through augmented virtuality, a form of mixed reality which integrates physical objects into a virtual<sup>ix</sup> environment. Physical objects (sculptures) have VR trackers attached to them, so that they are synchronized in time and space with their simplified, abstracted, digital imitations- the 3D models in virtual reality. This allows for the exhibition-goer to interact with the sculptures and experience a mixed reality where sense data<sup>x</sup> from what they touch, lift and move around is retrieved from the physical world and what they see through their eyes comes from a virtual, constructed counterpart moving in synchrony with it. The virtual models thus have two material counterparts- both the digital materiality it embodies and the sculptures that they overlay.

Over the course of the artistic research program this project will be developed through three iterations in collaboration with Cameron MacLeod. The initial version *Event Collider* was made during fall 2018 and presented in an artist run space in Bern, Switzerland. The second version *Two Rocks Do Not Make a Duck* was created during the one month "Digital Promises" workshop at Banff Center for Arts and Creativity in Canada in January 2019. From this point on site specificity became an important aspect of the work, as this would allow us to direct the participant's attention to the relation between the physical world and its digital counterpart. Our studio and exhibition space was overlooking the Rocky Mountains in the Banff National Park and we recreated a digital replica of this scenery so that when people put on the VR goggles they could see the virtual mountain range positioned in the same relation to their bodies as before. I created a series of rock shaped sculptures, 3D scanned and brought them into the VR scene. When the participant lifted and moved the rocks around it triggered events in the virtual world, for instance moving one specific rock would move the sun across the sky. The third iteration of this project will be made for the Munch Museum's exhibition *The Machine is Us* in 2021 and in this instance we will focus on developing the interactive element of the work, the different things that can happen in the virtual scene as a response to the participant's interaction with the sculptures and movement in space. We aim to facilitate an exploration of a mixed reality ecosystem - where abstracted information from the natural world, such as datasets describing the earth's rotation and orbit around the sun or 3D scans of plants, are imported into the virtual scene and made to respond to their interactions.

### SECRET SUPPORT, 2019

*Secret Support* (2019) is a project that examines the technology and industry of 3D printing, one of the ways in which a digital model can be turned into a physical object, and also how an artwork can be made by performing translations between these two states. It is a series of sculptures based on the support structure which holds an object in place while being printed on a Formlabs 3D printer, a scaffolding structure that is automatically generated by an algorithm to fit any shape. This algorithm is proprietary information and Formlabs' biggest business secret. The virtual structure cannot be converted into other digital file formats as

this would jeopardize the ownership of the algorithm. In need of working drawings to make sculptures based on this structure I had to go through the meticulous process of printing out the support structure, measuring the little plastic pieces by caliper and by eye, transferring this information to the 3D modeling software, make digital working drawings with correct angles and dimensions, then transfer this to 1:1 working drawings on a large piece of paper on which a welder could place the aluminum tubes that I had cut out for him before welding it all together.

This picking-apart and unmaking process was meaningful because it showed me how information is always instantiated in a medium, whether that be the gap of the caliper, my hand, brain or computer screen and how it through my interpretation changes from one state to another. Moreover, it made explicit to me the asymmetries in access to information-between independent and decentralized makers and the large corporations whose copyrighted products they contribute to developing through their use of it: Not only is the algorithm generating the support structure, and prompting this elaborate making process of mine, a secret. The online-based software system Fusion360, which I use to re-draw the shapes, also collects user data without telling their users what kind of data or how it is being used<sup>xi</sup>.

## HOLDER, 2020

*Holder* (2020) is a series of sculptures with accompanying Youtube videos. It takes a closer look at online instructionals for 3D modeling and the community that uses them, and explores the interactive, spatio-temporal possibilities of 3D modeling. By going through many of these instructionals whilst learning how to 3D model, I saw people, stories and objects that left an impression contrasting the cool neutrality of my 3D modeling software's user interface. Youtube instructionals are often used by members of the maker community. Through online networks they share designs, knowledge about how to make them and instruction videos introducing 3D modeling software. I noticed how the example objects in these videos often were of a particular, functional kind, as I ended up modeling many virtual wrenches and pen holders. I approached three different Youtube instructors who make tutorials using the same software as me, Fusion 360<sup>xii</sup>, and asked them to use my sculptures as exercise objects in their videos. The sculptures I had made were inspired by the Brazilian neo-concretist artist Lygia Clark's interactive sculpture series *Bichos* (1960) and the tool holders that we use to organize the tools in our workshop at Aldea. They were also designed to be simple beginner projects for people that are not experts in Fusion360 or CNC milling. Rather than holding tools the sculptures are made to hold color samples and material cut-offs from my studio that the exhibition goer can play with and create color combinations and new compositions. The designs are parametric<sup>xiii</sup> and customizable to fit the online maker's own needs. The commissioned instructionals were put into the existing Youtube channels where they can be found today by people learning how to work with 3D modeling software. In this way *Holder* is a work that can be engaged with on different levels; it exists in these platforms of knowledge sharing where makers can interact with it through 3D modeling or physical production, or exhibition goers can engage with it in the more traditional art context either by interacting with the sculptures or simply by looking at the work. The experience of seeing an object from different sides and understanding the logic of the build up of the sculpture are processes I have previously associated with moving around an object in a space, and with my hands-on studio practice. Now, however, these are things I can do using 3D modeling technology- by *orbiting* and *panning* around the object I see it from

all vantage points in all different sizes, by *extruding* and *slicing* I add and remove *bodies* and *components* and give it the shape that I wish<sup>xiv</sup>. This spatio-temporal experience of 3D modeling was one of the things that did not match my understanding of this technology as being disembodied or body-disengaging, and a motivation to start this work as part of my endeavour into understanding the dual nature of the 3D model.

In addition to making new artworks and following the Norwegian Artistic Research Program I organized a workshop at Bergen Senter for Elektronisk Kunst and Aldea Workshops teaching beginners how to design an object in 3D modeling software Fusion 360 and how to mill out their designs with the CNC in January 2020. I am also part of a reading group with colleagues in KhiO, and during the Oslo Artistic Research Week in 2020 we had a performative reading session based on texts by Donna Haraway. The dissemination of the work will happen in various exhibitions and events presented in the timeline below, as well as online through the Holder project.

## ARTISTIC REFLECTION

My artistic reflection will be published online on a website which navigates through its different sections by clicking on different parts of a 3D modeled cube. The cube is based on the one used to spatially navigate in different 3D modeling software programs and its 6 different sides will direct the reader to the parts: Texts, Photo Library, 3D models, Work Documentation, Links and Youtube videos. For the midway assessment I will have a prototype ready.

The **Photo Library** will be an archive of images showing the work in progress. The **3D models** will be a page that presents some of my 3D models that can be orbited. **Work Documentation** are images of work that is either finished or presented to the public in progress. **Links** will be an archive of references to other artists and different online resources, presented in a mind-map structure with lines in between the entities. **Youtube videos+** will take you to the three different Youtube instructional videos made as part of *Holder* in addition to a video recording of *Monday Lectures*<sup>xv</sup> where I presented my research project in April 2020. **Texts** will be a collection of essays written by myself where I provide background material about the project in addition to examining certain aspects of it through writing about them. In addition to adding a version of this project description I will share *Abstraction and Abstraction* - an essay where I explore connections between abstraction as artistic style and abstraction as intellectual technique, *Interview with Youtubers* - a collection of interviews I have made with the youtube instructors that made the Holder videos for me, and *Posthuman Makers* - an essay about how using 3D modeling is a tool not only of constructing our surroundings but also ourselves, written based on participation in the course *Technologies are Us: Feminist Perspectives on Posthuman Futures*.<sup>xvi</sup>

## THEORETICAL CONTEXT

What abstractions are, how they are made, how they work, what they mean in an epistemological sense and what they do to our society and material world has been a topic of concern throughout centuries. It is beyond the scope of this artistic research project to give a coherent overview of these discourses, but I will briefly point to some of those that have been significant in shaping my own understanding of this vast field, before moving onto the specific strands that I have chosen to work more closely with. One of my favourite texts

written about abstraction is American painter Peter Halley's essay "Abstraction and Culture", where he describes abstraction as being "based on the idea of the organization of discrete, specific incidents into more generalized, repeatable patterns". He proposes that "...abstraction really has nothing to do with aesthetic concerns, nor can it be formally characterized by the use of specific shapes, techniques or configurations."<sup>xvii</sup>

Philosophers, thinkers and writers from Aristotle to Husserl, Thomas Kuhn, Paul Feyerabend, Donna Haraway and N.Kathrine Hayles have critiqued the preference of the universal over the particular<sup>xviii</sup>, the scientific worldview based on simplified abstractions<sup>xix</sup>, the mathematization of nature, the quantification of everything<sup>xx</sup>, the implementation of standards into society<sup>xxi</sup>, ideas of objectivity and absolute truth<sup>xxii</sup>, the emphasis on information over materiality<sup>xxiv</sup> and the preference of the brain over the body<sup>xxv</sup>.

## POSTHUMANISM AND NEW MATERIALISMS

I have chosen new materialist and posthumanist theories to further think about my project because they specifically speak about embodiment, materials, and digital media in connection with abstraction, and of the co-evolution of humans and technology. Moreover, they are ongoing discourses that evolve alongside and influence technological developments.

In *How We Became Posthuman* N. Kathrine Hayles offers useful perspectives on the relation between the digital 3D model and its physical counterpart. The 3D model is at once an abstraction that can be boiled down to disembodied zeros and ones, and at the same time a highly particular technology created in a certain context which ultimately shapes what is made using it. In the first chapter of the book Hayles argues how the digital abstraction (like the virtual 3D model) only represents a fragment of all the qualities of the material object, how information is always instantiated in a medium, how information cannot flow unchanged from one material state to another and how we therefore cannot do away with the body and the material world as a grounds for living:

*My strategy is to complicate the leap from embodied reality to abstract information by pointing to moments when the assumptions involved in this move were contested by other researchers in the field and so became especially visible. The point of highlighting such moments is to make clear how much had to be erased to arrive at such abstractions as bodiless information.*<sup>xxvi</sup>

Hayles elaborates on what she wants to contest and why it is important in this current technological context, with a paragraph that also clearly shows what abstraction has to do with 3D modeling, computers and simulation technologies.

*I will identify two moves in particular that played important roles in constructing the information/materiality hierarchy. Irreverently I think of them as the Platonic backhand and forehand. The platonic backhand works by inferring from the world's noisy multiplicity a simplified abstraction. So far so good: this is what theorizing should do. The problem comes when the move circles around to constitute the abstraction as the originary form from which the world's multiplicity derives. Then complexity appears as a "fuzzing up" of an essential reality rather than as a manifestation of the world's holistic nature. Whereas the Platonic backhand has a history dating back to the Greeks, the Platonic forehand is more recent. To reach fully developed form, it required the assistance of powerful computers. This move starts from simplified abstractions and, using simulation techniques such as genetic algorithms, evolves a multiplicity sufficiently complex that it can be seen as a world of its own. The two moves thus make their play in opposite directions. The backhand goes from noisy multiplicity to reductive simplicity, whereas the forehand swings from simplicity to multiplicity. They share a common ideology - privileging the abstract as the Real and downplaying the importance of material*

*instantiation. When they work together they lay the groundwork for a new variation on an ancient game, in which disembodied information becomes the ultimate Platonic Form. If we can capture the Form of ones and zeros in a nonbiological medium - say, on a computer disk - why do we need the body's superfluous flesh?*<sup>xxxvii</sup>

Further on in the book Hayles traces the view of the human as an information processing organism to cybernetics and its influence on disciplines such as neurology and psychology<sup>xxxviii</sup>. She calls virtuality a cultural construction implying a separation between the physical and the digital which does not exist,<sup>xxxix</sup> and points to interpretation as the third component in the move from signifier (concrete, physical) to sign (concept, abstract).<sup>xxx</sup>

This emphasis on interpretation, context and situatedness is shared with Donna Haraway reminding us how all of the world's particularities matter for knowledge creation, and how accountability for these must be established for an ethical epistemology<sup>xxxxi</sup>. I understand this, what she calls a feminist objectivity, as involving that making abstractions and having the power to decide what is something's essence is not an innocent act, but one that requires taking responsibility for having that power. In line with this, posthumanism offers a critique of the assumed universal standard (the abstraction) the *human* in liberal humanism as not female, not of color, not a child, not a refugee etc. Dutch philosopher Rosi Braidotti states that the "The *human* is not only not universal but highly culture specific."<sup>xxxii</sup> Converging with the critique of this excluding concept of what a human is, posthumanism deals with how the boundaries of the human subject expand by interacting with technologies.

One of the seminal texts written on this topic is Donna Haraway's "A manifesto for Cyborgs"<sup>xxxiii</sup> where she urges us to look beyond binary oppositions such as human-machine, male-female and natural-artificial when thinking about what constitutes a human being. In *Untogether - The Power of The Cognitive Nonconscious*, Hayles goes into more detail in explaining how this happens. Introducing the term "The Cognitive Nonconscious" she elaborates on how humans, other biological organisms and technical systems interact in assemblages and how conceptualizing these interactions can "[enable] us to understand more clearly the political, cultural, and ethical stakes of living in contemporary developed societies."<sup>xxxiv</sup> Hayles and the french philosopher Cathrine Malabou refer to brain plasticity and epigenetics when explaining how our brains change in response to our environment and interaction with technologies. Based on environmental stimuli our brains can create new neural connections (synapses) and "forget" existing ones. The same environmental stimuli can activate and deactivate genes, making DNA based changes in humans possible much faster than previously thought.<sup>xxxv</sup> In the paragraph "The Co-evolution of Humans and Tools" Hayles describes how "Tool fabrication in this view resulted in cognitive changes that facilitated the capacity for language, which in turn further catalyzed the development of more (and more sophisticated) compound tools."<sup>xxxvi</sup> These discourses, which I was familiarized with through participating in the *The Cultural Brain* Course at the Karolinska Institute in 2013,<sup>xxxvii</sup> have implications for our use of 3D modeling tools and digital fabrication; in the process of constructing the digital-physical world we also construct ourselves and how we see ourselves.<sup>xxxviii</sup>

While making artworks and invoking these posthumanist and new materialist lines of thought, I aim to gain better insight into abstraction in 3D modeling, the ways the 3D modeling tools, the industry built around it and their users influence each other, and in the relationship between the physical and digital in sculpture practice.

## ART CONTEXT

The practice of Brazilian artist Lygia Clark has been an inspiration and reference not only in the making of *Holder*, but more broadly in thinking about interactivity and the possibilities and limitations of contemporary art in society. Throughout her career Clark moved from geometric paintings to interactive sculptures such as *Bichos* (1960), and to works turning viewers into makers, such as *Caminbandos* (1963). She was a founding member of the Latin American Neo-Concretist movement which opposed modernist claims of universality and “concrete art’s conception of the work as a rational artifact”<sup>xxxix</sup>. Instead the Neo-Concretists emphasized the subjective sensory experience of art. Turning their viewers into active participants was a common strategy for this generation of artists who believed in the social function of art, and thus sought to re-democratize art and to connect it to a wider audience beyond the traditional gallery space.<sup>xl</sup> This ambition is reminiscent of maker culture’s claims of individual creative empowerment and being a force for positive social change, in the way that they face the same challenges of reaching a diverse user base, or “that significant positions of the visible remain out of sight for large segments of society.”<sup>xli</sup>

The revolutionary potential of digital fabrication is forcefully declared in artist Morehshin Allahyari and Daniel Rourke’s 2015 *3D additivist manifesto*. Working with 3D printing Allahyari “thinks about technology as a philosophical toolset to reflect on objects and as a poetic means to document our personal and collective lives and struggles in the 21st century”<sup>xlii</sup>. Oliver Laric is another contemporary artist who uses 3D technology both in the making of his artworks and their conceptual frameworks. By means of 3D scanning and digital fabrication techniques his work urges us to rethink what is original and authentic, and about the structures that are built up around proprietary information. In artistic research context Merle Ibach is a designer and PhD researcher at the Critical Media Lab in Amsterdam who explores additive<sup>xliii</sup> design processes and their ways of becoming, and in the essay “Unmaking-against general applicability” in *Critical Makers Reader* she gives a detailed account of transformation from 3D model to 3D-printed object.

A number of contemporary artists make works that contest the idea of disembodied information by showing us its material side. Starting with some local examples Åse Lövgren and Stine Gonsholt’s recent movie *The Valley* (2019) depicts the waterfall as the material basis for bitcoin mining and Oslo based artist Ayatgali Tuleubek creates a sauna using heat generated by computers<sup>xliv</sup>. Swedish artist Nina Canell shows us the sculptural side of information transmission by displaying slices of huge cables (*Brief Syllable (Weak)*, 2015) and Irish artist John Gerrard makes the cloud a bit more tangible by showing the gigantic datafarms where servers are located in the desert (*Farm (Pryor Creek, Oklahoma)* 2015).

Rebecca Nadjowski is an artist and PhD researcher I met during the Digital Promises workshop at Banff, who explores the material possibilities of photomedia and has an interesting perspective on digital abstraction. About her project *Echo* where she 3D scans plants in the botanical gardens of Melbourne she elaborates “Depth, texture, color and form of the plants along with the atmospheric conditions that affects the intensity of photons bouncing off of flora all become transformed. They move from a plane of environmental matter and force to a plane of digital materiality, where data is encoded and continually refigured and assembled as manipulatable, visual objects on a screen.”<sup>xlv</sup>

Looking at the relations between the tools that we use, the people that use them, and the knowledge that is produced by them, is an endeavour that has been undertaken by many

artists over the last couple of decades, resulting in many exhibitions with the label “Art and Science”. Ongoing while I was undertaking my arts education, this has been an influential tendency for my own practice. One of the leading artists working in this field is Norwegian artist Torill Johannesen, whose work explores and uncovers connections between tools and the knowledge produced by them, often through the use of various kinds of photo based media, for instance image-based machine learning (Skogsaken, 2019).

Cameron MacLeod, my husband and collaborator, is a Canadian artist and arts administrator. We are collaborating on the piece *Two Rocks Do Not Make a Duck* and artistically we also share an interest in collective making processes enabled by online communities, and in exploring the artistic possibilities in digital fabrication. Over the past two years he has been an indispensable help and he has had a vital influence on my work, not only through our collaborative work. He has also been the driving force behind the development of Aldea’s digital workshops, and the one who kept on building and solidifying Aldea when I shifted my focus to this artistic research after we opened our doors in 2018. In this way, with some help from myself and others, he has created the place where I work and enabled me to have access to tools and workshops in ways that I otherwise would not.

## PREVIOUS RELEVANT WORKS

Sexagesimal (2014) is a work that serves as a good example of how I use the method I describe as unmaking as a way to get an embodied understanding or experience of something. The sexagesimal numeral system is what we use to measure and organize time and space, and I was curious as to why we don’t split these up in tens and hundreds, as we do when using the decimal numeral system for other things in our daily life. With 60 as its base number, the sexagesimal numeral system is the reason why the hour is divided into 60 minutes, the circle into 360 degrees and the Earth into latitudes and longitudes of 90 and 180 degrees, and so on. I applied the factor numbers of this numeral system as diagonal lines defining the width of an aluminum sheet with a given height, and installed the pieces leaning against a wall according to the same angle. When people moved along the piece in the space their perception of this line would change in correspondence to their movements.

In 2016 I started looking at standards in the 3D modeling and the people, industries and stories behind them. The video piece *How to Make a Utah Teapot* shows ceramic artist Anne-Lise Karlsen wheel throwing a Utah Teapot, a standardized reference object common in 3D modeling software. The model was developed by computer scientist Martin Newell in the mid-1970s and the computer-generated teapot has since then achieved a unique cybercultural status due to its widespread usage as a standard function in the feature libraries of 3D modeling software.

After a visit to Switzerland in 2010 where I noticed their half-timbered houses *Riegelbau*, I started working with load bearing structures, and Secret Support continues this larger body of work. By building support structures myself I have looked at how the shape of these structures have changed through technological developments, and reflected over what implications these changes have for the work of the people that make them: At first the same people would gather materials, construct the house and live inside it. Through scientific and technological advances skills were specialized and tasks split up, usually separating hand and head. The pattern drawn by the support structures on the swiss farm houses that I saw were not quite standardized but expressed a situatedness of this house, telling a story about what materials were available, what the weather conditions there were like and what

equipment and skills the people building it had. Moving onto industrial architecture serving the coal mining industry in Spitsbergen the loadbearing shapes became more organized and symmetrical, and accompanying the sculptures Terra Nullius (meaning land which is not claimed) was a fanzine documenting some aspects of the industry itself as an economic foundation of the Longyearbyen settlement. After some work with the generic triangle shaped Pratt trusses, I visited Sao Paulo and came across some workers assembling a gigantic christmas tree (soon to be covered in christmas decorations) consisting of aluminum modules in a roundabout. At this point I thought of this as an end stop for the craft of making support structures, where all agency and creativity is removed from the maker. Seeing the support structure of 3D prints and thinking of how a maker's approach to digital fabrication involves using a variety of skills, made me think there was more to consider in connecting support structures, technology and craft and to open this project up again.

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<sup>i</sup> By digital materiality I mean for example the material processes that happen in the computer and the screen to visualize the 3D model, or the waterfall generating power to the data servers where the information is stored. This digital materiality is important as context and reference, but not my main focus.

<sup>ii</sup> Donna Haraway, “Situated Knowledges, The Science Question in Feminism and The Privilege of Partial Perspective” Published in *Simians, Cyborgs and Women*, 1991, Free Association Books, Great Britain.

<sup>iii</sup> N.Katherine Hayles, 2017, *Unthought, The Power of The Cognitive Nonconscious*, prologue, The University of Chicago Press, London

<sup>iv</sup> In *The Craftsman* and the chapter “Fractured Skills, Hand and Head Divided“ Richard Sennett discusses how industrial production leads to a specialization of skills that involves separating practical work from creativity and thinking. Richard Sennett, 2008, Yale University Press, New Haven and London.

<sup>v</sup> See for example the youtube channel Get Hands Dirty, created 2015.

[https://www.youtube.com/channel/UCETeXD\\_3awsQv-9rSdCYXQQ](https://www.youtube.com/channel/UCETeXD_3awsQv-9rSdCYXQQ)

<sup>vi</sup> Wikipedia, a nice example of distributed cognition in itself, defines distributed cognition as "a collection of individuals and artifacts and their relations to each other in a particular work practice". Accessed on [https://en.wikipedia.org/wiki/Distributed\\_cognition](https://en.wikipedia.org/wiki/Distributed_cognition) 30.06.2020. See also Hayles’ writing on distributed cognition in “How We Became Posthuman” p 281-282, 288, 290.

<sup>vii</sup> A good summary of the ethical challenges of maker culture is given by Gareth Foote and Eva Verhoeven in the essay “Tactics for a More-Than-Human Maker Culture”, published in *The Critical Makers Reader*, 2019 Institute of Network Cultures, Amsterdam.

<sup>viii</sup> I follow the Apple Dictionary version 2.3.0 definition of digital “(of signals or data) expressed as series of the digits 0 and 1” and “Involving or relating to the use of computer technology”.

<sup>ix</sup> I follow the contemporary mainstream understanding, exemplified by the Apple Dictionary entry for Virtual /Computing: “not physically existing as such but made by software to appear to do so: *virtual images*”. A different definition of virtuality is offered by N.Kathrine Hayles on p13 in *How We Became Posthuman*: “the cultural perception that material objects are interpenetrated by information patterns.

<sup>x</sup> In *How We Became Posthuman*, 1999, University of Chicago Press, London, chapter 3 “Contesting for the body of information: The Macy Conferences on Cybernetics” Hayles traces the popularized understanding of perceptions as “sense data” back to Cybernetics and its influence on other disciplines.

<sup>xi</sup> More about asymmetric power relations between users and industry on p11 in Shoshana Zuboff’s *The Age of Surveillance Capitalism*, 2019, Public Affair, New York

<sup>xii</sup> Fusion 360 is a 3D modeling software program made by AutoDesk and an industry standard in maker culture. Used at Aldea to run our CNC machine and making these sculptures.

<sup>xiii</sup> Parametric means that it is based on a set of parameters that can be easily changed at any point in the design process.

<sup>xiv</sup> Words in italics indicate names of operations in Fusion360 for navigation and sculpting.

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<sup>xv</sup> Monday Lectures is a lecture series organized by the students at The Faculty of Art, Music and Design at UiB. During the Covid-19 lockdown in spring 2020 these lectures that normally take place at campus were shifted into online formats.

<sup>xvi</sup> A 3-day PhD course, 23-25 Sept 2020, hosted by the Centre for Women's and Gender Research at UiB.

<sup>xvii</sup> Peter Halley, "Abstraction and Culture", *tema celeste* (Autumn 1991) 56-60; reprinted in *Abstraction*, 2013, Whitechapel Gallery and MIT Press, Cambridge

<sup>xviii</sup> Aristotle contested Plato in asserting that the thing (material) comes first and the concept (form) next, that we derive universals from particulars and not the other way around. (See for instance <https://plato.stanford.edu/entries/form-matter/>, accessed 09.09.2020)

<sup>xix</sup> See for instance Paul Feyerabend, 1999, *Conquest of Abundance, A Tale of Abstraction versus the Richness of Being*, University of Chicago Press, Chicago.

<sup>xx</sup> See for instance Theodore M. Porter, 1995, *Trust in Numbers, The Pursuit of Objectivity in Science and Public Life*, Princeton University Press, Princeton, New Jersey

<sup>xxi</sup> See for instance James C. Scott, 1998, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed*, Yale University Press, New Haven and London.

<sup>xxii</sup> Thomas Kuhn was one of the most influential critics of positivist science and the idea of objectivity, introducing the term *paradigmatic shifts* into the discourse of the evolution of scientific knowledge.

<sup>xxiii</sup> Donna Haraway, "Situated Knowledges, The Science Question in Feminism and The Privilege of Partial Perspective" discusses objectivity in relation to visualizing technologies and the ethics in grounding/situating one's perspective and thus becoming accountable for "what we learn how to see"

<sup>xxiv</sup> See N. Kathrine Hayles, 1999, *How We Became Posthuman*, University of Chicago Press, London, Chapter 3 "Contesting the Body of Information: The Macy Conferences on Cybernetics"

<sup>xxv</sup> See Hayles, *How We Became Posthuman*, Chapter 1 "Toward Embodied Virtuality"

<sup>xxvi</sup> Hayles, *How We Became Posthuman*, p 12

<sup>xxvii</sup> Hayles, *How We Became Posthuman*, p 12-13

<sup>xxviii</sup> Hayles, *How We Became Posthuman*, p 84

<sup>xxix</sup> Hayles, *How We Became Posthuman*, p 13

<sup>xxx</sup> Hayles, November 2019, *Computers and Meaning: The Case of OpenAI's Text-Generating Program*, Digital Narrative Network Conference, Faculty of Art, Music and Design, Bergen

<sup>xxxi</sup> Donna Haraway, "Situated Knowledges - The Science Question in Feminism and the Privilege of Partial Perspective"

<sup>xxxii</sup> Discussed in by Rosi Braidotti in her lecture *Posthuman Knowledge*, March 2019 at Harvard Graduate School of Design, Cambridge, Massachusetts. She first speaks about how the "human" was "not women, not animal, not nature" and then elaborates on how almost everyone else than the white, already free man was excluded, leaving a narrow definition of who is human and has the associated privileges. Accessed 04.06.2020 at <https://www.gsd.harvard.edu/event/rosi-braidotti/>

<sup>xxxiii</sup> Donna Haraway, "A Manifesto for Cyborgs", reprinted in *Simians, Cyborgs and Women*, 1991, Free Association Books, Great Britain

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- xxxiv Hayles, *Unthought*, Prologue
- xxxv Hayles, 2012, *How We Think*, The University of Chicago Press, London, p 100
- xxxvi Hayles, *How We Think*, p 90
- xxxvii An Interdisciplinary one year long course at the Center for Culture, Cognition and Health at the Karolinska Institute that I participated in alongside my MA studies in Stockholm.
- xxxviii See for example the chapter “The Coevolution of Humans and Tools” in Hayles, *How We Think*
- xxxix Exhibition Catalogue for the exhibition “Sites of Abstraction” Los sitios de la abstracción latinoamericana, p 228, 2010, Es Baluard, Palma
- xl *Lygia Pape at Hauser and Wirth*, Youtube, The Art Channel, accessed 5. Sept 2020 <https://www.youtube.com/watch?v=YtwJkikaM-w>
- xli Juan Ledezma, 2010, “The Sites of Abstraction: Notes on and for an Exhibition of Latin American Art”, published in Exhibition Catalogue for the exhibition “Sites of Abstraction” Los sitios de la abstracción latinoamericana, Es Baluard, Palma
- xlii From the artist’s website <http://www.morehshin.com/artist-information/>, accessed 06.Sept 2020
- xliii Additive manufacturing is a fabrication technique based on adding materials, e.g 3D printing
- xliv *Groundbreaking Computational Methods for Generating Heat and Value*, 2020, In collaboration with Michael Rasmussen
- xlv Rebecca Nadjowski, *Indeterminate*, eco-media 2020 online conference hosted by Screen & Sound Cultures and the Critical Intimacies Reading Group at RMIT University, Australia. Accessed zoom recording via Youtube 1.Sept 2020 [https://www.youtube.com/watch?v=-O\\_sMjD8l9I&t=4654s](https://www.youtube.com/watch?v=-O_sMjD8l9I&t=4654s)