Forge, Fire, Quench:

TRANSPOSING THE TRANSFORMATIVE PROCESSES OF TRADITIONAL BLACKSMITHING INTO CONTEMPORARY SCULPTURAL PRACTICES

A PROJECT SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

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JUNE 2019
Declaration

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the project is the result of work which has been carried out since the official commencement date of the approved research program; any editorial work, paid or unpaid, carried out by a third party is acknowledged; and, ethics procedures and guidelines have been followed.

I acknowledge the support I have received for my research through the provision of an Australian Government Research Training Program Scholarship.

Mary Jane Hackett
June 2019
Acknowledgements

I wish to express my appreciation for the vital contribution made by my supervisors. I would like to thank Associate Professor Linda Williams for supporting me when applying for PhD and again as I completed. Thank you for your immediate understanding of my project and guidance in articulating it. Our meetings influenced my thinking at a deep level and my practice will forever be richer for the experience. Your generosity, strength and knowledge combined with gentleness will always inspire me. I am deeply grateful.

Thank you to Louise Weaver for your aesthetic eye which has strengthened my own. I enjoyed our chats over coffee and discussions on art and have benefited from your comprehensive knowledge on the work of contemporary artists.

Thank you Doctor Maggie McCormick for your guidance from the beginning of this project and over the greater period of my PhD. Thank you for your encouragement, warmth and support. I particularly appreciated your presence at exhibitions. Thank you Professor Jeremy Diggle for enabling the expansion of my drawing practice and for overseeing the shift from an object making practice to that of sculpture. Thank you to the staff of the School of Art including David Forrest, Phil Edwards, Shannon Stanwell, and all Post Graduate Technicians.

I am grateful for the Higher Degree by Research Travel Grant. The travel grant made it possible for me to attend and participate as an exhibitor and speaker in *The Art of Research V: Experience, Materiality, Articulation*, Aalto University, Helsinki, Finland. Thank you to organisers of the above conference for the generous invitation to participate. Thank you to the editors of the online journal, Studies in Material Thinking, for the invitation and inclusion of my paper,
Finding Form in the Dynamics of a Quench, in their journal. Also thank you to Nils Hint for the invitation to speak in Tallinn, Estonia. Thanks to Jewellers and Metalsmiths Group of Australia (JMGA) for the opportunity to speak on behalf of Blacksmith Doris at their 2014 conference and to Overview for their inclusion of that paper, and to Tassia Joannides and Renee Ugazio for the invitation to present at Research Exchange, and to all my fellow candidates.

I am honoured to have exhibited with Nick Hackett, Renee Ugazio and Rushdi Anwar, the members of Make and others. Exhibiting was made possible through the support from D11, First Site, RMIT gallery in building 2, Clare McCracken, Claire McArdle and Project Space RMIT, organisers of Artland, PS50 and WOT Studios, Studio 2017, Quoil Gallery, Gallery of South Australia, Radiant Pavilion, and the Wandering Room.

I would like to thank old and new mentors: Ray Norman for your support, always; Sieglinde Karl-Spence; Dianne Beevers for your ongoing encouragement and friendship; and David Clarke for your valuable time and invaluable knowledge. I would also like to thank the women of Blacksmith Doris as they inspired this research; and colleagues and students at Melbourne Polytechnic and Chisholm Institute for support and inspiration.

I would like to acknowledge all photography, video contributions made by Mark Ashkanasy, Marc Morel, Angus Hackett, Arthorse, Matto C Lucas and Nick Hackett. Thank you to June Hannah for early editing, Annalea Beattie, Bridget Hackett and Dr Susan Lowish and Nick Hackett for discussions and editing; Stuart Hackett for formatting; and Mel Connel for lighting and assistance with installation.
When beginning a project of this size it is easy to believe that life will be the same at its conclusion. This can never be true. Children grow up, leave home and take on their own challenges. Friendships come and go, and family members and friends become frail or are lost forever. During this project I have experienced times of joy and deep sadness, illness and new experiences, and a small few have been there with me through the twists and turns.

My deepest thanks and eternal debt go to my husband, Nick. You have been forever present and patient, and have kept me together when I could not. Our discussions over technique, theories, and writing kept my mind focused while your care stopped me from starving. Your technical assistance was invaluable and without you, this project would not be completed.

I thank our children, Angus, Stuart and Bridget and their partners, especially Mel. You have been constant and steadfast in your support and help. I am grateful for dinners with loud discussions, insults and laughter, all of which grounded me. I am also grateful for sharing the fun of building and gardening with all of you. This kept me sane.

Thank you Sue for the solidness of an old friendship, and Angela for the pleasure of a new one.
For Vonda and George
Figure 1: Mary Hackett, 2016, *Quench in blue and pink*, digital image, video still, video: Angus Hackett.
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Abstract

This doctoral project converts the material processes of blacksmithing into contemporary sculptural practice through a series of conceptual shifts. Blacksmithing and sculpture have traditionally focused on human endeavour, experiences and needs. However, while contemporary sculptural practice explores current ideas of materiality incorporating both sentient and non-sentient agency, by contrast, blacksmithing has struggled to keep up with contemporary thought. From the early 20th century, the social demand for objects made by blacksmiths fell dramatically and its creative techniques stagnated with the demise of its craft-based skills. At the same time, sculptors who used blacksmithing processes did so largely in response to traditional cultural expectations.

This research project explored the historical and material agencies of both blacksmithing and sculpture, including the agencies of material processes acknowledged in Actor-Network Theory. The combination of these methods led to an understanding of sculptural practice with a less formal and more material process. The creative outcomes of this research include a substantial body of work resulting in Fountain: Dance of the water droplet [fig. 2], an artwork focusing on the multiple formative agencies of blacksmithing.
ABSTRACT

The findings of this research demonstrate the benefits of transposing a highly personal studio practice into an historical revaluation of its innate connections with blacksmithing. This study not only adds to the discourse of artistic materiality, it also aims to establish the traditional craft of blacksmithing as one relevant to contemporary discourse.
Introduction

Context

The ancient techniques of silversmithing involved moving metals favoured for their malleability, lustre, status, and cultural significance in order to make vessels conform to a specific standard. While teaching silversmithing I watched a student drop a newly raised copper vessel into a slightly larger clear glass beaker full of boiling water. The objective was to turn the colour of the vessel to a rich red. The vessel was heated until it glowed yellow, it was picked up with tongs and dropped into the beaker. Immediately the water around the vessel boiled and vaporised. Due to the comparatively similar sizes of the two vessels, the copper one appeared to be suspended in mid-air. There was a sharp hiss and a sucking sound as the heat of the vessel reacted to the water. At the sound, the whole room turned towards the spectacle just in time to view the vessel’s levitation.

The circumstances surrounding the incident of the studio-based process were privileged and serendipitous, and only occurred because the class was learning this ancient technique. The student, having completed their silversmithing, had chosen a certain method to colour the work, using a beaker with the intention that it would hold hot water without breaking. The outcome was a witnessed engagement of a dynamic interaction between copper, water, heat and human action.
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Fountain: Dance of the water droplet

In this work, I sought to capture the processes of the vaporisation of water. As mentioned, the inspiration for *Fountain: Dance of the water droplet* [fig. 2] arose in the silversmithing classroom when I witnessed how water vaporised around the copper vessel in ways that reminded me of the cooling processes undertaken in blacksmithing. The connection between the two studio-based processes are significant as blacksmithing grew from the knowledge accrued when manipulating metal in silversmithing (*Tylecote* 2002, p. 47). This experience also reminded me of how sculpture and smithing are intrinsically connected through history and materiality, as matter and energies are exploited in both practices for the benefit of humanity.

During my Masters research, in my work *Conduit: an Exploration of the Relationship Between Hand, Metal, Motion and Form* (*Hackett* 2011), I had begun to combine silversmithing and blacksmithing techniques, using them to create both copper and steel objects for the hand [figs. 3 & 4]. That project focused on the physical connections between human maker and metal. And it was through the recognition of that connection I became aware of the energies involved and how much they dictated my work and my actions as a maker.

Figure 2: Mary Hackett, 2017, *Fountain: Dance of the water droplet*, sculpture; mild steel, stainless steel, water, rubber, glass, electric hot plate, electrical cord, 1500 mm x 1000 mm x 2500 mm, technical assistance: Nick Hackett, image: Mark Ashkanasy.
**Research Problem**

As the social and creative practices of blacksmithing were restrained by industrialisation and commercialism, it generally became anachronistic. Though for millennia blacksmithing played a crucial role in social history, its creative processes have clearly changed over time. Based on this history, one of the central aims of my research is to ask how it might be redefined as a new approach to sculptural practice. In the current context in which the world seems to bury itself in highly processed waste, a revaluation of blacksmithing also has the potential to revive a renewed respect for primary materials and traditional craft-based processes.

Processes of creativity developed through the manipulation of matter have long been a primary means of measuring human identity as well as a method of gaining advantage for personal profit. As the world that we have made acts upon us, it transforms the way we manipulate matter. And as the political theorist, Hannah Arendt, observed ‘[w]hatever touches or enters into a sustained
relationship with human life immediately assumes the character of a condition of human existence’ (Arendt 1998, p. 9). Arendt’s comments also suggest we are constituted by the natural world, which is to say that we belong to it, not the other way around. Jane Bennett’s recent work on the field of new materialism proposed a similar view when she remarked ‘to really understand social practices ... it is necessary to understand the nonhuman components as well as the human components’ (The New School 2011). One question that arises from this is why we continue to understand ourselves through social and creative practices rather than considering how nonhuman components connect with and reconstitute the human.

Social creativity becomes a political space where it is imperative that nonhuman components of social practices are seen as significant for their own sake. Hence Bruno Latour imbues nonhuman components with qualities commensurate with meaningful agency (2005, pp. 111-112).

In the past research on blacksmithing has focused on the blacksmith as creator and how blacksmithing practices function socially, or it commented on the metallurgical qualities of steel. My own research asks whether material agencies within blacksmithing might be afforded a space of meaning through contemporary sculptural practice. With this in mind, the following two central research questions were formed:

• What are the creative connections between contemporary sculpture and traditional blacksmithing practice?

• How can sculptural practice reveal the dynamic interactions between artistic and material processes?
My research project aimed to test the capacity of sculpture as a social practice. It explored how the interactions of matter are active participants in the blacksmithing processes rather than purely as the result of exclusively anthropocentric processes. I approach these research questions in a number of ways, first through studio techniques for combining blacksmithing and artistic methods, and then through the collation of historical, social and material information. Both strategies are based on my experience as an artist, they are informed by previous knowledge of smithing practices, and are in other words, practice-led.

Practice-led research is intentional learning through practice that is informed by, and stems from, a theory base which can lead to ways in which ‘practice becomes theory generating’ (Bolt [2006a], p. 12). While discussing practice-led research, Barbara Bolt identifies a transitional anomaly that she discovered within her own painting practice which led to new knowledge. Bolt had failed to paint the Australian landscape using her ‘pre-existing’ understanding of perspective due to the harshness of the Australian sun. This transition prompted her to reassess how she would paint the Australian landscape’s space and light.
Figure 3: Mary Hackett, 2011, Conduit (Venus in the foreground, Ink Pot and Flower in the background), installation, copper, painted steel stands, technical assistance: Nick Hackett, image: Marc Morel.

Figure 4: Mary Hackett, 2011, Pomegranate, object from Conduit, mild steel, 109 x 76 mm, image: Jeremy Dillon.
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Art research seeks differences within repetition with the aim of embracing the material interactions between various components of the work. This differs from other theories of performative research such as those suggested by Andrew Pickering, for example, when he discusses research processes in science. Pickering and Bolt’s ideas of performative research both rely on repetition of actions, and a series of responses and observations while applying acquired knowledge. What differentiates science, is that it aims to establish facts that describe, model or change the world as a way of ‘coping with material agency’ (Pickering 1995, pp. 6, 7). Bolt refers to this method as ‘constative’ research (Bolt 2006b, pp. 133). In artistic paradigms, on the other hand, performative research draws out the differences that repetition highlights, seeking the ‘force and effect’ of those anomalies (Bolt 2016, pp. 139, 140).

In my own research, creative transitions such as the shift from silversmithing to blacksmithing have become key to generating new ways of viewing creativity as distinct from scientific or technological methods of approach. The creative disruptions, between the fields of sculpture and blacksmithing have helped me to map and clarify ideas arising from the historical, material and cultural contexts of the two traditions.

When discussing the characteristics of creativity as a social mediator and how it

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1 Here Bolt applies a term used in John L. Austin’s speech theories to suggest a statement of fact (Austin 1962, p. 3,4).
2 Her argument draws a link to Austin’s performative speech which relies on culturally accepted, and repeated, words that bring about an agreed outcome. Austin’s performative utterance is a command that, when spoken, brings that act into being, in the same way that perception of prior painting processes were acknowledged as being accepted practice (Austin 1962, p. 6).
RESEARCH PROBLEM

can benefit from Actor-Network Theory[^1]. Albena Yaneva asks that we consider that ‘[C]ontext is made of the many dimensions that impinge at every stage on the development of a project’ (Yaneva 2009, p. 284).

It is a ‘mediator’, speaking on behalf of a social body and ‘constitutes, recreates and modifies social relationships’ (Yaneva 2009, p. 278). This means that we can shift the context of sculptural engagement within the social setting. Moreover, by displacing anthropocentric discourse through the acknowledgment of nonhuman processes, sculpture has the potential to capture material agencies and celebrate their contribution to human life. In this way, sculpture, and indeed blacksmithing, can become a type of democratic materialism that allows for the creativity of nonhuman agents.

This emphasis on creativity differs from previous research in the historical field of blacksmithing practices and their influence on Western cultures. The work of R. F. Tylecote (2002) and Robert Raymond (1986) for example, give essentially chronological accounts of metalsmithing which include blacksmithing. For centuries metallurgists such as Theophilus Presbyter (c.1070-1125CE) (1979) and Cyril Stanley Smith (1960) conducted research on the structure of iron and steel and its manipulation. Charles M. Keller and Janet Dixon Keller (1996), on the other hand, explored the working space of blacksmiths and how they thought through practice. More recently, Latifa Sayadi (2013) has compiled the work of women blacksmiths from around the world to begin feminist discussions on blacksmithing.

[^1]: Actor-Network Theory (ANT) advocates for non-human agents as equal to their human counterparts within social situations. The main developers of ANT, Michel Callon and Bruno Latour together with John Law, began to build a non-human approach to viewing the natural and social world to map all that influences a social situation.
My own research is not essentially metallurgical, nor based on scientific analysis. I do not consider myself to be a blacksmith but rather an artist concerned with the interactions between human and nonhuman agencies in studio and blacksmithing practices. In addition, although I do discuss women’s blacksmithing and sculpture, my research is not based primarily on feminist issues.

While I acknowledge the research of anthropologist Stanley Ann Dunham (1992) who highlights the resurgence of blacksmithing in Indonesia, and Harald Alexander Veldhuijzen’s (2005) archeological findings, their contributions are not essential to my argument. Similarly, while research in social studies such as those by Ronald V Morris (2007) usefully explores the revitalisation of teaching blacksmithing in an educational context, it is not germane to my own case. My own research focuses mainly on blacksmithing and sculpture in Western cultures, and omits iron, blacksmithing and sculptural traditions of Asia and Africa, including the spectacle of the Iron Flower fireworks of China (Birties 2019).

This research project does not participate in the art and craft debates that persists in art criticism. Throughout the research I have used the word craft to describe blacksmithing as I am drawing a distinction between the practice of blacksmithing and sculpture in terms of the major focus of each. During discussions I have pointed to the practice-based processes of making in blacksmithing while discussions on sculpture have often focused on concepts. This is in keeping with the spirit of both practices as blacksmithing covers a broad scope of uses while sculpture uses a broad range of techniques and ideas.

Since the turn of the 20th century sculptors used blacksmithing as a creative material. While there are many accounts of traditional sculptural materials such as stone and wood, or of sculptors who use steel, there is little published research
on the influence that the production of steel and blacksmithing has had on sculptural practice. There are some exceptions to this, such as Karen Bane Devich (1957) who wrote her masters of arts project on a sculptural work: *I am a walking fire, I am all leaves*, in ways that described blacksmithing fabrication, symbolism and the ‘new’ technology of oxyacetylene welding. Moreover, in Australia, Nick Hackett’s (2014) research questions our perception of the permanence of steel and wrought iron within a public space context through his own blacksmithing practice.

These sculptural projects are of significance to the collective research of blacksmithing and sculptural practice, however, they are not essential to my own argument. My research project aims to contribute to how the role of the artist is shifting from the creative perspective of an individual maker to that of a co-maker who acknowledges both human and nonhuman agents as co-constituents in art and, thus decentering cultural anthropocentrism.

In Chapter One there is a brief history of blacksmithing beginning with the use of ochre and early metal use. This is followed by the material agency of metal and the energies surrounding it in Chapter Two. The creative links between blacksmithing and sculpture are discussed and related to my own practice in Chapter Three. Here I focus on the transition from small objects created while silversmithing to sculpture. Chapter Four further describes the exploration of nonhuman agencies within my studio-based research, and gives grounds for a more democratic sculptural practice that promotes the nonhuman contributions of matter. Finally, Chapter Five reviews the use of steel within 20th century sculpture, comparing it to my own and considers sculptors who have already established a practice that allows nonhuman matter agency.
Figure 5: Mary Hackett, 2017, *Quench study (Time)*, detail, sculpture, steel, image: Mark Ashkanasy.
Chapter 1

A Brief Historical Account of Human Agency in Blacksmithing

Tracing the history of blacksmithing begins as humans adapted the properties of the earth at their feet. It follows technological developments of the manipulation of first copper, gold and silver, and then iron and the industrialisation of steel.

1.1 The blacksmith

A blacksmith works with an anvil and hammer, fire contained in a forge or fireplace, and a vessel of water beside it. The blacksmith heats steel in the fire until the steel glows yellow, then takes the steel from the fire and hits it with a hammer on an anvil. Once the form is achieved, the object is cooled in the water. Blacksmiths who manipulate their steel when hot are distinguished from silversmiths, whitesmiths (tinsmiths) or metalsmiths who work with their combination of metals cold. Each kind of smith is proficient to a certain degree
in the knowledge of specific metals, yet all share a basic understanding of the malleability and ductility of metal in the smithing process.

There are variants in current job descriptions within the field of blacksmithing, and though the term blacksmith generally refers to artisan blacksmiths, it includes references to farriers (those who make horseshoes); steel fabricators (welders), or industrial blacksmiths working in large factories. Artisan blacksmiths tend to work in small workshops producing decorative or functional ironwork and, like most smiths, have developed understanding of a variety of metals and their uses.

1.2 The adaptation of metals in Prehistory

Elizabeth Grosz suggests it is conceivable that social relatedness and attachment to place prompted a desire for body, dwelling, and symbolic adornment (2008, pp. 10-17). Though we can only speculate on the genesis and motivation behind the uses of metal by early human beings, evidence suggests that metal played a role in facilitating social connections within particular groups.

Ferric oxide based clay pigments, or ochres, have been mined and used in painting since the Palaeolithic period. It marks the first human link with metal ores and, in particular, to iron. Ochre painting is tied to ceremony and the expression of identity. In traditional societies, it is still applied to the body in contemporary

1 A red ochre mine at Karrku, in the south of Warlpiri country, is still in operation. It has been mined for ceremony activities since, at least, 30 000 BCE (Curran 2010).

2 In 2018 the earliest known Australian human, Mungo man (LM1), was returned to his resting place. It is understood that he lived at least 42 000 years ago. Mungo man’s remains are the oldest found evidence of ochre ritual burials (Bowler et al. 2003). Further, a portion of a human skeleton, now know as the Red Lady of the Paviland, was found covered in ochre in a Welsh burial cite. The Red Lady, a Palaeolithic man covered in ochre, is an example of ochre usage in other parts of the world (Jacobi & Higham 2008).
initiation ceremonies and in burial rituals, revealing deep connections, not only to family, but to the earth (Curran 2010; McGrath & Phillips 2008)

Ores such as copper were threaded as beads for adornment in the burgeoning agricultural societies of the Neolithic period (Roberts, Thornton & Pigott 2009; Thornton et al. 2002). These gradual shifts in technique saw the beginning of the Copper Age, or Chalcolithic Period, which is said to have lasted from c.4,500 to 3,500 BCE in Western Asia and Europe. Artefacts found in Eastern Europe, from around the late 5th to early 4th millennium BCE, show visible signs of lead and arsenic impurities within the copper, as accidental alloys. By the mid 4th millennium BCE arsenic and antimony were added to copper deliberately to add strength (Roberts, Thornton & Pigott 2009). A copper awl [fig. 6], a tool for piercing holes in materials like leather, found in the Jordan Valley, Israel, revealed visible traces of antimony, cobalt, lead, arsenic and nickel [fig. 7]. The awl, dated to at least 5th millennium BCE, indicates a step towards bronze casting (Garfinkel et al. 2014; Roberts, Thornton & Pigott 2009).

Figure 6: A copper awl, 5th millennium BCE, Tel Tsaf, Jordan Valley, awl, copper, 41 x 5 mm, image courtesy of University of Haifa.
The first known gold artefacts were found in grave sites at Varna I, Bulgaria, dated to the middle of the 5th millennium BCE, the late Chalcolithic period. Some bracelets, pendants and tools were coated with a layer of gold sheet, while objects were gold alloyed (blended) with silver and copper. Leusch et al. (2015) suggest that the gold alloys reflect the copper alloying processes of arsenic and tin found later in the Bronze Age.

As copper and gold artefacts were found together at the site, it is speculated that the Bulgarian smiths used their established metallurgical knowledge to work with gold. Because techniques were already in place it was easy to translate processes over to the new materials, providing a broader colour palate to manufactured objects. Evidence of early experiments in bronze shows a desire to duplicate the colour of gold which was most likely used as a decorative material within that culture, suggesting that colour held value (Leusch et al. 2015).

The discovery of tools, first in copper and then gold, poses the question of function, because though there is evidence of weapons made from copper and gold, they were soft unless alloyed. Additionally, the rarity of such metals, especially gold, implies that the objects had a high social status and were probably mostly used for symbolic practices. Copper and gold ores with impurities influenced the composition of the final metal, causing a harder, more useful alloy. In some cases, such as bronze, the resulting metal was easier to melt and pour for casting. A metalsmith wishing to prosper from the transmutation of these metals could take advantage of these anomalies, and would strive to control the outcome.

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3. See the discussion on a Bell Beaker blade in A Beaker Period Copper Dagger Blade from the Sillees River near Ross Lough, Co. Fermanagh (Sheridan & Northover 1993).
5. The research undertaken by Leusch et al. (2015) conclude that metalsmiths were organised,
CHAPTER 1. A BRIEF HISTORICAL ACCOUNT OF HUMAN AGENCY IN BLACKSMITHING

Antiquity: Bronze and Iron Ages

Metal was so important to the growth of European civilisations that archaeologists classified periods of history to indicate how whole societies were transformed by their use of metal. Bronze, as an alloy of copper, tin and sometimes arsenic, was found to be harder than purer metals which advantaged those who used bronze tools in military campaigns and agriculture. Jewellery and statuary were cast in bronze as well. It was to be iron, however, that had the most far-reaching influence on the history of humankind (Pense [2000], Muhly et al. [1985]).

The Copper Age, merged with the Bronze Age which, in Europe, spanned from c.3200–600 BCE. The Bronze Age, to some degree, overlapped the emergence of the Iron Age, which began in approximately the 11\textsuperscript{th} century BCE, and extended into the use of iron in modern Europe (Thornton et al. [2002], Muhly et al. [1985]).

A small section of bronze foil made to decorate a ceramic pot was the first intentional tin bronze to be discovered. It was found in southern Serbia and is dated from the 5\textsuperscript{th} millennium BCE. Whereas, ‘two pins and a flat axe’ that were found in Susa, Iran, and dated from the 4\textsuperscript{th} millennium BCE, are amongst the first tin bronze objects to be discovered (Thornton et al. [2002], p. 1452). Pins, awls and needles dating from the late fourth to early 3\textsuperscript{rd} millennium BCE show production of bronze artefacts was well underway in Amuq, Anatolia (Yener & Vandiver [1993]).

There has been a great deal of speculation on the source of tin used in early bronze production. However, a proportion of tin trade was documented in Syrian creative and specialised which infers a social structure that was elaborate. A percentage of the work of the metalsmith within that system was symbolic and highly valued which in turn elevated them as craftspeople.
cuneiform tablets dating back to the 18th century BCE. There was a tin mine in Kestel, Anatolia which was close to the bronze production site of Göltepe, another mine in Bolkardağ, along with other possible sources (Yener & Vandiver 1993). In addition, tin was traded from the region of Bactria, which includes modern Afghanistan (Thornton et al. 2002).

Cyprus was copper rich and tin poor. Copper, in the form of sand cast billets called oxhide ingots, were traded throughout the Mediterranean at the turn of the 2nd millennium BCE (Stos-Gale & Gale 2010). The Anatolians shared their metallurgical skills and their tin with the Cypriots, either through commercial connections or as refugees living in Cyprus (Mellink 1991; Mellaart 1958).

The Aegean region developed and strengthened through extensive bronze use and trade. The people of the Aegean established connections through trade in agriculture, mining and other industries, including tin from as far away as Britain, and possibly East Asia. Bronze accelerated the social consolidation of the Aegean civilisations and their expansion in the ancient world.

Unlike copper, bronze was resistant to force and bronze casting allowed for finer craftwork which led to the bronze swords of the Aegean warriors. Longer than their copper daggers, these swords possessed obvious advantages over their copper counterparts and were of great benefit to the warriors whose responsibility was to defend or advance borders. A further difference is notable in how both the dagger and sword were used. According to archeologist, Barry Molloy (2010) the dagger was a multipurpose tool made for both hunting or farming, while the sword was purpose built for killing human enemies.
CHAPTER 1. A BRIEF HISTORICAL ACCOUNT OF HUMAN AGENCY IN BLACKSMITHING

Figure 7: Horse with Incised Mane, c. 750-725 BCE, Greece, figurine, bronze, 42 x 70 x 14 mm, ARTstor database.
Not all objects in bronze were for military use. Bronze artefacts such as sculptures were produced in Greece after the Archaic period of 650-500 BCE, and well into the classical age. The Greeks perfected bronze processes creating large and small sculptures. The larger bronzes were cast in sections and riveted or welded together, while smaller sculptures were cast in multiples. Thousands of Greek bronze horse statuettes were created in the 17th century BCE (Hemingway & Abramitis 2017) [fig. 7]. The horse was a symbol of wealth and power and the statuettes were believed to have been offerings made by owners of horses.

The Sky Disc of Nebra, [fig. 8] Saxony-Anhalt, Germany, which is dated to c.1600 BCE, is 30 centimetres in diameter, and is an astronomy chart, bearing clues to its provenance within the trade route taken by the Greeks. The tin within the bronze has been traced to South West Britain while the copper was from Austria (Timberlake 2017). The disc features the sun, moon, the Pleiades star constellation, and references the cycles of the seasons, which suggests shared knowledge of astronomy across cultures (MacKie 2009).

In ancient times, iron from meteors was more valued than gold. Such sources of metal had sacred significance as they were referred to as ‘Iron of the sky’ (Comelli et al. 2016). Meteorites were considered gifts from the gods and as balls of fire fell from the sky, they were often followed by an earth tremor. Nine beads made of iron from meteors, date back to the transition period of the middle and late Bronze Age c.3200 BCE. These beads were forged from thin sheets of iron and then rolled up to form a tube (Rehren et al. 2013). A technique that was well-known and used by smiths from at least the middle of the 4th millennium BCE in copper and gold beads found in Ilgynly-depe (Turkmenistan). All examples found clearly show

\[6\] Although other researchers suggest that the practice is as old as 9th millennium (Rehren et al. 2013 p.4789).
Another example of iron from meteorites forged into sacred objects is an iron dagger that was found in Tutankhamun’s tomb, alongside other treasures which dates from the 14th century BCE [fig. 9]. The dagger was wrapped to Tutankhamun’s right leg, while another dagger with a gold blade rested on his stomach (Comelli et al. 2016). The iron dagger was well made and decorated which demonstrates both the level of skill required to make such an item and its high value. The dagger was:

a finely manufactured blade, made of non-rusted, apparently homogeneous metal. Its handle is made of fine gold, is decorated with cloisonné and granulation work, and ends with a pommel of
rock crystal. Its gold sheath is decorated with a floral lily motif on one side and with a feathers pattern on the other side, terminating with a jackal’s head.

(Comelli et al. 2016, p. 1302)

It had been assumed that a high level of technical knowledge of terrestrial iron was achieved by 2500 BCE, with evidence drawn from the Alaca Höyük iron dagger. Recent analysis shows that the iron is meteoric (Raymond 1986, p. 61; Nakai et al. 2012).

People began to experiment with terrestrial iron around c.3000 BCE. Iron lumps found in the Sinai desert were formed accidentally as slag residue from the copper
smelting process (Pense 2000). Terrestrial iron was difficult to produce because it required a furnace that could reach the melting point of iron which is 1538° Celsius.

Three iron objects with the composition of 0.1 to 0.3% carbon was found in Kaman-Kalehöyük, Turkey. They have been dated to between 2000 and 1800 BCE and were produced by the group of people known as ‘proto-Hittites’ (Akanuma 2008, p. 313). These iron objects are among the earliest examples of mild steel, which, by definition, contains a carbon content of between 0.05–0.25%. As iron rusts readily it is difficult to ascertain the extent of the iron use in Anatolia, although there are references to small iron objects, including sculptures, in Hittite cuneiform texts (Cordani 2016). These inventories and artefacts found in Anatolia have offered strong evidence to suggest that the Hittites successfully established steel-like iron technology by at least 1200 BCE (Raymond 1986, p. 62).

The innovation of steel production coincided with widespread social instabilities within the Mediterranean basin. These instabilities are now referred to as the Late Bronze Age Collapse when many major city centres were either abandoned or destroyed. It is believed that a series of events over the period of time between 1250 to 1000 BCE culminated in this collapse rather than a single catastrophe (Drake 2012). These events are understood to be climate change; industrial advances and mass production; along with political unrest and invading neighbours. Climate change brought drought and famine; which ended in agricultural disasters and loss of vegetation (Kaniewski et al. 2013). Vegetation loss, such as the deforestation of Cyprus, could have been assisted by bronze production which ceased when invasions and sacking by the ‘Sea People’, and
others from the North, impeded trade (Kaniewski et al. 2013).

After conquering the Hittites, the Assyrians had adopted their technology in iron making. Supported by superior iron weaponry, they conquered Mesopotamia, southeastern Turkey, Iran and the northern Levant (Haidar 2011). The spread of iron smelting and blacksmithing continued to Palestine, then Egypt, along the Mediterranean and across Europe to the Greeks (Tylecote 2002, pp. 53-4).

Historians have assumed that knowledge of steeling of iron spread from Anatolia out to Africa and Asia, although this claim is in dispute with strong indicators of independent innovations (Raymond 1986, Veldhuijzen 2005; Alpern 2005).

Early iron objects were small with jewellery and daggers forged from a spongy mass comprised of iron, or bloom, made from heating iron ore and charcoal in a furnace, and slag (impurities including silicates). The bloom was forged to expel slag which added carbon to wrought iron, an almost pure iron with silicate and impurities and, later, steel. Further discoveries were cooling to harden the steel, quenching, and then tempering. Quenching left the steel brittle, but tempering, reheating the metal and halting the heat at a certain point relieved the brittleness leaving the steel flexible. This steel was perfect for sword making. Though objects were created for domestic use, the strength and flexibility of iron weapons gave their bearers great military advantage (Raymond 1986, Tylecote 2002, pp. 48-49).

From the beginning of the rule of Diocletian, the Romans relied on factories to supply their armies. Each of thirty-two factories specialised in forging certain pieces of army equipment such as in Lucca, for example, where swords were

7 The Greeks documented iron processes on their ceramic vessels.
CHAPTER 1. A BRIEF HISTORICAL ACCOUNT OF HUMAN AGENCY IN BLACKSMITHING

forged, while the town of Cremona supplied shields (Tylecote 2002, p. 60). The Roman Empire had a monopoly on metal production as the wealth of their conquered countries became their own. Gold, silver, copper, zinc and iron mines were owned and run by the Romans across the empire, including at Tartessus in Spain at the mines of Rio Tinto (Rothenberg, Freijeiro & Bachmann 1981, p. 114; Raymond 1986, p. 84). As skilled organisers, the Romans created factories for domestic ware including one in Scotland, c.87 CE, for mass produced nails. Iron was the driving force of civilisation in the Western world. Those who owned iron, owned the world.

This understanding of the importance of iron is borne out in one of the most mystifying iron objects ever made: The Iron Pillar of Delhi [fig. 10]. Erected as a public commemorative pillar in the city of Delhi, India, it was forged from an iron amalgam impervious to rust. Reportedly commissioned by King Samudragupta, the pillar was built in c.370-375 CE as a symbolic flagstaff to honour the god Vishnu for ground conquered from the king’s enemies (Anantharaman 1997). Most memorial columns across the ancient world were carved from stone. The fact that this column was forged from iron demonstrated a display of might that would instil respect in the enemies of the king. This was analogous to the fear felt in recognition of the power of iron weapons.

The same iron that was used to make the Pillar of Delhi, known as wootz iron, was also traded from India as billets and forged in Damascus into some of the most sought-after swords in the world. The high carbon within the Damascus steel meant that the swords were strong, rust resistant, sharp and flexible. The swords made from Damascus steel (with wootz billets) were characterised by a

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8900 000 nails were found in a fort at Inchtuthil, Scotland. (Tylecote 2002, p. 63).
Figure 10: Iron Pillar of Delhi, c.370-375 CE, Delhi, pillar, iron, 7160 mm, ARTstor database.
decorative pattern that resembles water ripples. Damascus steel swords were forged and used well into the next era (Wadsworth & Sherby 1980; Wadsworth 2014, Srinivasan 1994).

Iron in pre-modern Europe

The might of the Roman Empire was destroyed by Germanic tribes such as the Goths and Vandals. Such invasions from the North at first interrupted the trade in metals and produced a general stagnation of the European economy. However, the subsequent Germanic rule of Roman territories culminated in the rule of Charlemagne (742 - 814 CE) who was crowned Holy Roman Emperor (Latowsky 2013, pp. 94-5). As Charlemagne led campaigns against the Moors and Saxons, legends of the time described the expanse of his armies and the fear that his iron clad cavalry and infantry instilled in his enemies.

Though the Franks and the Norse people generally shared respectful relationships through trade, by the time of Charlemagne’s death, however, there was strife, and the Norse expressed their grievances through raids as Vikings. As Eginhard and the Monk of St Gall, (775 – 840) wrote in the Vita Karoli Magni (Life of Charles the Great):

> Then could be seen the iron Charles, helmeted with an iron helmet, his hands clad in iron gauntlets, his iron breast and broad shoulders protected with an iron breast-plate: an iron spear was raised on high in his left hand; his right always rested on his unconquered iron falchion. The thighs, which with most men are uncovered that they may the more easily ride on horseback, were in his case clad with plates of iron.

(Eginhard 1922, p. 146)
is widely known, the Viking Norse peoples were formidable opponents in battle. In part, their skill in weapon making was due to Sami blacksmiths (Jørgensen 2012, 2015, pp. 309, 313). The Sami peoples developed their blacksmithing skills through forging anchors, nails and rivets for boats; as well as agricultural and domestic items such as horseshoes, stirrups, and ploughs (Goodrich 2010; McCormick 2007). Viking raids extended to England between 793 CE and 1066 CE looting monasteries and disrupting metal craft making by the frequency of their attacks.

The monks of the French Cistercian order, who practiced a life of work as worship, had arrived in England in 1128 CE where they began mining and smelting, alongside other craft activities. As the need for iron forges increased, the monks gathered a labour force through ‘bread converts’: companies of men who accepted monastic discipline in exchange for food and clothing. Tenant workers mined and smelted the ore which was bought by the monasteries where it was forged into tools such as farm implements and horse shoes (Fleming 1986; Lynch 2008).

Blacksmiths over Europe were kept busy forging swords and armour for feudal wars and the Crusades. When the military were not fighting over home borders, they were answering calls to reclaim the Holy Land from Muslim rule during the Crusades of the 11th and 12th centuries. Pope Urban II called soldiers to arms for the First Crusade which ran from 1095 to 1099 CE. Urban proclaimed: ‘Let those who in the past have been accustomed to spread private war so vilely among the faithful advance against the infidels’ (Asbridge 2004, p. 36). This was the first of many crusades undertaken right up to the Early Modern Period.

Along with metal weapons, blacksmiths made the cervelliere, or metal skull-cap,
that was commonly worn by soldiers until the 12th century. During the Crusades, chain mail was also worn. There were two types of skull-caps made: a wrought iron and steel cap. As John Muendel explains, the softer wrought iron cap was cheaper and easier to make. ‘[I]ts fibres were hammered tightly together with frequent annealing to prevent brittleness, and then it was cold-forged for further strength and stability’ ([Muendel]2002).

The steel cap was more complicated. Fusing the steel segments was an erratic process, as the carbon was not evenly spread throughout the steel, as steels with inconsistent carbon content meant different forge-welding temperatures. John Muendel makes it quite plain that making steel, to an extent, still held mysteries to the blacksmith:

"This discontinuity meant that each piece would have to be reworked in coordination with the discriminating eye of the smith, who had no idea as to the amount of carbon in each item." ([Muendel]2002, p. 101)

It is understood that the first European mention of the Chinese invention of gunpowder was during the mid-13th century. Roger Bacon learned of gunpowder from Franciscan monks who had travelled to China, and wrote about it in On the Marvelous Power of Art and of Nature and on the Nullity of Magic. How influential Bacon was in the history of European firearms is contentious, however, the Europeans, eager for victories, recreated cannons by experimenting with both iron forging and bronze casting. Although the pot-de-fer, or iron pot was the first iron cannon used in Europe, the first forged cannon was the bombard which was prone to blow apart. The bombards, through which stone or
forged steel cannonballs were discharged, were in widespread use until the 16th century. From the cannons a large body of artillery was conceived, such as the arquebus which appeared in the 14th century (Davis 1928; Carman 2016, pp. 17, 18; Chase 2003, pp. 24, 61, 92).

The production of iron work of all kinds increased to keep up with demands of the Crusades and civil wars, alongside agricultural needs. Blacksmithing developed higher quality products and specialised in areas such as armoury and farrier work. To organise and regulate this expansion, guilds were established, including the Blacksmiths Guild. The Blacksmiths Guild fraternity begun in 1325 under the rule of Edward III who incorporated the motto: ‘By hammer and hand all arts do stand’ (Noble 1889, p. 62; Tremblay & Ruddel 2010, p. iv).

**Iron in early modern Europe**

The 15th century was a period of considerable technological development with such inventions as the water-milled furnace, mathematical instruments and new designs in military weaponry and armoury. Certain sections of the Cistercian order adopted new technology such as a waterwheel to power bellows, with the first one established in Britain in 1408 CE (Fleming 1986).

Along with a burgeoning affluence, the invention of the printing press by Johannes Gutenberg (1400–1468) transformed access to knowledge in ways that are still felt today. According to Elizabeth L Eisenstein, it opened closed doors of ancient knowledge by making it possible to duplicate the written word easily and relatively cheaply. As Eisenstein remarks, this was advantageous for publishers, authors and readers by ‘call[ing] the attention of readers to special services and products’
This was true for Georgius Agricola (1494-1555) who wrote and printed several books, two of which concerned metal and mining - *Bermannus, sive de re metallica dialogus* (1530), and *De Re Metallica* (1556). His first book was an attempt at a scientific study of metal while his second, which features detailed woodcuts of technological advances of his times, held information of mining and smelting. *De Re Metallica* was published and sold throughout Europe and became the major textbook for miners and metallurgists for 180 years (Bouheiry 1994; Agricola, Hoover & Hoover 1950, p. iv).

Along with the circulation of information, iron production in 16th century Europe increased due to innovations, such as the introduction of the blast furnace. China had cast iron in the blast furnace since at least 1st century CE. The first known European blast furnace is dated from 1345 CE and was found in what was the County of Namur, Carolingian, which is now Numur, Belgium (Tylecote 2002, pp. 76, 95-6).

The blast furnace was fed by a constant supply of ore and fuel (charcoal), from the top, while air was forced through tubes lower down. This differed from a bloomery as it reached a heat that melted the iron, casting ingots rather than the early amalgamated iron and slag of the sponge iron. The resulting ingots were called ‘pig iron’, as they looked like piglets. The furnaces supplied more iron than was previously possible. While it is assumed that the new cast iron supplied guns, in addition, they supplied blacksmiths with larger quantities of bars forged down as with bloomery iron (Tylecote 2002, pp. 95-6, 102).

In England, the blacksmiths’ trade was not diminished during the civil war of
1.2. THE ADAPTATION OF METALS IN PREHISTORY

1642-1651 CE. when the Parliamentarians and Royalists fought over the religious and political control of Britain. Nevertheless, despite the boom in armoury, congeniality depended on loyalty and blacksmiths could either benefit or be plundered (Edwards 1998, pp. 234-271).

The Industrial Revolution

By the late 18th century, Europe, and in particular Britain, was undergoing a fuel crisis, that disrupted the production of iron goods, but also led to some of the first inventions of the industrial revolution. This, with the burgeoning population led to the depletion of forests for a range of uses including building, ship-building, mining and the need for charcoal to fuel the fires for iron production, and blacksmithing. All of which made timber scarce and expensive.

In response to the scarcity of wood, Abraham Darby began sand-casting iron using coke (pre-cooked coal) in a foundry at Coalbrookdale in 1709. Darby had witnessed coke used for brewing malt where it caused foul tasting malt due to impurities such as sulphur in the coal, though Darby realised its potential for casting iron. Using coke Darby manufactured cast-iron stoves at a more affordable price. The Darby foundry also cast pistons and cylinders for pumps built to dredge water from coal mines designed by Thomas Newcomen (Ashton 1924, p. 27, 30-31, 40-41; Raymond 1986, pp. 151-153, 164). Darby’s discovery was pivotal in the emergence of the Industrial Revolution. As it is pure carbon less was needed in the furnace, so not only was it beneficial for the iron casting industry, it saved on fuel at the blacksmith’s forge.

Prior to the Industrial Revolution (1760 - 1840), English blacksmiths worked at
their forges as they had for centuries. In villages and towns blacksmiths continued to fashion armoury, along with everyday agricultural tools, horseshoes, and architectural fittings for their local communities. Some came under the influence of the Worshipful Company of Blacksmiths which was once the fraternity of the Blacksmithing Guild. The company had undergone several charters that allowed certain freedoms for members including the freedom to sell within the city walls. It also provided apprentices protection, fair pricing and customer security (Noble, 1889, pp. 44-5).

The absolute power of church and monarchy was crumbling through conflicts such as the Jacobite Rising of 1745 and the Seven Years’ War, which served to strengthen the British Parliament. Ideas of equality and democracy, were stirring in such British colonies as America, while France was on the verge of a revolution. At the same time, the dynamics of social wealth, power control were shifting to the entrepreneurs of the Industrial Revolution (Taylor, 1987).

A key turning point in the industrial revolution occurred when James Watt after viewing Newcomen’s coal mining ‘atmosphere pump’, realised how he could redesign and improve an engine that ran on steam. He was able to achieve this by using the casting and hand finishing system John Wilkinson devised to cast cannons, which led to the piston and the steam engine revolutionised industry. The Watt steam engine transformed iron smelting as it replaced the water used to drive the bellows while the bellows were superseded by the piston (Ashton, 1924, pp. 37, 41, 42, 46).

This was also the time when British textiles and bakeries were industrialised through the introductions of machines made using the new cast iron methods which multiplied the volume of fabric created. These same new methods enabled
the construction of Iron Bridge in Shropshire in 1792 [fig. 11], which opened up trade between towns in Shropshire. Cast and fabricated and featuring a solid iron arch, it is credited as being the first iron bridge in the world. By the 19th century experiments were undertaken to create a reliable steam train, and in 1829, Stephenson’s Rocket became the first to carry people across the country. Steam ships were developed in the later part of the Industrial Revolution using even more advanced technologies (Miller & Brooks 2014; Ashton 1924 pp. 43, 140; Osborne 2013, pp. 279, 281-282).

Over the next few centuries in both Europe and Australia the manufacture of steel...
increased due to the Bessemer process introduced by Henry Bessemer (1813-1898) in 1856. With the increase of steel manufacture the powers of manufacturers strengthened, and one company in particular, known as Krupp, held great influence. From the 17th century until World War II, the Krupp dynasty had supplied war machines to the world’s largest powers. In the modern era, Krupp supplied steel for skyscrapers, ships, railways and bridges, while both world wars developed and supplied guns to Germany. During the second world war, the Krupp company benefitted from the forced labour of Jews, especially women from concentration camps, as well as Western and Eastern POWs. After the war, in 1948, Alfried Krupp, was tried for war crimes (Mason 1984, pp. 3, 122; Watts 2002; Goldman 2017). Their assembly-line method of production persisted, however, and was adapted in Fordism as an essential mode of modern mass-production.

The Australian Context

Socially, there was a burgeoning underclass in England. With severe crowding in English gaols, and with the American independence, there was a need for a new penal colony. This led to the arrival of the first fleet at Botany Bay, Australia, in 1788. They were there to establish the new colony of Australia where skills in traditional craftsmanship were much needed. Blacksmiths were essential for the sustainment of the new colony.

The first documented account of blacksmithing was by Watkins Tench

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(1759-1833) in *A Narrative of the Expedition to Botany Bay*. Tench made it clear that blacksmiths were so important for the success of the colony that the erection of a forge was amongst the first duties (Tench 1998, p. 30).

Up until 1850’s wrought iron and nailing rod was shipped into Australia. Then in 1848 the first commercial iron foundry, the Fitz Roy Ironworks, Mittagong, commenced production of wrought and cast iron after deposits of iron ore had been found locally in 1833. Although it closed in 1910, while it was open it supplied Australia and California with wrought iron, cast iron objects, and rolled iron rails for the railways (McKillop 2006, p. 15).[13]

In contrast to the industrialisation and company driven steelworks, farriers (blacksmiths specialising in horse shoes) were sent along to the battlefields of World War I, tending to the needs of the cavalry (Throssell 1980). This war represented a turning point for blacksmithing as an essential craft since it was the last major war that depended on horses. Since the end of the First World War, the Australian blacksmith in particular has become either a hobbyist or a bespoke artisan.

**The craft of blacksmithing**

This chapter has followed the trajectory of blacksmithing as a human endeavour, that developed through the exploitation and accumulation of knowledge on the reactions of metals. This knowledge overlapped with creative practices in ways

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[13] Explorations of iron ore deposits were undertaken in various areas of Australia, including Tasmania where ore was found and experimental steel production carried out between 1872-1873. This ended with the collapse of the furnace after making a single steel billet (Burch 2018, p. 248)
that correlate with Barbara Bolt’s (2006a) understanding of artistic research where transitions in production, followed by reflections on those transitions, creates something new.

Both Tylecote and Raymond consider the history of metalsmithing as a sequence of ‘independent discoveries’ that occurred across the world rather than as a diffusion from a single cradle of civilisation. They acknowledge that the history of metalsmithing, or metallurgy, could not be told in a single volume and chose to emphasise the latest in material or archeological evidence at the time of writing (Tylecote 2002, p. xi; Raymond 1986, p. vii). Like Tylecote and Raymond, I have begun my research by tracing the history of early metal usage. By contrast, Cyril Stanley Smith (1960) writes the history of the analysis of metals, from the point of view of the social usefulness of metal.

These historical accounts, and my own brief survey, reveal the metalsmith as an agent in cultural progress. They omit, however, the affects that these metals have had on people and how metals, and other elements, react with each as material agents. The next chapter, gives a brief account of historical concepts held on materiality and draws attention to Bruno Latour’s Actor-Network Theory which attempts to address agency imbalances. To further readdress questions of nonhuman agency, Chapter two focuses on metal as social agent.
Chapter 2

Material Agency

The previous chapter followed the history of blacksmithing from early use of ochre through to copper, gold and silver, bronze and, finally, to iron and steel. In particular, it traced how humans have exploited the minerals of Earth, in other words, it highlighted the human agency in the making practices of blacksmithing. In this chapter, I explore the material agency of matter and its affects on people in relation to the history of blacksmithing.

2.1 Agency

Actions with affective qualities can be understood as having a form of social agency. Although this has previously understood to relate specifically to humans as agents with the ability to contemplate actions, philosophical opinion has shifted away from this anthropocentric viewpoint. Through Actor Network Theory and other investigations, social agency has now been decentralised to include other nonhuman agents, including the view that matter itself holds sway
over actions (Knappett & Malafourisff2008, pp. ix-xi).

Questions on the agency of things have always been divided. To give a sketch of the main positions: followers of materialism, especially materialist monism, maintain that all things are matter. This view is in contrast to idealism which holds to the position that everything derives from the mind. Pluralism, a third position, maintains that there are at least two opposing principles, mind and matter.

Followers of materialism maintain that things have a singular or minimal origin, as when, for example, references to materialism in the middle ages suggests (Robertson 2010, p. 105). One of the earliest documented materialist theories, the Indian-based Chārvāka, can be traced back to the 1st millennium BCE, and explores the idea that life is only what is visible (Bhattacharya 2013). Later, in the 6th century BCE, Greek philosophers Thales, Anaximander, and Anaximenes, proposed that all substances could be reduced to a single entity. Indeed, Thales believed that matter consisted of water (Idang 2013). As atomists, ancient Greek philosophers Leucippus (5th century BCE), Democritus (c. 460 BCE-370 BCE) as Leucippus’ student, and Epicurus (341-270 BCE) imagined the world as consisting of a void and particles which came in various sizes. Democritus surmised that the air held both mind and soul particles which we would breath in until we die, when we would breath them out again (Chitwood 2007, p. 139). Epicurus hypothesised that to produce change, particles, or atoms, collided with each other as an atomic swerve and believed that this movement created new matter which eventually separated to repeat with other particles (Morel 2009, p. 76). Although he agreed with the atomists in regards to atoms, Empedocles (495-435 BCE) surmised that there were four elements from which all things
were made - fire, air, water, earth - a view which was widely influential in the Greek period and which later influenced medieval thought. Aristotle (384-322 BCE) added aether as a fifth element and dropped any notions of atoms. Aristotle divided material from form, which he considered as being the idea of an object. In his view, all things were governed by material, formal, efficient and final causes (Aristotle & Lee 1952, pp. 7, 13, 227).

It is generally understood that Aristotle’s theories were favoured until the rediscovery of Lucretius’s (c.99-55 BCE) *De rerum natura* by Poggio Bracciolini in 1417. Kellie Robertson (2010) makes it plain that during this period of following both divine rule and Aristotelian philosophy, the functionality of the natural world was still being questioned through verse and poetry. Alan of Lille’s *De planctu naturae* and Bernard Silvestris’s, *Cosmographia, or De mundi universitate* are instances of poetic discussions of the nature of being where life was brought forth through divine power. Other examples of metaphoric attempts to explain the physical world through poetry are found in *Roman de la Rose* and Dante’s *Commedia*. Robertson states that during ‘the Middle Ages, science happened in poetry and vice versa’ (Robertson 2010, p. 111).

In the early modern period, however, the understanding of material agency began to shift in the 17th century early enlightenment. Francis Bacon (1561-1626), and others, who were concerned with the approach to research dominant through the

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1 *On the Nature of Things*
2 *The Plaint of Nature*
3 *On the totality of the world*
4 *Romance of the Rose*
5 *Comedy*
Middle Ages, returned to the ancients and revived the philosophies of the atomists (Watson 2006, p. 665; Smith 1960, p. 71). Francis Bacon expressed his concern thus:

Those who have presumed to make pronouncements about nature as if it were a closed subject, whether they were speaking from simple confidence or from motives of ambition and academical habits, have done very great damage to philosophy and the sciences.

(Bacon, Jardine & Silverthorne 2003, p. 27)

Bacon’s contemporary, Rene Descartes (1596-1650) dismissed Aristotle’s theories of elements. He argued that moisture, heat, dryness and cold are incapable of adequately explaining matter, and claimed that matter is devisable by arrangement of shape and size of its parts. Descartes determined that what we see may be completely different to what that something is, as our senses can deceive us (Descart & Chávez-Anvizo 1997). He imagined that the mind and body were separated, and perceived the body as a machine functioning with the use of a ‘system of pulleys, funnels and sieves’ (Wolfe 2017, p. 44). Descartes also considered that the mind was the premium substance from which matter extended for without it humankind would be unable to question its own existence.

The 17th century was a period of serious and sustained debate on whether the mind could be regarded as separate from matter, as Thomas Hobbes (1588–1679), Spinoza (1632-1677) and others engaged with Descartes and proposed new ideas. While they are now often simply classified as mechanists, corporealists, naturalists or materialists, in their own lifetimes many of these
thinkers were considered heretics. Despite the theological restraints of the period, however, the prevailing philosophical questions were centred on matter and how it manifested (Springborg 2016). In the present day context, many of these positions have once again become central to critical debate.

Actor-Network Theory looks at situations from a position that is not exclusively centred on human agency, but instead regards the social fabric as an integration of both human and nonhuman actors. In Actor-Network Theory particular situations are regarded as neither entirely separable, nor in isolation from, other situations, nor purely social interactions between human and nonhuman agents. It holds, instead, to the model of an intricate transformation. Technologies such as blacksmithing, for example, are not seen as exclusively processes which are dominated by human agency, but follow the interactions and connections of the matter involved in blacksmithing. These interactions are viewed as both social and natural (Nimmo 2011).

The agency of matter is vital to making. For centuries blacksmiths have taken advantage of the effects that forging, heating and cooling have on steel. This holds for all metalsmiths and their respective materials, notwithstanding differences in how they react individually. The metal’s physical characteristics, its scarcity, malleability, where it was found, and how it reacts when heated or cooled has agency and influences how humans have utilised it. From such attributes, however, cultures have ascribed various metaphysical qualities to metals, forming myths around them, and questioning the nature of their existence.
2.2. GOLD

The agency of matter as it is understood in Actor Network Theory is germane to the remaining sections of this chapter in how they discuss the material and cultural evaluation of various metals, and is the theoretical basis from which the later chapters on studio-based research proceed.

2.2 Gold

Early European alchemists, armed with the skills of metallurgy and the knowledge of philosophy worked to find the chrysopoeia, or the process of transmutation of base metals into gold. Alchemists were convinced that gold was the purest of metals, as it does not tarnish, and that all other metals could attain the same attributes by undergoing a series of processes.

Alchemically, gold is associated with the sun which in some cultures such as in Ancient Egypt, was connected with divinity. In ancient Greek mythology, Jason and the Argonauts sought after Phrixus’ Golden Fleece, a symbol of kingship. While in biblical accounts, gold, as well as silver, was used to reflect the purity of a spiritual life. However in Ezekiel 7:14 the Bible warns against the futility of chasing earthly riches. In common speech, metaphorically speaking, the ‘golden rule’ is that a ‘golden child’ can do no wrong and a golden opportunity is something not to miss. In the mathematics of the natural world, Euclid’s golden ratio, or phi, is 1.61803398875.

Gold is soft enough to hammer into fine sheets for gilding, a technique used to cover base metals, wood, ivory, or ‘cartonnage’ (linen and gesso) since, at least

6Also called the ‘Philosopher’s Stone’, chrysopoeia was said to be the elixir of life (Principe 2013 p. 25).
2300 BCE. Gilding was applied to religious or royal objects. During the Middle Ages it became a technique used in illuminating religious texts. The objective of this technique, gilding, was to render ‘mankind’s soul closer to the spiritual world’, or to demonstrate a monarchs wealth (Sandu et al. 2010, pp. 47-9). The contradiction to this is what the Earl of Salisbury, in *The Life and Death of King John* declared: ‘To gilde refined Gold, to paint the Lilly ... Is wastefull, and ridiculous excesse’ (Shakespeare, Furness & America 1919, p. 297). A gilded cage, furthermore, is nothing but a pretty prison.

Even in a more secular age, in Joseph Wright of Derby’s painting, *The Blacksmith’s Shop* (1770-1771) [fig. 12], gold appears symbolically, hidden beneath a depiction of a steel billet as a focal point in a rectangular segment of gold leaf. The intention of this gilding was to reflect the hot steel but more importantly, to portray blacksmithing as spiritual, or regal endeavour (Solkin 2003).

Gold (Au) along with silver (Ag), platinum (Pt), palladium (Pd), ruthenium (Ru), rhodium (Rh), osmium (Os), and iridium (Ir) are defined as noble metals as they are resistant to oxidation and corrosion. Gold has long been used to fill teeth due to its malleability, purity and for social status, and like silver, was amongst the earliest metals to be used as currency.

Entire economic systems have been, and remain based on gold and silver. The restriction of the use of gold and silver was in place from the early Greeks through to the 17th century, where the French, German and British underclasses were subjected to sumptuary laws (Mills 1984, Riello & Rublack 2019, pp. 48-52, 102-105, 182, 189, 233-236). While our present day monetary system
2.2. GOLD

involves the use of coloured plastic cards, they are still ranked by their references to metals such as titanium, platinum, sliver and gold. Moreover, noble metals are now found in high-end electronics such as computers and phones.\footnote{Although not classified as a noble metal, adding titanium to a mobile phone is considered a luxury.}

Image removed due to copyright restrictions

Figure 12: Joseph Wright of Derby, 1770–1771, The Blacksmith’s Shop, painting, oil on canvas, 1283 x 1041 mm, ARTstor database.
2.3 Silver

Silver is whitish in colour, is reflective when polished and, when pure, does not easily tarnish. In the west it has long cultural associations with femininity and the moon. Metaphorically, clouds are said to have a silver lining which is something to be thankful for, while a ‘silver fox’ may be grey-headed but still speaks with a silver tongue. Palms are ‘crossed with silver’ in order to curry favour, which is a reference to how Judas Iscariot betrayed Jesus (Luke 22: 1-6). And a silver bullet could fix anything, especially werewolves.

As it is non-toxic, silver is a primary metal for silversmithing. Indeed, Persian Kings would not drink from anything else. It has antibacterial properties and, as such, has been used medicinally, even in the care of wounds at least since the time of Hippocrates (c. 460 - c. 370 BC) (Alexander 2009).

2.4 Alloys

Silver, gold and copper can be alloyed to create metals that perform differently to the parent metal, by distorting the structure of the atoms as they are melted together. This distortion makes it hard for the layers of the new metal to slide over each other, causing it to be physically stronger, though less malleable (Alexander & Street 1989, pp. 102-112).

Gold and silver are readily alloyed with each other and with other metals like copper, tin, nickel, and zinc. Gold, for instance, can be alloyed with silver, copper and other metals to change its colour and to create a more durable form of
gold. While sterling silver, a combination of 92.5% silver and 7.5% copper, is the common silver alloy used in jewellery and silverware applications. Due to the copper content, the resulting alloys will oxidise, meaning that oxygen combines with the copper within the metal to form \( \text{Cu}_2\text{O} \).

Copper is alloyed with zinc and, historically, tin and arsenic to produce bronze, or with other metals such as aluminium, to make brass. Both are stronger, harder and have a lower melting point than copper. They continue to be used both domestically and industrially - a brass band would not be the same without the brassy toned musical instruments. From its introduction in 1971, the British penny was a bronze alloy, later it changed to copper-plated steel. Australia’s one and two cent pieces were also bronze.

Bronze, brass and copper have accrued metaphorical imagery. Biblically, Moses’ bronze snake healed the Israelites. It was a reminder of their sin and the power of God. In the present, the ‘bronzed Aussie’ can be a healthy outdoors type or has spent far too much time in the sun. Brass can be bold or tacky, which, for the latter, is particularly so if you are a woman. To be copper-bottomed is to be reliable which stems from the British navy cladding the hull of a ship with copper around the 18th century (Staniforth 1985).

2.5 Copper

Possibly the first metal that humanity transformed for use is copper, a base metal that is easily oxidised and corroded. It is also one of the first metals that a silversmith will learn to form with a hammer. The forming techniques of forging
(moving the metal with a hammer) and raising (creating a vessel from a flat sheet) compresses the particles of the copper. In between forging sequences, the copper is re-softened with heat from a gas torch, annealing, when crystals regrow, or recrystallise, and the copper becomes malleable again. It is then cooled quickly in water, quenched, which, it is said by Rupert Finegold and William Seitz to aid plasticity of both copper and silver (Finegold & Seitz 1983, p. 63).

A black copper oxide (CuO) forms on the surface of the copper which can enter the lungs, and seep into the pores of the smith if left. While a small amount of copper is important to human health, larger doses can be poisonous (Emsley 2002, pp. 120-121).

As it is reactive, the colour of copper can change to green, blue, red black or orange, through chemical processes called patination. For instance, to obtain a blue patina, the copper is placed over a bath of ammonia; for red it is heated and plunged into boiling water or cold into molten potassium nitrate.

Over time, copper changes naturally to a bluey-green patina called verdigris as it reacts to the atmosphere. Verdigris inhibits further corrosion to the metal, or passivation. It is this verdigris-coloured stone that early humans picked up from the earth to use as decoration and currency, including the oxhide ingots of Cyprus discussed in Chapter 1.

In ancient times, copper was a valuable metal. There is evidence to suggest that during the Chalcolithic Period, and even into the Bronze Age, copper objects were indicators of age, gender and social standing. Copper rings, beads, armbands and daggers found in cemeteries of the time attest to the importance of copper symbolically (Derevenski 2000; Greener 2012). Indeed, Joanna Derevenski (2000) suggests that copper became emblematic of time passing as it
is impermanent in nature, being easily recycled and transformed. From approximately 500 BCE, copper coins were in use in Turkey and Iraq alongside silver and gold, although copper coins held a lower value. Later, during the Iron Age, copper coins were used in Imperial Rome. Spain established copper currency during the late 14th century, and later Sweden followed. Swedish coins, due to the low price of copper, weighed as much as 20 kg. During the Middle Ages, copper was a significant material for church roofing, and during the 15th century, as copper plate for printing (Radetzki 2009, Flaten 2012). Now, as copper does not react to water and is a good conductor of heat and electricity, it is valued for its plumbing and electrical applications domestically and commercially. At present, Australia’s current telecommunication system relies on copper for its wireless and cable systems.\footnote{It is generally paired with optical fibres.}

In mythology, the Greek god of fire, metallurgy and blacksmiths, Hephaestus\footnote{The name can also be spelt: Hephaistos.} was married to Aphrodite, the Great Goddess of Cyprus, from the island known for its copper mines during the Bronze Age. According to Greek mythology dating back to the Late Bronze Age and possibly further, to the Neolithic period, Aphrodite was the protector of metallurgy, and taught the Cypriots to work metal. Small statuettes that sat on copper ingots and dated to the 12th century BC were worshipped by the copper miners. The statuettes ensured ‘fruitfulness of the mines and even more of the smelting furnaces and the processes by which the raw copper was produced’ (Kieburg 2006, p. 214).

There is evidence that Aphrodite evolved from the Assyrian goddess, Ishtar, while Hephaestus and Ares, together, were inspired by the ‘Syrian god Baal, the
Canaanite Reshef or Mesopotamian Nergal’ (Kieburg 2006, p. 215). Aphrodite appeared when these cultures came together for the purpose of making and acquiring bronze. It is inevitable that there were exchanges of cultures. Further exchanges occurred into the Iron Age as Aphrodite, also known as the goddess of love and fertility, became the inspiration for her Roman counterpart, Venus, who was married to Vulcan, god of blacksmithing, and was the lover of Mars, god of war.

2.6 Iron

Iron was a form of currency throughout the Iron Age where billets of iron were exchanged and then forged into swords and other needed objects. Old and Middle Hittite texts reveal the use of iron in festivals, rituals and myths which is also evident in other Iron Age cultures (Cordani 2016; Tylecote 2002, pp. 21, 48, 53).

The Iliad and the Odyssey may have been written over a thousand-year timeframe as they reference Hephaestus, the Trojan War, bronze and iron. Within the texts, iron weapons are mentioned, as well as character attributes of the warriors or war itself:

In the Iliad, the noise of war is an “iron din” (17:425) and Patroclus’ funeral pyre burns with the “iron rage of fire” (23:177). In the Odyssey, Eumaios and later Odysseus observe that the infamy of the suitors spreads to the “iron skies” (15:328, 17:564).

(Russo 2005, p. 24)
Iron is still evocative of war, or an attitude of toughness, through descriptors such as the ‘Iron Curtain’, ‘iron-fisted’, ‘Iron Lady’, and ‘iron hand in the velvet glove’. Iron, though a base metal and not as valuable as the noble metals, is complex, with attributes that go beyond physical strength. For one, iron on its own is soft and reasonably malleable, not adamantine.

Iron oxides permeate our entire global system including within the human body. Iron flows through our bloodstream in haemoglobin and is attached to oxygen as it is transported through our blood. Iron is essential to the quality of human life: too little causes anaemia and, with extreme cases, heart problems and death; too much can produce haemochromatosis, which can be potentially fatal. The iron in haemoglobin reacts with oxygen and is visible when we are cut and red blood flows to the surface of our skin.

Red rust is the evidence of an electrochemical corrosion of ferric oxides which occurs when oxygen is combined with the atomic particles of iron exposed to water. Pure iron (Fe) does not occur naturally on the surface of Earth as our atmosphere contains oxygen. Iron reacts readily with oxygen (O) causing a number of oxides including a red iron oxide ($\text{Fe}_2\text{O}_3$) and black iron oxide ($\text{Fe}_3\text{O}_4$). These oxides manifest in minerals such as haematite, meaning blood-like stone, magnetite, a grey stone with strong magnetic qualities, along with other forms of iron compounds.

Together with nickel, the rare earth elements and cobalt, iron is permanently

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10 Iron oxide is ‘present in almost all of the different compartments of the global system: atmosphere, pedosphere, biosphere, hydrosphere and lithosphere and take part in the manifold interrelationships between these compartments’ (Cornell & Schwertmann 2003, p. 1).

11 Rust can also suggest the stiffness that comes with old age or lack of continued practice.

12 Elements with ‘atomic numbers 59–70’ (Cullity & Graham 2009, p. 489).
magnetic, or ferromagnetic, when sustained below a critical temperature (Curie temperature) which for iron is 770° Celsius. When iron is cooled to this point its electrons spin the same way causing all the neighbouring atoms to align (Cullity & Graham 2009, pp. 126-127).

Cosmologically, iron is the last chemical element to be formed within a star. This process begins with the simplest atom, hydrogen (H), which splits under pressure to produce a new element - helium (He). Helium in turn creates another element, and so on until iron, which is the heaviest element that the star can produce before it explodes. Primordial matter catapults through the universe, some forming iron meteorites. Planetesimals, small planets, with molten metallic cores collided and increased in size to eventually create planets through gravitational attraction, including Earth.

During the Earth’s formation, iron and silicate separated due to density variations of elements, forming the core, mantle, and crust (Ozima, Korenaga & Yin 2012, pp. 31-37). The centre of Earth’s mass, the iron core, is understood to be divided into liquid and solid iron in addition to elements having affinity with it, such as nickel. The earth’s mantle, much of which is silicate, contains more iron which feeds into the Earth’s crust, flowing up to the surface through volcanic activity just as other metals do (Frost et al. 2004).
2.7 Steel

Iron’s elemental crystal structure exists in a number of different states, or is polymorphic, as are other elements such as tin and carbon.\(^{13}\) Iron moves from one crystal structure, as an arrangement of atoms, to another when heated above 910º Celsius, which enables it to absorb carbon to create a stronger metal - steel (Alexander & Street 1989, p. 57; Higgins 1991, pp. 10-15, 153).\(^{14}\)

Mild steel contains between 0.05–0.25% of carbon making it a versatile metal as it is ductile and yet strong which is why it is the most common of modern steels. Since Bessemer revolutionised its mass production, steel has been used extensively in the construction industry, for the manufacture of transport, agricultural machinery, as well as domestically.

As it is such a reliable commodity, it has recently been suggested that it become a measurement of economic growth (Ravazzolo & Vespignani 2017). Even prior to its full mass production capacity, the 18\(^{\text{th}}\) century Scottish economist Adam Smith (1723-1790) gave an account of how Britain prohibited its colonies from steel manufacture as a way of maintaining power (Smith 2013, p. 749).

The precursor to mild steel, wrought iron, was the basis for the oldest form of manufactured steel, forged from a spongy, porous mass of iron called blooms.

\(^{13}\) Carbon’s elemental crystal structure can transform under pressure as well as through temperature, existing as graphite and diamond.

\(^{14}\) This is not the same as metal transforming from solid to liquid or gas when heated, allowing the metal to alloy as, in the case of an alloy, the elemental crystals stay the same while blending with a compatible metal. In the steel process, the temperature of iron, after reaching above the 910º Celsius, it is lowered to 712º Celsius, the carbon within this steel attaches to some of the iron, ferrite, creating cementite (Fe\(_3\)C). which in turn attaches to more ferrite giving layers of ferrite and cementite, combining to form pearlite. When the structure of carbon steel is lower than 0.8% the pearlite attaches to ferrite creating a low carbon steel.
smelted in small furnaces. The blacksmith forged and heated the bloom until most of the silicates and slag were expelled, while carbon from the charcoal blended with the iron. The process was time consuming and laborious, with only small quantities able to be produced (Pense 2000).

The earliest high carbon steel was Wootz\footnote{This is possibly from the word ‘melt’ as suggested from various Indian languages (Barnett et al. 2009).} with between 1.1-1.8% carbon. Wootz was made by adding wrought iron and carbon (some smiths added cast iron and particular leaves and bark) to a closed crucible, and heated. Barnett et al. argue that phosphorus (P), possibly in the form of *Cassia auriculata* added as bark or leaves, was part of the alloy that caused wootz’s hardness (Barnett et al. 2009, pp. 2192-2193). The addition of phosphorus added strength to the wootz while making it resistant to corrosion. Wootz was characterised by visible hard brittle clusters of iron, cementite, within the steel. As it was highly prized, Iron Age blacksmiths tried to replicate wootz, also known as Damascus steel, by layering and twisting, folding and fusing wrought iron steels (pattern welding). Contemporary Damascus steel is an adaption of this process.

Metallurgists have created alloyed steels to improve mechanical properties, create resistance, combat corrosion, impact or heat friction. Some steels are designed for cutting other steels and are required to withstand friction. High tensile steels contain elements like chromium, silicon, nickel, molybdenum, manganese, and vanadium, and are used for mechanical parts that are subjected to stress. Although the amount of carbon in stainless steels can be low, they can contain up to 26% chromium and 12% nickel and are corrosive resistant. Corten was also designed to be corrosive resistant by creating a protective rust-coloured patina. It is used for
making shipping containers and architectural structures such as public buildings and bridges.

Steel has become a common fixture within most modern cultures, permeating our daily lives, and with it, like other metals, it has transformed the lives of humans both literally and figuratively. To be ironclad indicates that something cannot be challenged. It stems from 18th century warships clad with steel to protect them, although ironically, those same warships have also been described as ‘iron coffins’ according to the research of Walter Mangual (2011). A mind like a steel trap is sharp witted, while to be steely is to be hard and cruel.

Born Iosif Vissarionovich Dzhugashvili, Stalin adopted his infamous name as it meant steel (Pisch 2016, p. 24). Stalin’s nom de guerre was deliberate as described by Anita Pisch:

> The use of ‘steel’ as a metaphor in portrayals of Stalin implied personal qualities of courage, determination, ruthlessness, toughness, and unbreakability. These qualities were compatible with those required in an underground revolutionary, and translated well into the leadership role ... Stalin may also have had earlier metaphoric associations with the tough metals from his Georgian childhood. Rieber posits that the cult of iron and steel was a widespread and possibly unique phenomenon in the Caucasus, especially in the oral tradition of epic Ossetian tales. One of the most popular heroes is Soslan Stal’noi who was a defender (and sometimes vengeful destroyer) of his kinfolk.

(Pisch 2016, p. 202)
CHAPTER 2. MATERIAL AGENCY

Early philosophers and theorists such as Aristotle, and later Francis Bacon (1561-1626) observed its production and reactions to unravel steel’s mysteries (Bacon, Jardine & Silverthorne 2003, pp. 123-124, 134). For centuries blacksmiths have forged steel, adjusting and improving its manufacture. Despite humanity’s close relationship with steel, until recent times, understanding how it is transformed to a useful material has eluded its makers.

![Figure 13: Forge, 2016, image: Arthorse.](image)

### 2.8 Forge

Used as a verb, forge can make progress, a copy, a partnership, or change the shape of metal through hammering. In the case of blacksmithing, to forge means to make objects with steel. As a noun, the forge is the fireplace where steel is heated and
the space in which the work of forging takes place [fig. 13].

In a contemporary setting the blacksmith’s forge is more likely to be gas and they will possibly possess a power hammer, a mechanised hammer, to forge with. Oxy-acetylene torches, which are gas and oxygen, electric welders such as TIG or MIG\textsuperscript{16} will also be on hand for joining steel through heating, or welding. Early Iron age forging fireplaces were a ‘charcoal fire in a small open pit with or without bellows’, although forges with bellows could reach temperatures above 1100\textdegree Celsius. The extra heat allowed for welding and for forging larger objects. There were hammers, plier-like grips called tongs, an anvil stone to hammer onto, and a forging stone to protect the bellows from the heat of the fire\textsuperscript{17} (Einarson 2011). The basic forge has hardly changed, although blacksmiths build fireplaces, which are still equipped with bellows and tuyeres, and their anvils are forged or cast. There is still an array of hammers and a large number of tongs.

Steel is heated in the forge, whether coke fire\textsuperscript{18} or gas, until a bright yellow-orange. Then it is pulled from the fire and taken to the anvil which is generally placed within reach\textsuperscript{19} The blacksmith hits the steel with a hammer while holding it in a gloved hand or with tongs. Once the steel has cooled to a point where it is not pliable, the work is either heated again for continuous forging, quenched, or left to cool.

\textsuperscript{16}TIG welders use rods that are fed into the join, while a MIG welder has a continuous wire feed. They melt through an electrical current called arc welding.

\textsuperscript{17}Some forging-stones in early Nordic countries have been found to be decorated with a carved image of Loki with stitch marks in his lips. According to Norse mythology Loki, the trickster god, gambled his head and lost to the blacksmith dwarfs, Brokkr and Eitri (Einarson 2011).

\textsuperscript{18}Coke, as discussed in Chapter 1 is pre-cooked coal that rids the coke of impurities.

\textsuperscript{19}A large steel stake with a pointy end, a beak, and a flat end.
The smith’s equipment such as the forge, anvil, vice and quenching bucket are arranged for maximum efficiency while blacksmith’s hand tools are placed strategically prior to commencing work (Keller & Keller 1996, pp. 67, 90). Typically, the blacksmith anticipates the steps required as they determine ‘the tools and movements needed to complete a task’ (Hackett 2016a, p. 5).

At forging temperature, around 1260º Celsius, the steel is almost butter soft and can be forged until the heat decreases. When larger pieces of steel are forged, especially under a power hammer, the force of the blows can generate more heat which prolongs forging time. Forging the steel cold can be undertaken when the blacksmith neatens the outer layer of the steel object. However, this treatment deforms the crystal structure of the steel unless reheated.

The social theorist, Richard Sennett (2008, p. 172), has emphasised how repetition and mistake making creates good practice. In terms of blacksmithing, this is realised by ensuring that hammer blows are dealt with a force that is firm, rhythmic and strategically placed, assuring the correct movement of the steel. If the aim of the hammer is wrong, the steel can move in an undesired direction, or the hammer can hit the anvil which will cause an uncomfortable rebound. In these ways the smith learns how to thin steel out, thicken it, curl or create an angle or point that becomes second nature. Habits formed in this way become internalised so much so that it is difficult for the blacksmith to explain basic forging steps (Keller & Keller 1996, p. 112).

As has been discussed, those cultures that established a forge could rule. A case in point is how the Philistines forbade the Israelites to forge weapons as written in 1 Samuel 13:19. God comforted the Israelites by declaring that blacksmiths were created by God and that weapons forged against them would be defeated (Isaiah 54:16-17).
2.8. FORGE

Mircea Eliade (1978, pp. 94-108), in his book, *The Forge and the Crucible*, depicts the first smith as a god who had fallen from heaven. Blacksmiths were not only makers and architects, they were creators of music and the forge a place of cadence and initiations. The forge still resonates as a place of symbolic importance. The sculpture, *Kolme seppäät* (1932) [fig. 14], by Felix Nylund (1878-1940) is an example of the cultural significance of the blacksmith. It depicts three blacksmiths forging at an anvil and is situated prominently in the city of Helsinki. It represents, not only the mythological past, but also labour and collaboration.

Figure 14: Felix Nylund, 1932, Kolme seppäät (Three Smiths Statue).

Thor’s hammer, Mjölnir, is an example of the symbolic importance of forging. Thor used it in battle as a weapon. It was also associated with protection in war and in the marriage chamber. A study undertaken in the 19th century suggests its phallic connotations (Lindow 1994, pp. 486, 489, 490, 503). The hammer and the anvil in *Roman de la Rose* were emblematic of procreation.

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20 When the Norse gods created Asgard, they built a forge after they had built the great hall. At this forge they made steel and created hammers and tongs (Sturluson & Brodeur 2006, p. 25).

21 *Three Smiths Statue*
Death and Corruption come together to put to destruction whatever they find within her forge, she continues always to hammer and forge and always to renew the individuals by means of new generation.

(De Lorris & Meun [1995] p. 270)

2.9 Fire

Fire, that ephemeral and dangerous force, has also captured our imagination as inspiration for poets and philosophers over centuries. In *Konungs skuggsjá* [22] a king draws the magnificence of the sky to the attention of his son by comparing it to fire and sparks of a forging. I emphasise that the two characters were royal:

as soon as the smoke begins to grow thinner, the light begins to brighten again; and it happens at times that people think they see large sparks shooting out of it as from glowing iron which has just been taken from the forge. But as night declines and day approaches, the light begins to fade; and when daylight appears, it seems to vanish entirely.

(Larson [1917] p. 150)

The king knew that the son would have gazed upon the same sparks created at the forge and he understood how the experience of the forge would affect his son. He employed that image, the recall of the forge and the colour of the metal as it comes from the fire, to describe the sky that he wanted to share. The experience of the

[22] *The King’s Mirror.*
forge, those things that the father, the king, and the son, the prince, both felt were amazing, so much so that they caught their breath, astonished, when they saw it.

Gaston Bachelard recalls sitting beside the hearth waiting for his grandmother to cook his supper during his childhood. In his hungry impatience he commanded the fire to eat so that his own food would come quicker. Fire was hungry too. When he finally bit into the treat of a hot waffle, Bachelard remembered that he was ‘eating fire, eating its gold, its odor’ (Bachelard 1968, pp. 15). The connection between the flashing of the fire and the richness of gold informs us that the waffle was transformed into an object of desire not just fuel for his body.

Ruth Russo considers fire’s ability to be both constructive and destructive quoting the words of Pliny from the 1st century CE. Russo herself states that fire ‘works in so many different ways: it reduces or oxidizes ores, depending upon conditions; it fuses glass and clay but breaks down gypsum and limestone’ (Russo 2005). Regardless of the danger involved with the chemical reaction between oxygen and a fuel, our working relationship with fire is a long one. There have been discoveries of fire hearths that are possibly 1.42 million years old (Watson 2006, p. 36).

Alchemists, the precursors of chemists, conducted their purification experiments with the help of fire. Maria Hebraea (c. 100 - 300 CE), was claimed by Zosimus (c. 300 CE), a later alchemist, to be the creator of a large collection of alchemic equipment made of glass, clay and metal (Principe 2013, p. 15; Patai 1995, p. 61). Although this is a topic of debate, according to Zosimus, Maria (who was also known as Maria Judaea and other names) invented the balineum23 a hot water bath that kept chemicals at a certain temperature over a fire. The beginning of metallurgy, too, would have began at the cooking hearth.

23 Called the bain-marie in honour of Maria Hebraea, it is even now used in cooking and science.
Fire has protected us, provided heat, made food palatable, and is instrumental in the transformation of earth and metals. Fire has been vital in the creation of civilisations and emblematic of both passion and purification. It is understandable, yet in some ways ironic, that the hearth, the nurturing domestic fireplace, became the origin of metal fabrication. Although, the cooking hearth needed to be tweaked. Francis Bacon remarked that it ‘may be commonly experienced in furnaces that smelt iron, in which the fire from firewood and branches of trees is not very useful’ (Bacon, Jardine & Silverthorne 2003, p. 123).

The forge, a brick or steel fireplace, is used to heat the steel to forging temperature. The vessel section of the forge is raised off the ground to approximately hip height with a flue over the top to control the direction of the flame and smoke. At the bottom of the vessel is a pipe that air is forced through from bellows or fan which is generally electrically driven. This pipe is called a tuyere and it is there to regulate airflow. Too much air pumped through the tuyere creates an oxidising fire which causes an undesirable amount of scale, iron oxide ($\text{Fe}_3\text{O}_4$) coating, to form. Less air through the tuyere provides a reducing fire that, in turn, causes less scale. As John Lord Bacon explains, this type of fire burns all of the oxygen out of the air and not only reduces scale but ‘scale already formed may even be turned back to iron’ (Bacon 1935, p. 40). The amount of fire depends on the work undertaken.

To help control the size of the fire within the vessel, a mound with a small hollowed section is made from sifted coke dust and water mixed to a mud. The mound is

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24 The idiom of fire and brimstone has been used to control the church congregations since at least the time of the King James bible. Sodom and Gomorrah were destroyed by fire and the Israelites were warned of a repeat if they turned from God as his breath is fire (Genesis 19:24; Deuteronomy 29:23; Isaiah 10:17; Revelation 21:8).
moulded to create a gentle slope down to the tuyere which is protected from the mud. Once the mound is built the fire is lit inside the hollow and the bellows are turned on and air rushes up through the tuyere. While the fire is building momentum, coke is piled around the hollow and a few pieces are added to the fire. As those pieces catch alight and glow orange from the heat, the amount of coke is increased until the fire is piled high with coke to burn well. At this point, air flowing through the tuyere is reduced. Building a mound of coke over the fire raises what is called the ‘heart of the fire’ which is visibly the hottest spot in the
fire. When the heart of the fire is sitting high in the forge, the steel can be slipped under the coke pile to rest upon the hearth, and heated to forging temperature [fig. 15].

When a new smith heats their work, they inevitably find that they will burn it when distracted. It is obvious that the piece is burning because it will let off sparks while in the forge. It is disappointing for any blacksmith when they find that this has happened as it means that their work has been damaged by overheating.

Dr Albert Sauveur states that steel that has been exposed to high heat ‘develops a very course structure’ (Sauveur 1935, p. 297). Sauveur understands that the structure of the steel consists of ‘large ferrite cell walls and offshoots of ferrite penetrating the pearlite’ (Sauveur 1935, p. 297). The resulting steel is fragile and will show cracks. At times steel that is overheated can be corrected by reforging, though quenching and repeated heating can hinder this repair. Blacksmiths tend to abandon overheated steel and begin again. For this reason, sparks emitted from the forge are not always a sight that brings joy to the blacksmith.

Apart from heating the steel to forge, the fire is used for fire welding, a technique of joining two sections of steel together. The steel sections are plunged deep into the heart of the fire, deeper than would normally occur in a forging situation. Prior to this, the sections to be joined are cleaned of scale or rust and sprinkled on with a flux (borax) which forms a protective glass coating. When the steel is white hot and looks wet, indicating that the external surface of the steel is at melting point,

25 A fire that has had a considerable amount of steel heated in it throughout the day can develop clinkers which are spent coke and slag (a glassy conglomerate of impurities). The clinkers sit at the bottom of the hole, blocking the tuyere causing an inefficient fire and a dangerous spray of sparks. To rectify the problem, the bellows are turned off and the clinkers allowed to settle, and then removed.
it is ready to weld. While at this temperature the steel pieces are swiftly placed
onto the anvil, one on top of the other, and given a series of hammer blows which
enables the iron crystals to fuse.

It is obvious from his writing that Aristotle spent time contemplating making
processes such as iron production when he writes: ‘[w]rought iron indeed will
melt and grow soft, and then solidify again. And this is the way in which steel is

2.10 Quench

Aristotle criticised Empedocles and Anaxagoras’ theories on fire being in the sky:
‘Lightning they then suppose to be this fire flashing through the clouds, thunder the
noise of it hissing when quenched’ (Aristotle & Lee 1952, p. 227). He ruminates
that it cannot be right as:

boiling is caused by the wind produced in water by fire and cannot
exist in the water before hand; and though they do not call the noise
boiling but hissing, yet hissing is boiling in miniature (for when the
fire on impact is quenched yet masters the moisture, it boils and causes
the noise).

(Aristotle & Lee 1952, p. 229)

When forging, the steel is cooled quickly, or quenched. Quenching can be carried
out in water or other substances such as oil or brine: each used to moderate cooling
times which affects the change in structure at different rates. Brine, for example,
cools steel down quicker than water does, while water cools faster than oil.
Water is used for basic quenching. If the steel is in the fire and about to be picked up, the smith will pour water over the end of the steel to be held, while the other end stays hot [fig. 16]. This method also helps to prevent movement in a specific area. Another technique is to hold the hot end in tongs and dip the other end in water. However, other methods are undertaken when steel tools need hardening.
and tempering through heat treatment, for instance a knife needs to be flexible and hold a sharp edge.

To quench harden, the steel is heated until the particular section is at between 815°- 900° Celsius, a critical temperature when the new crystals within the steel begin to grow. When plunged into a quenchant, the new crystals form a needle-like structure called martensite which is hard but brittle, causing the steel to be susceptible to shattering. To counter these effects, the hardened steel is tempered which is a process of controlled re-heating and re-quenching the steel. The object is reheated, watching ‘carefully for the colour of the metal to change’ (Hackett 2016a, p. 7). Tools are heated to a certain colour ranging from yellow to blue, depending on its use, and dipped into the quenchant, usually oil. This second quench arrests the metal at a point where the heat has released the stresses created from the first.

It is important to clarify that quenching steel with a low carbon content, such as mild steel or wrought iron, causes a modest hardening, like work hardening with a hammer. However, the steel will not be hardened at a molecular level like the tool steels with high carbon content.

Since it became a part of forging practice, quenching has been associated with magic and mysticism. Just like heating steel, the reactions associated with quenching were hard to fathom, this includes the use of water in a quench. ‘Sometimes water softens and dissolves, as in the cooking of food or the washing of dirt from fabric; and sometimes water hardens, as in the miraculous toughening of iron’ (Russo 2005, p. 26).

The first mention found of quenching is when Cyclops loses his eye to Odysseus and his warriors:
The Cyclops’ eye hissed round the olive stake in the same way that an axe or adze hisses when a smith plunges it into cold water to quench and strengthen the iron.

(Homer, Rieu & H. [2003], p. 106)

The hiss would have been as evocative to the reader as the colour of the sunset in *Konungs skuggsjà*. The king in this particular poem not only describes the sky in terms of the colour of steel at the forge, he suggests that ‘it looks very much as if the light were overcome by this smoke and about to be quenched’ (Larson [1917], p. 150).

All kinds of matter, liquids as well as solids, have been used, or said to have been used by blacksmiths and metallurgists. ‘The Ancients thought it was done by some Superstitious Worship’ which was probably why odd tempering techniques were devised (della Porta [1658], p. 305).

Theophilus Presbyter recommended to:

Take a three-year-old goat and tie it up indoors for three days without food; on the fourth day give it fern to eat and nothing else. When it has eaten this for two days, on the following night shut it up in a very large jar perforated at the bottom, and under the holes put another vessel, intact, in which you can collect its urine. When enough of this has been collected in this way during two or three nights, let the goat out and harden your tools in this urine.

(Presbyter, Hawthorne & Smith [1979], p. 95)
Theophilus also prescribes the urine of red-headed boys, while earlier myths proposed that the perfect quench was obtained by using virgins and slaves (Presbyter, Hawthorne & Smith 1979; MacKenzie 2007).

One recipe, however, is quite similar to that used by Japanese sword makers where clay is involved in the quench. Theophilus’ suggestion was to wrap the files in goat skin and cover them in clay. He then goes on to say that the files should be heated until the goat skin is burnt, then the clay is to be removed and the file plunged into water (Presbyter, Hawthorne & Smith 1979, p. 95). Japanese sword makers place clay on the edge of the sword as it cools the steel slowly, keeping the edge at martensite while the rest of the blade will stay ferrite and pearlite. Done well, this leaves a dividing line between the two different steels and is an indicator of a well-made sword. After a series of heatings, the sword is then plunged into water where it dramatically flexes as it cools (Kapp, Kapp & Yoshihara 2012, pp. 165-183).

The scholar Giambattista della Porta (1535-1615) believed that steel would ‘grow hard by its contraries, and soft by things that are friendly to it; and so … came to Sympathy and Antipathy’ (della Porta 1658, p. 306). For della Porta, the hardness of steel was determined by the place where the water was gathered. He recalls the observations of Pliny who claimed that oil softens steel while water hardened it. Porta also wrote detailed observations of quenching such as the use of dung, fat, ground ox and goat hooves, mallows and bean pod juices, while his tempering observations were as follows:

When the iron is sparkling red hot, that it can be no hotter, that it twinkles, they call it silver; and then it must not be quenched, for it would be consumed. But if it be of a yellow or red colour, they call it
gold or rose-colour: and then quenched in liquors, it grows the harder: this colour requires them to quench it. But observe, that if all the iron be tempered, the colour must be blue or violet colour, as the edge of a sword, razor or lancet: for in these the temper will be loft if they are made hot again. Then you must observe the second colours; namely, when the iron is quenched, and so plunged in, grows hard. The last is ash colour: and after this if it be quenched, it will be the least of all made hard.

(della Porta 1658, p. 306)

Each tool or weapon required its own particular quenching agent, for example: a saw made to cut an iron saw needed ‘a liquor made of Water, Alom, and Piss’ (della Porta 1658, p. 308). Though unrefined, della Port’s entire chapter on steel tempering, shows considerable comprehension of material reactions and effects without the benefits of modern chemistry.

**Metal Materiality**

Within this chapter is a brief overview of the human quest for understanding materiality ending with Bruno Latour’s Actor-Network Theory which draws on human and nonhuman entities to establish a thing. This is in contrast to earlier ideas of things, including humans, being made of matter and spirit, or reduced to an atom. With this in mind, the chapter has reflected on the agency of metals on humankind as apposed to the first chapter which briefly chronicled the history of human endeavour with regard to metal. This chapter explored how metals have effected humans emotively, as well as metals’ ability to effect each other, and
then narrowed to focus on the materials, processes and energies within blacksmithing. More could be said here as the examples of how metals effect our being, and that of each other, is vast proving that matter is very active indeed.

The following chapter will deliberate on the creative connections between contemporary sculpture and traditional blacksmithing through to my own practice. The chapter begins with exploring the purpose of blacksmithing and sculpture and shifts in the understanding of each practice. This is followed by ways in which my own practice has been shifted through the influence of blacksmithing and sculpture.
Chapter 3

Transformations: creative processes within blacksmithing and sculpture

The last chapter discussed the material agency of blacksmithing processes. I now turn to the question of the creative connections between blacksmithing and sculptural practice which rely on successful aesthetic transformation. These connections are, to some extent, evident in my working methods.

In this chapter I emphasise material production linking the transformative processes found in blacksmithing and sculpture to articulate ‘what has emerged or what has been realised’ through creativity (Bolt 2006a, p. 14). Across history, and over the generations, variants in culture are gradually transformed by new technologies, techniques and social processes. Such cultural variants are one of the driving forces of creativity which, by definition, is the act of something new and original. The following accounts include historical and gender concerns as well as actions within my own practice that have led to transformative processes in sculptural blacksmithing.
3.1 Creative Blacksmithing

Blacksmithing is recognised as both a technical and creative craft practice. As a traditional craft in a technologically advanced age, it is often perceived as a technical and aesthetic process that is declining. Contemporary sculpture, on the other hand is widely understood as an active and relevant art form that expresses aspects of human experience. Additionally, while blacksmithing is traditionally a masculine craft, contemporary sculpture has effectively become gender neutral. Though valued differently, both blacksmithed and sculptural objects are nonetheless created in the current social context that requires equity in response to questions of gender.

Manipulation of steel in blacksmithing

Blacksmiths solve problems, as is expected of all traditional crafts, and often produce objects assessed for their utility value. The social theorist Richard Sennett has remarked that skill, which is the basis of blacksmithing, is firstly a corporeal experience that leads to reimagining objects such as tools through prior knowledge and improvisation. Sennett regards the main concern for a craftsperson is the aim to make ‘something well’ (Sennett 2008, p. 9-10).

Objects such as the sword, the plough and spurs transformed the military and agricultural development of early modern societies, and were esteemed for their
strength and usefulness. The sword defeated enemies and expanded boundaries; the sharper plough dug dirt that other farmers could not; while bits and harnesses controlled horses for faster movement over vast areas and varied terrains. The utility value of the blacksmith’s work was crucial since a poorly forged sword promised death to the one who held it, and a hoe that could not dig deep in the hard ground lessened the yield.

These blacksmithed objects held special importance as the iron ore used for forging was hard to source, while the steel and the objects took a great deal of time to make. The raw materials were mined, the bloom made and worked until it was useful. Then the object was formed. The utility object was valued for both the time that it took to make and the cost of materials with which it was made. Moreover, such objects were often agents of myth that played a role in national epics and in shaping the public imagination. The Old English poem, Beowulf, itself a myth of battles won and lost, draws our attention to the sword, Hrunting:

The iron blade with its ill-boding patterns had been tempered in blood.¹ It had never failed the hand of anyone who hefted it in battle, anyone who had fought and faced the worst in the gap of danger.  

(Heaney 2000, p. 101)

Hrunting alone was responsible for winning or losing a fight, and eventually failed Beowulf when battling Grendel’s mother (Heaney 2000, p. 101).

¹Tempering, as discussed, is a process after quench hardening that is undertaken to toughen the sword, stopping it from shattering. Although there are myths surrounding blood tempering such as tempering into a slave, this reference probably meant that it had been part of many battles.
As the level of sophistication in regard to weaponry increased, so did the technology to make them. First water mills, steam, and then electrically-run power hammers took the place of the blacksmith at the forge. Powered hammers became more capable of forging larger objects as they gained speed and efficiency. While iron casting and then milling techniques were perfected to produce machine parts and decorative iron sections for domestic use that were cheaper and increasingly more accurate.

In the present, designers solve problems using computers and three dimensional printing to produce much needed mechanical parts, while hydraulic presses push out everyday objects such as steel cans from thin sheets of steel. The portable metal can was first invented to feed armies in battle, but quickly became a reliable container of preserved foods in most Western households. Nevertheless, while it is more convenient to store canned vegetables and fruit than to shop for seasonal food, the convenience of the can does come at an environmental cost. As cans are emptied of their contents, they are usually thrown away. And just as they are made quickly they are then disposed as rapidly in ways that make it clear they are not valued for their cultural significance. This is also true of all commercially made steel objects.

On the other hand, in the 21st century objects made in the traditional way by blacksmiths have accrued sentimental value as objects connected with history. This connection occurs regardless of the object’s use-value, which is displaced by the way it provides material traces of earlier technologies and the formal characteristics of objects from earlier cultures.
Blacksmithing as identity

It was not only crafted forged objects that held cultural importance in a community. The blacksmiths social role was pivotal in the establishment of European law and order, serving those with the means to pay for tools of military control. Early historical poetry such as *Völundarkviða, The Lay of Völundr*, within the tradition of Old Norse poetry or *Poetic Edda*, confirms the importance of the blacksmith’s skill (Einarson 2011). In fact Völundr’s expertise was so highly regarded that he was taken prisoner by a king who wished to keep the work of the blacksmith to himself. As the poem suggests, those who were in control of the blacksmith, by inference controlled the community in which they lived.

The ability of blacksmiths to command fire and move metal with great ease was also associated with the role of the shaman (Einarson 2011; Eliade 1978, p. 81). According to the oldest known version of the European folk story, *The Smith and the Devil*, the smith makes a pact with an evil creature. If the creature provided the smith with the knowledge of fire-welding, the smith would give him his soul. Once the knowledge was acquired, however, the smith used his new-found knowledge to fire-weld chains to imprison the devilish creature and smiths were portrayed as vengeful tricksters to be feared as their skills were powerful (da Silva & Tehrani 2016). This legend highlighted the cunning of the smith god which has classical precedents in the ancient myth of Hephaestus, blacksmith to the Greek gods, who was highly skilled but also lame and misshapen. Repeated orally over centuries, *The Smith and the Devil* is a prefiguration of the Faust legend.

By the 19th century the importance of the smiths’ traditional role in the modern community can be seen in the first of Joseph Wright of Derby’s paintings of
blacksmiths at work, *The Blacksmith’s Shop* (1770-1771) [fig. 12]. Here the blacksmiths are seen busy at the forge helping a party of late night riders. The smiths’ concentration focuses upon the steel in a workshop that is part of an ancient building, possibly a church. This setting not only connects the painting to traditions of an earlier era, but also to a form of skilled work associated with the sacred, in a time when ideas of the sacred were being challenged.

Though the nature of hand-skilled crafts had slowly eroded overtime, the new industrial models of the 18th century destroyed them (Thompson 1966, pp. 234-268). Manufacturing now took place in large industrial buildings under poor conditions. Workers were instruments in production lines working at repetitive tasks. Joseph Wright represented the dehumanising demise of craft making in paintings such as *Arkwright’s Cotton Mills by Night* (1782-1783) [fig. 17] where the weavers who had previously worked in cottage industries at home are hidden behind the factory walls during a night shift working with the new weaving machines.

In an earlier painting, *An Iron Forge* (1772) [fig. 18], Wright has painted a blacksmith workshop which is equipped with a steam-powered hammer. There is only one blacksmith at the forge, now, leaving behind the sense of community that was visible within the earlier blacksmithing painting. There is a perceptible sense of hierarchy where the boss, whose face is discernible, is standing upright, his arms folded and his legs apart in an attitude of power. The worker, on the other hand, is bent over his task. His face is turned from us, obscuring his identity. We are denied any hint of his character. In the earlier work, *The

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2 This painting is discussed in Chapter 2 in regard to the added gold leaf.
3 See the argument made by D H Solkin (2003) in *Joseph Wright of Derby and the Sublime Art of Labor*. 
Blacksmith’s Shop, there is a sense of camaraderie in the ways bodies are physically engaged in their tasks. Here, however, the worker stoops. There is an understanding that he will be in this position for a while, experiencing the full force of that hammer as it falls to hit the steel. It is the hammer that is in control now, not the blacksmith. His identity as artisan is compromised. Finally, instead of the workshop being open to the outside world it is closed and the hour of the day is unknown. There is no hint of the function of the object worked upon, or for whom the work is made.
Wright’s final blacksmithing painting *Iron Forge viewed from without* (1773) [fig. 19] reveals the devastating impact of the Industrial Revolution on artisans. The mill, for that is now what it is, not a forge, is in ruins as metaphor for the loss of craft making. The owner rests back upon the building wearing what appears to be a velvet jacket. The worker is bent over the power hammer as before and he is portrayed as less than human. The steel worked by the power hammer is invisible, seemingly irrelevant, as the focus of production is money and power.

By the mid 19th century, the age of British industrialisation, blacksmiths had lost their mystique. In Charles Dickens’ (2010, pp. 5-6, 63, 200) classic novel, *Great Expectations* (1861) the blacksmith character, Joe Gargery, had become the ordinary man full of goodness and honest work in symbolic opposition to those with inherited wealth.

The status that blacksmiths had experienced in the Iron Age had eroded. From the Middle Ages the smithy was commonplace within every village community. As industrialisation gradually replaced the need for strenuous human labour, the traditional skills and hard labour of blacksmithing were regarded as regressive.
In Australia, blacksmithing has become a craft of nostalgia, an institution that gazes deeply at the past rather than keeping an eye on the future. Blacksmithing is constantly aligning itself with re-enactment clubs, lost trade demonstrations and ‘old boys’ clubs.

3.2 Creative Sculpture

To be creative in both blacksmithing and sculpture means to be able to think and make in three dimensions. As with blacksmithing, the acquisition of skills has been an integral component of the creative process of sculptors for centuries.

Manipulation of matter in sculpture

Carving and modelling are traditional sculpting methods. While ivory, wood and stone were carved, modelling was used for ceramics and bronze casting. Although it has similarities to modelling as it is plastic when heated, steel forging and fabrication is neither truly carving nor modelling. Early historical examples of forged steel sculptures are rare, although the Iron Pillar of Delhi (c.370-375 CE) discussed in Chapter One, was forged and fabricated from wootz and able to withstand rusting. Frank Eerhart (2012) draws attention to more contemporary forged sculptural artefacts made throughout a number of African cultures. During the 20th century, while the tradition of carving and modelling, were

Rhys (Carpenter 1960) uses the terms glyptic and plastic extensively throughout Greek Sculpture: a Critical Review.
3.2. CREATIVE SCULPTURE

slowly replaced, steel became an important aspect of the ‘new’ assemblage sculpture during the Cubist era.

According to Carmen Giménez, the sculptor David Smith (1906-1965) referred to Julio González (1876-1942) as the father of iron sculpture, although conflicting opinions on this claim exist from as early as 1957 (Giménz 1993, p. 13). The art historians and critics, Michel Ragon and Howard B. Garey, wrote that ‘[t]here are some who claim that González invented ”aerial” sculpture before Lipchitz and sculpture in wrought iron before Gargallo’. They were very firm, though, in their belief that ‘[i]t is well known that the first sculptures in wrought iron and sheet metal were those of Gargallo towards 1906’ (Ragon & Garey 1957, p. 18). Francisco Calvo Serraller’s (1993, p. 98) research suggests that González taught, both Pablo Picasso (1881-1973) and Pablo Gargallo (1881-1934) to work with iron.

Julio González, his sisters, Pilar and Dolores González, and brother, Juan, exhibited in the Barcelona Expositions of 1892, either under their own or their father’s name. In the 1896 catalogue of the Barcelona Exposition, Julio’s entry was a ‘Branch of flowers of forged and beaten iron’ (Ritchie & Gonzalez 1955-1956, p. 4).

Santiago Rusinol (1861-1931), a Spanish painter, poet, and playwright had witnessed sculpture that had been forged from wrought iron when he stated in an 1893 lecture:

There, in the darkness of those sooty workshops, under the ringing chorus of constant hammering on the anvil, I think I see springing

\[5\] It is highly possible that their work was not categorised as sculpture, but rather as decorative arts.
from the tire . . . an art without aesthetic rules or absurd restrictions, 
an art free as smoke, born from fire, and wrought in fire.

(Rusinol cited in Ashton 1993, p. 28)

As craft or industrial based techniques supplanted the traditional sculptural processes of stone carving and bronze casting, still life gradually replaced the figurative subject matter. Within Cubism, ‘it was possible to “make” a piece of sculpture for the first time in history … to assemble it in parts, as a craftsman would a table or a chair’ (Tucker 1974, p. 60). Though the collages created by Pablo Picasso and Georges Braque (1882-1963) in the period between 1912-14 were far from the considered skill of a craftsman, Tucker understood the significance of their work (Heuman 2009). These sculptural objects were challenging the structure of sculpture, the accepted sculptural subject matter and its production. I will discuss the implications of fabricated sculpture further in Chapter five.

**Sculpture as an expression of identity**

In contrast to the utilitarian skills of the smith, it is widely understood that the primary intention of the contemporary sculptor is not to solve problems but rather to adapt spatial form to address human experience and the imagination. When discussing creativity within sculpture, criteria needs to shift to accommodate imagination as a process alongside skill.

Over the history of human endeavour, some sculptures have held commemorative or monumental significance while others were symbolic or ceremonial either
socially or on a personal level. As a memento, memorial or fetish, sculpture has portrayed mortals and higher beings, especially from classical mythology. Although animals were depicted, this was largely in relation to human interests. Sculpture was an essential component of a community, possessing agency within its materiality. Julio González made comment on the change of sculptural identity that occurred through modernism:

The masses attach themselves to that art which responds to their needs. Those of the Middle Ages saw cathedrals, those of our day see collectivist constructions embellished with decorations of an abstract tendency.

(Ritchie & Gonzalez 1955-1956, p. 43)

While modernism had changed contemporary sculptural aesthetics and ideals, and representation has once again become an option, sculpture has maintained its position as being in relation to the human experience. Over time the agency of material has diminished. Social sculpture, established by Joseph Beuys in the early 1970’s, was an attempt to address problems that he saw within social systems, including those evident in art. Founded on the main idea that human beings are creative, art for Beuys was based on production and creativity where the artist did not automatically belong, but rather was required to find a purpose. According to Beuys, artists should make themselves useful (Lange 2007, p. 184). He claimed that everyone can be an artist, and hoped that the common individual would see themselves as artists within their own area of life (Bodenmann-Ritter 2007, pp. 189-197).
Along with social sculpture, Beuys organised political parties, including the German Green party and the Organisational Office for Direct Democracy founded in the 1970s, which like his art was also designed to change social norms. Bueys considered traditional democracy as a system that stifled society. These social reforms involved public discussions and ‘conceptual artworks’ which were the foundation of lectures and performances (Mesch 2007, pp. 199, 202-208). Social sculpture’s physical output became almost unimportant as the focus of Social Sculpture was for all people to identify as a creator.

**Sculpture as a measurement of the other**

To make sense of the potential for sculpture to be a source of comparison, I draw attention here to one of the oldest representational sculptures ever found, the Löwenmensch (Lion-Human) figurine [fig. 20]. This figurine, part lion, part human, was discovered in Hohlenstein-Stadel, Germany, and is believed to be approximately 30-40 000 years old. It has been carved from a mammoth tooth (Piprani 2011).

The historian, John Piprani explores ideas of how early humans may have transferred the traits of an animal onto themselves through the figurines they made. He argues that sculpture provides an understanding of materiality that our own culture has lost, along with an ability to comprehend animal behaviours differently to our own. According to Piprani, animals were once seen as a collection of actions carried out rather than a thing. Artefacts transferred actions to the human who possessed it allowing them to become a hybrid of the animal
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Figure 20: Lion Man from three angles, 30-40,000 years old, figurine, mammoth ivory, 310 mm, viewed 3 March 2019, © Ulmer Museum.
and themselves. This was important when it came to crucial hunting activities as the hunter would adopt the lions’ ability to hunt in packs and stalk their prey (Piprani 2011). Though it is not fully explained here, it is possible that the mammoth tooth itself is imbued with the actions of the prey. The Löwenmensch figurine is the expression of this particular culture’s understanding of their relationship with other sentient beings, and their ability to bring them together.

Following Piprani’s thoughts, this suggests that the use of iron in the Iron Pillar of Delhi [fig. 10], the monument to Vishnu, was neither incidental nor only symbolic. Symbolism attached to iron, how it is portrayed, may well have been regarded as a way of reinforcing Vishnu’s strength, and through association, that of the King who ordered its creation. However, it was forged from the best quality iron made at that particular time, which draws on iron’s materiality to embody the might of Vishnu, rather than being solely symbolic. The Iron Pillar of Delhi delivers a number of interactions with other tribes of people and with metal.

Other examples of how materiality has influenced sculpture and its social
contexts include the Ankishi figurines (or nail fetishes) of the Congo, West Africa. According to the anthropologist, Alfred Gell. Ankishi figurines are understood as magical as they hold within them a spirit. These sculptural objects are judges carved into a human-like figure from a Mukula tree whose sap has the appearance of blood. Nails holding messages of complaint in regard to a perpetrator of a crime are then hammered into the surface. The perpetrator is then killed by this judge. According to Gell (2010, pp. 51-65) the figurine moves from being a passive tree to an object of agency by the act of doing through the intention of the sculptor involved. In this social situation the sculptures divide the good from the bad.

Up until now, sculpture has been largely understood within the context of the community in which it was created. The appreciation of sculpture has relied on formal and symbolic references that are imbedded within, and can only be read, not through the senses, but rather, through the processes of cultural language. In this spirit, sculpture has depended upon what Katve-Kaisa Kontturi views as ‘pre-conditioned knowledge and a pre-chosen political viewpoint’ (Kontturi 2014). In other words, the creation of sculpture has relied upon a dependence on an understanding of the other.

The exploration of identity in blacksmithing

Blacksmithing, too, has depended upon culture and its expectations and is linked with masculinity. The general perception of a blacksmith has much in common with Longfellow’s village blacksmith:

With large and sinewy hands; And the muscles of his brawny arms
Are strong as iron bands.

(Longfellow[1872], p. 147)

Some of the more well-known traditional objects of blacksmithing such as daggers and swords for war represent a strong masculine world of death and destruction (Brunning[2013], Harlow[2004], p. 44; Hadley[2004], p. 302). Yet blacksmiths not only forged tools for war, but were also responsible for making tools for agriculture and cooking, and cooking is also connected to blacksmithing through the fireplace. In ancient Nordic communities, for instance, the forge stone, a blacksmithing hearth, was close to the cooking hearth. The 13th century Norse poet, Snorri, used ambiguous language when writing Snorra Edda, or Prose Edda, implying similarities between the two fires. Both hearths are parts of a procedure that transforms either food or steel ‘into something desirable, even consumable’ (Einarson[2011], p. 85).

In more modern periods the domestic hearth and the blacksmith’s forge were separate and have gained an almost antithetical significance. While the forge is imagined as masculine, the hearth, the traditional location of fire in the home, is seen as a place of nurture and nourishment: women’s work (Young[2005], p. 123).

There have been a few women blacksmiths throughout history although information or evidence of their existence is difficult to find. Most women associated with the forge have been portrayed as allegorical, mythological or metaphorical figures. In Old Norse myths, giantesses who gave birth to many sons were imagined in metaphorical language with bodies like smelting furnaces.

6It has been argued that the forms of these weapons have phallic symbolism, which is seen as more proof of their masculinity (Brunning[2013]).
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and iron bloom as offspring. It seems that these giantesses were the furnaces, or
the axes, swords and other iron objects, or were related to activities associated
with tool use were the offspring (Gansum 2004; Einarson 2011).

By the 13th century, a French poem, *Roman de la Rose*[^7], by Guillaume de Lorris
and Jean de Meun, the figure of ‘Nature’ is shown as a woman forging babies at
her anvil [fig. 22] beseeching the lovers to return to the business of procreation:

He enjoined her to remain within her forge and labor as she was
accustomed to do when she had no sorrow … Nature remained in
her forge, took her hammers and struck out and shaped everything as
she had done before.’

(De Lorris & Meun 1995, pp. 320-321)

Illustrations of a woman blacksmith were depicted in the Queen Mary Psalter
manuscript (c.1310 CE) and again in the Holkham Bible (c 1327-1335 CE) [fig.
23]. The woman’s name was possibly Hédroit, whose story was first told in
French literature in around 1200 CE. It appears that her husband was asked to
forge nails to drive into the hands and feet of Christ. He begged to be excused
from the task and his wife forged the nails instead. This story helped reinforce
the assumption that woman blacksmiths were evil (Lipton 2014, pp. 222 -223;

There were medieval women blacksmiths who worked with their husbands and
joined guilds. An example is Katherine, the wife of the king’s former smith, who
was asked to forge for the king in 1346 CE while Andrew, her son and the new
smith, was in Crecy campaigning.

[^7]: *Roman of the Rose*
Later in the 18th century, poet, William Hutton (1723-1815), described an encounter with women blacksmiths in Birmingham:

In some shops I observed one or more females, stripped of their upper garments, and not overcharged with the lower, wielding the hammer with all the grace of the sex. The beauties of their faces were rather eclipsed by the smut of the anvil; or, in poetical phrase, the tincture of the forge had taken possession of those lips, which might have been taken by a kiss. Struck with the novelty, I enquired, ‘whether the ladies of this country shod horses?’ but was answered, with a smile,
Throughout the 19th century there was an increased hostility towards women working in all trades, perhaps mainly because women’s employment in trades led to less skilled work for men. Industrialisation and a desire for cheap labour, on the other hand led to employers taking advantage of women needing income, on
the other hand led to excluding their male counterparts. This in turn antagonised those who saw women staying home as carers as a status symbol (Rose [1988] Blackburn [1997, 2001]). By the 20th century the sweatshop conditions ensured that women chain makers and nailers became victims of the new mechanisation. In an attempt to improve their conditions, women chain makers and nailers were portrayed as slaves (Chase 2017, p. 45).

Mary Reid Macarthur, the Secretary of the Women’s Trade Union League, advocated the rights of working women from 1901 until her death in 1921. In an article written in 1910, Macarthur relays a story of 800 women chain makers who went on strike for better pay (Malone 2002). Although their work was hard, it seemed that the lowly tasks of women making chain became a part of female identity. And one 79 year old woman, Mrs Patience Round, was employed as a blacksmith making chain for her entire working life (Daily Express 1910).

By contrast, in 2008, Michelle J Parker became the first woman accepted to the Livery of the Worshipful Company of Blacksmiths, a London guild since, at least, 1325, with women granted entry in 2004 (Jeal 2008). Moreover, by 2009, as women felt uncomfortable learning blacksmithing in designated clubs over-represented by men in Melbourne, Australia, Blacksmith Doris was formed to support women wanting to practice the craft (Hackett 2013). Blacksmith Doris is understood to be one of the first contemporary women’s blacksmithing groups in the world, if not the first.

Contemporary women’s blacksmithing projects still contain gender bias. For example, a number of blacksmiths who identify as women have a tendency to

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8 Her article was written for The Women’s Trade Union League and later for the Christian Commonwealth.
create objects that are traditionally used by women, or more actively assert a practice that is traditionally for men, such as making weaponry. An example of the former is Elizabeth Brim. Brim always wears pearls when forging delicate tutus [fig. 24], high-heeled shoes and frilly aprons in steel. These ‘feminine’ objects are reactions against masculine perceptions of blacksmithing, as well as responding to gender expectations (Meilach 2000 pp. 139, 242; Andrews 1994 pp. 173 - 75).
CHAPTER 3. TRANSFORMATIONS: CREATIVE PROCESSES
WITHIN BLACKSMITHING AND SCULPTURE

Figure 24: Elizabeth Brim, 1999, *Tutu*, sculpture, steel, approx. 914 x 610 mm (size 6), Photo © Tom Mills.

Figure 25: Cal Lane, 2007, *Car Bombing*, sculpture, steel, life-sized, Art Mur.
Smith and artist Cal Lane, uses industrially made steel building tools, such as spades and wheelbarrows in her sculptures and, like Brim, sees notions of gender as the principal focus for her work. Lane’s sculptural practice questions gender norms by burning lacework motifs into those steel objects with a plasma cutter. "Doilies" (2000) consists of circular steel plates cut into lace patterns. The dialectic is obvious: industrial versus domestic, strong versus delicate, masculine versus feminine, functional versus decorative (Peck 2014, p. 42).

Such examples validate the traditional expectations of ‘womanhood’ as they focus attention on its supposed opposition: the perceived masculinity of blacksmithing, as well as the building industry as a whole. Pearls, tutus, high-heels and lace form visual cues for femininity; and are symbolic and decorative in their nature. The sculptural artefacts of Brim and Lane are reminders of believed binary gender distinctions that leave me wondering if it is possible to blacksmith or make sculpture without gender-based references.

Katve-Kaisa Kontturi argues that it is possible. She writes that by giving up ‘the comfort of positioning, the reliance on pre-conditioned knowledge’, we do away with the need for binary viewpoints, thus blurring implications of the historical ‘language’ of blacksmithing and sculpture (Kontturi 2014, p. 45).

One language barrier to overcome is the importance of scale. Iris Marion Young has argued that women use their bodies differently to men insofar as:

- a woman typically refrains from throwing her whole body into a motion, and rather concentrates motion in one part of the body alone while the rest of the body remains relatively immobile. Only a part

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9 A tool for burning holes into metal using an electric current.
of the body, that is, moves out toward a task while the rest remains rooted in immanence.

(Young 2005, p. 36).

This observation is visible in domestic spaces where women tend to family needs. Elizabeth Grosz’s (1994, p. 85) ideas match these observations, though she views women’s restricted access to wider spaces as the problem. Women are very capable of larger movements which is exemplified in the spaces occupied by dancers. The barriers, it seems, are largely due to social perceptions of gender.

### 3.3 Transformation in sculptural creativity

In my own research I shifted focus from my profession as a silversmith to a blacksmithing practice which enabled me to engage with larger work. I had repurposed steel cans left over from meal making using techniques found in silversmithing to transform an industrially made can into a delicate, steel vessel unfit for holding food. It is possible to turn the vessel upside down, or peer into its hollow, and can be seen in its entirety by moving the hands. It does not tax us physically as we do not need to move around it. While it is in the hand, we can feel that it is an extension of our body, like a hammer, though we cannot feel that we are a part of it.

The silversmith traditionally made vessels or utensils for the table or ceremonial use from silver or gold, although there were also a great deal of gilded copper and brass. Due to the preciousness of the materials used, and the time involved in their production, the objects made by the silversmith were owned by the rich
or powerful. By the middle ages the most powerful within European communities were the church or state. The church required the silversmith to provide reliquaries, candlesticks, chalices and alter pieces. Noble families commissioned articles such as table pieces, cutlery, and salt cellars - including the famous Benvenuto Cellini cellar made between 1540 and 1543 for Charles IX of France [fig. 26].

By the early 18th century silversmiths such as the American, Paul Revere Jr., created silver tea sets for the tea parties of the upper classes [fig. 27]. Most of the
objects made by the silversmith were vessels, designed to contain, though the more general intention of these pieces was to confer social status and prestige on their owners. Not everyone could drink tea at that time, let alone from their own silver tea pot.

Although these objects were impressive in their form, they were relatively small in relation to the human body. The question of scale is germane to both traditional blacksmithing and sculpture, just as it is in the silversmithing traditions that I am trained in. Objects forged by the silversmith were usually made and experienced while in the hand by their owners or admired from a short distance by guests. Their size added to the perception of preciousness that these objects contain within their form. We could imagine the owner of the object encountering the metallic surface, the shape of the form and the texture of the design embossed there. The holder would feel a certain possessiveness over the smaller object. We could then imagine the viewers’ encounter differently. Maybe they would admire the form, the texture and the shine of the metal while simultaneously feeling envious of the owner’s possession. Due to intimacy of scale, these imagined experiences of owner and viewer are conflicting and suggest a feeling of care for that object, yet separates them from having an empathetic rapport, or personal connection.

At the commencement of this research, my shift from silversmithing to blacksmithing was due to a desire to create sculpture that is closer in scale to the human body. Scale effects how we relate to a sculpture. If, like the Cellini saliera, the object is smaller than we are, our response to it differs from that of the Iron Pillar of Delhi. We treasure the small, are in awe of the large, and I suggest that we have more empathy with those that are similar to ourselves, whether or not it is figurative.
There is a degree of separation from the smaller object, like looking from a plane at land below. This can be explained through the Cellini salt cellar, or saliera, where the forms of Neptune and Tellus recline on top of a base decorated with images of the wind and periods of time. Beside each god is a dish and box for condiments. Though we can touch them or take salt or pepper from their dishes, due to their scale, they occupy a distinct space to our own.

Over the long tradition of blacksmithing, material value determined scale, for instance, the length of a knife or sword was forged in accordance with the space that was needed between attackers. A dagger would be appropriate for close contact fighting, while the length of a sword would keep an opponent at a greater distance.

The scale of objects created by the traditional blacksmith may shift from something as small and intimate as a door latch or key. By contrast it could be as large as steam ships as they were once riveted together by blacksmiths. Even now, industrial blacksmiths forge crank shafts for ships, with the assistance of a power hammer as they would weigh many tons. The Iron Pillar of Delhi is over seven metres high and was forge welded together at a time when iron was created in small billets and fire welded. It was made using similar processes required when making smaller objects, and yet was designed to stand out as a marker, to tower over those around it.

The 20th century painter, Mark Rothko recognised that larger works have a profound experiential effect on the maker as well as the viewer. He observed that, with smaller paintings we ‘look upon an experience as a stereopticon view with a reducing glass. However you paint the larger pictures, you are in it’ (Rothko, 1951, cited in Rothko 2006, p. 74). It is easy to imagine that the
blacksmiths who worked on the Iron Pillar of Delhi would have felt much the same, being with the tower as it grew.
Figure 28: Hackett, M. 2013, Steel *Can Study I* (Fragility and Preciousness), 2013, vessel, steel, approx. 130 x 8 mm, image: Marc Morel.
Scale: connection and the processes of drawing

To test the materiality of larger sculptures, I drew *Steel Can Study I (Fragility and Preciousness)* (2013) [fig. 28], onto my studio wall. The drawing extended the hand sized vessel, forged using silversmithing processes from the cans that I discussed earlier, to as large as my own body. In this way both the drawing and my body were equal in size. This was an important studio-based experiment, as I was hoping to compare how I related physically to the larger objects as opposed to the smaller vessel.

I drew *Steel Can Study I (Fragility and Preciousness)* several times, which was much quicker than starting a steel sculpture, to explore variations. At first, I worked charcoal and water with a paintbrush and my own hands onto the studio wall, following the form of the small vessel as I rolled it in my hand. Later, paint and charcoal were worked onto large sheets of paper taped to the studio walls. In this way, I physically negotiated the entire vessel by mapping it from both outside and in, interpreting the spaces, cracks and pleats.

This was a physically engaged process of studio-research as my body stretched and bent to adjust to the size of the drawings. The form of each drawing occupied the space as far as I could reach. Bending down caused my legs to ache, while the stretching could only be undertaken for short periods of time as it cut the circulation from my hands. Water dripped down my arm and onto my clothes and floor, while my hands and studio became coated in charcoal. In this way I physically immersed myself in the drawings and studio.

Creating these particular drawings was more physical than making the smaller vessel, and although they were drawings and not sculptures, the presence of each
one differed from the original object. As the wall drawings were equal in size to my own body they presented a profound corporeality. This corporeality was amplified in the drawings by the appearance of circular or spherical forms which made visible the actions of my circling arms. Drawings were integral in expanding the scale of my sculptural works.

Figure 29: Mary Hackett, 2013, *Scale Study 1*, Charcoal and conté, approx. 2200 x 1200 mm, image: Marc Morel.

Figure 30: Mary Hackett, 2013, *Scale Study 2*, Charcoal, approx. 2200 x 1000 mm, image: Marc Morel.

Figure 31: Mary Hackett, 2013, *Scale Study 3*, Charcoal, approx. 2200 x 1200 mm, image: Marc Morel.
Figure 32: Mary Hackett, 2013, *Scale Study* (studio walls), Charcoal and conté, image: Marc Morel.
Figure 33: Mary Hackett, 2013, *Scale Study 4*, Charcoal, conté and acrylic paint, approx. 3000 x 1500 mm, image: Marc Morel.

Figure 34: Mary Hackett, 2013, *Scale Study 5*, Charcoal and conté pastel, 2200 x 1200 mm, image: Marc Morel.
Figure 35: Mary Hackett, 2013, *Scale Study 6 (Rust)*, Charcoal and conté pastel, 2200 x 1200 mm, image: Marc Morel.

Figure 36: Mary Hackett, 2014, *Scale Study 7*, Charcoal and acrylic paint, approx. 2400 x 4300 mm, image: Marc Morel.

Figure 37: Curling sections of steel by hand, 2016, image: Arthorse.
Scale in blacksmithing and sculpture

I followed the drawings and observational experiments with blacksmithing larger pieces. When I silversmith small pieces, most of the physical activity engages the top half of the body. One arm holds and swings the hammer while the other steadies the object as it sits on the stake to be forged. This was discussed in my earlier research, Conduit: An exploration of the relationship between hand, metal, motion and form (Hackett 2011). The physical work of a silversmith not only relies on smaller movements, these movements are carried out within a smaller space. The effort of blacksmithing, on the other hand, shifts with the size of the work. For one project a small amount of effort is needed, for another there will be a great deal. Blacksmiths, for the most part ‘think hot’ (Keller & Keller 1996, pp. 53-55). This means that the majority of the work managed at the forge requires the steel to be yellow-hot. To maintain this heat the blacksmith will be constantly moving from forge to anvil in a series of heating and forging. Although the forge and the anvil are close in proximity, it still requires physical effort. For most projects, the blacksmith moves their entire body, constantly shifting from the fire to the anvil, first heating and then hammering. Due to the constant movement throughout space, the work of the blacksmith relates directly to their body.
Figure 38: Curling sections of steel by hand, 2016, image: Arthorse.
Putting into practice what I had experienced when drawing I begun to curl sections of steel rod by hand. I heated the rod beginning first in the middle until it was yellow-hot and, by a series of awkward manoeuvres, bent it. I continued heating and twisting the rod in increments until it was a series of spirals. To achieve this, I used my entire upper body and the floor to support the steel [figs 37, 38]. I found that I had to stretch and bend to accommodate the metal. The longer the piece the more awkward the smithing, and the amount of movement increased. Soon my entire body was twisting to accommodate the steel as it bent and curled with my movements.

These explorations revealed a reciprocal relationship between myself and the metal where the bending brought me closer to the movement of the steel, and it to me. The metal and myself moved together in a way that artist, Barbara Hepworth called a ‘dance’. Hepworth has solidified her response to the landscape in sculpture through the rhythmic movements of her dance [fig. 39]. She stated that: ‘[y]ou can’t make a sculpture, in my opinion, without involving your body. You move and you feel and you breathe and you touch’ (Hepworth quoted in Nemser 1975, p. 21).

For Hepworth there is a connection between her body and the landscape, where her sculpture acts as a link between the two, while she facilitates the creation of that link. Interestingly, Hepworth and Henry Moore saw their work as beyond scale as, when they made maquettes they were already viewing them as large. For them, there was a ‘privileging of the artist’s vision’ (Wells 2015, para. 9).

Scale, according to Rachel Wells, is the quantitative comparison of two similar objects such as a large or small shell. This is in opposition to the idea of size as the qualitative comparison between two disparate objects. The relational
comparison is explained by Wells in *Scale in Contemporary Sculpture: Enlargement, Miniaturisation and the Life-Size* (Wells 2015, pp. 6-10). With this theory Wells determines how Henry Moore was able to experience a maquette that he was working on as life size. Wells claims that Moore was able to envision the piece at life size and discusses how there was no distinction between size of a sculpture and its ability to be monumental.

In Moore’s sculptures there is a ‘privileging of the artist’s vision’ (Wells 2015, para. 5), and a denial of the influence that matter, and the experiences working with that matter, brings. It seems that it would not depend on what the sculpture was made from; it would say the same thing as if matter is not important in the making. It is comforting to note that, when Moore scaled up his work from plaster to polystyrene and then to bronze, the polystyrene did make its own mark in the bronze by retaining a sense of both the lightness and smoothness of the polystyrene model (Wells 2015, para. 16).
Creativity and the tool

I rarely used a hammer within the studio-based research, opting instead to focus on incidental blacksmithing processes such as the twisting discussed in the previous section, Scale in blacksmithing and sculpture [figs. 37, 38]. However, in early experiments I did explore the role that the hammer and anvil play within blacksmithing.

Thin sheets of reclaimed steel were repeatedly folded and forged until there were quite a few layers that partly fused together as they were forged. The folded steel created a material with the texture of hard filo pastry. Concurrently, I used a blacksmithing technique called upsetting [fig. 40], which thickens a section of the steel, usually an end. The part of the steel to be thickened was heated to yellow-hot while keeping the rest of the steel cooler through quenching. The steel was then pulled out of the fire and rammed down onto the anvil. I had become a hammer.

A blacksmith wields a hammer, a block of steel onto which a wooden handle is fitted, to forge steel that sits on an anvil, a steel block. The anvil counters the force of the downward hammer blow which squashes the metal through force and weight. These two tools are a link between ourselves and outside of ourselves; a way for us to manipulate things that our bodies are not capable of doing. Andrew Pickering states that the ‘machine … is the balance point, liminal between the human and nonhuman worlds and liminal, too, between the worlds of science, technology and society’ [Pickering 1995, p. 7]. I believe that Pickering would include the simple tool such as a hammer.

Figure 40: Body as Hammer, ‘Upsetting’ the end of the steel by heating it until it is yellow hot and hitting it onto the anvil which spreads that section of the steel. Image: Blacksmith Doris.
Figure 41: Hammers and stakes, 2016, image: Arthorse.
The hammers and anvils were used not just by our human ancestors, but also by other creatures such as fish, birds and mammals who adapted other materials as anvils and hammers to open hard shelled foods (Pasko 2010; Shumaker, Walkup & Beck 2011). The hammer and anvil are crucial technological adaptations that have effectively shaped civilisations and thus simultaneously influenced the human body including the coordination between hand, eye, and brain. The body has learned to accommodate the hammer in the hand, swinging the handle as a counter leaver.

For blacksmiths, the process of forging with a hammer on an anvil is synonymous with blacksmithing. The hammer and anvil impart a texture on the steel as an indicator of the force of the blow, the direct result of the force used by the blacksmith.

My time upsetting the steel reminded me of Robert Smithson’s contemplations on the irony in the circularity of the process of steel tools digging the dirt which made them (Smithson 1968, pp. 82-85). All tools created have similar beginnings. The matter constituting the tools both creates other things and are themselves co-creators.

As the hammer and anvil are symbolic of blacksmithing practice, however, they have reinforced the idea that the blacksmith as the only creator within the making process. By first shifting from the hammer and anvil, to upsetting, and finally, to twisting the metal by hand, I attempted to highlight the steel’s partnership

10 The English word for hammer derives from the Old Norse and means rock, which points back to the hammer’s origin.
11 Early human tools have been found dating back 3.3 million years (Hovers 2015).
12 The symbolic emblems for Hephaestus, the Greek god of both blacksmiths and sculptors were the hammer and anvil, as well as tongs.
within the creation of itself. The act of twisting the metal, which I have earlier
described as a dance, to some extent revealed this partnership, while the texture
on the completed metal itself, reinforces this collaboration as it shows the
movement of the steel.
Tools for framing

A series of photographic drawings were created to find a sculptural form that would depict the impact of dropping hot steel into water during the blacksmithing process of quenching. I found the sense of the weight and force from the gravity pulled the steel down into the water, which in turn, dispersed, creating waves and vessel forms [figs. 1, 49]. I wanted to capture these forms in a sculpture while simultaneously conveying the movement downwards.

I had observed a vessel form within the quenching process that had captured my attention as it revealed the movement downwards of the steel ball in the water. The turnip peel was chosen as it was able to stand in for steel within the photographs, being flexible enough to move but sturdy enough to create a form. The peel also helped to visualise a solid form of water which was not possible in the video, and fleeting in a quench.

I placed turnip peel in a support frame and photographed it as it fell [fig. 41]. I took a great deal of photographs that drew out different aspects of the effects of gravity on the spiral created by the peel. In the photographs, the turnip peel suggested both the vessel form of the water, while accentuating the movement downwards of the ball. This is discussed in Finding Form in the Dynamics (Hackett 2016a, p. 3). The process of taking a volume of photographs allowed a wider range of viewing aspects that drew out a variety of qualities which impacted on the sculptural output of the work. One such quality was that the peel would unfurl completely if held by a wooden or metal frame but would fall to the ground curling up completely if it slipped. It also helped me realise that blacksmiths view a quench from the top and not from the side as in the videos. The form would need to change according
Sculptors make use of certain techniques, and relevant tools, such as drawing and photography, for preliminary thinking, composition, or framing. Framing is essentially a tool for selecting and accentuating energies in order to connect them in new compositions with others. According to Elizabeth Grosz (2008 pp. 10-11), the sculptor, like other artists, frames forces and energies found in nature to draw attention to them while drawing in the viewer. Framing is a form of enticement, and a way of capturing the viewer’s attention and participation in the work.

Figure 42: Mary Hackett, 2014, *Quench no. 13*, digital image, black and white.
Figure 43: Mary Hackett, 2014, *Quench no. 78*, digital image, black and white.
Process

In this chapter I have argued that through creativity, regardless of type, we express our identity, measure ourselves in relation to things around us, and manipulate matter for our own purposes. Blacksmithing’s creative processes rely on skill and usefulness while sculpture, though traditionally linked to skill, depends on imagination as a process. We need to bear in mind that these processes are not mutually exclusive, for example sculpture was linked to skill, and without imagination blacksmiths could not possibly solve problems. Instead the difference is the weight given to each of these creative activities. Through my creative explorations it has been possible to transform conventional norms within blacksmithing practice. The following chapter turns from the use of materials as reflection of the human condition and focuses instead on explorations of matter interaction through the body of work within this research.
Chapter 4

Sculpting giving prominence to agencies in blacksmithing

Through the previous chapter it became apparent that creative practices, regardless of type, are a deeply human endeavour in which matter becomes a signifier of identity, a measurement of value, or the material means to satisfying human needs. In this chapter I describe and explain the sculptures and exhibitions that were undertaken in the studio-based research and then link it to concepts of democracy and Actor-Network Theory. It explores the proposal that creative processes could benefit significantly through the acknowledgement of the dynamic character of material processes for their own sake.

To begin exploring this notion, I draw attention to Barbara Bolt’s statement:

    Positivist scientific thinking has demanded observable, measurable and repeatable processes and methodologies; conceptualism has privileged the driving idea and Visual Culture, driven by a cultural studies agenda, has emphasised the social production and reception
of art over material production.

(Bolt 2006a, p. 13)

Conventional research paradigms do not always work well when applied to artistic practices as they tend to overlook the ways artistic knowledge is gained as artists focus on material agency. Conceptualism, or art that is theory driven, causes material agency to become a mere tool of creative practice rather than as subject matter with which artists engage. While conversely, the study of material agency has largely remained in the arena of science where energies and matter are quantified.

4.1 Finding forms in material agency

As an early example of scientific material studies, the natural philosopher, Robert Hooke (1635-1703) drew matter while looking at it through the new technology of the microscope. As a scientist of the early Enlightenment, Hooke undertook experiments on gravity, elasticity, and fire, and noticed reflections on the surface of iron sparks, of which he described as being globule. He formed a theory on combustion and wrote that: ‘air is the universal dissolvent of all sulphureous bodies, and that this dissolution is fire; this [is] done by a nitrous substance inherent and mixed with the air’ (Hooke cited in Turner 1956, p. 298). By 1679, Hooke had proven that combustion and inhalation were linked by demonstrating that a chemical reaction takes place in both. Hooke’s scientific curiosity and observations brought about new knowledge.

The physicist, Arthur Mason Worthington (1852-1916) first captured images of the
coronets and jets of splashing water droplets and devised ways of observing and capturing the forms with a camera. In his book, *A Study of Splashes*, he reflects on rain:

> There will be but few … in some heavy shower of rain, beguiled the tedium of enforced waiting by watching … the thousand little crystal fountains that start up from the surface of pool or river; noting now and then a surrounding coronet of lesser jets.

(Worthington 1908, p. 1)

His study was sparked by a desire, not only to understand, but to express his experience of a splash (Worthington 1908, pp. x, 8-14).

Hooke and Worthington carried out their scientific investigations using microscope or a camera as tools that allowed for viewing matter in a new way. In *The Mangle of Practice*, Andrew Pickering (1995) describes how scientists work with their subject matter, their tools, and equipment to seek answers. Scientists make observations and then decisions informed by knowledge gained from their own experience or from prior research. They apply what they know and wait for reactions and then readjust their experiments. Hooke’s and Worthington’s curiosity caused a pursuit of knowledge.

Science seeks finite and falsifiable truths through experimentation that can be used to successfully predict and measure the behaviour of materials where art ‘produces sensations, affects, intensities’ (Grosz 2008, p. 1). Within the act and presentation of art there is a desire to share the forces of nature, or ‘chaos’, although art tends to reflect our humanness through matter. The practical work within this research
explores material agencies used in blacksmithing neither for scientific truth, nor to reflect the human value of the craft, but to reveal the intensities of nature.

**Explorations of the qualities of steel**

While drawing to change the scale of my work, I simultaneously explored the energies and reactions that are noticeable during blacksmithing. A number of commercially bought steel spheres, scrap steel and fragments of oxidised steel caused by heating, called scale, were placed in situations that would create reactions. Some were left in brine, buried in dirt, or wrapped in clay to observe rusting. Rare earth magnets[^1] were dipped in the scale and an oxyacetylene torch[^2] was used to fuse, or melt, steel together and to burn holes [fig. 48]. Photographs were taken of hot steel being held in the hand [fig. 47], while other steel segments were buried in the heart of a blacksmith’s fire.

As expected, each rusting sphere aged differently. The one left in brine rusted to the colour of egg yolk [fig. 46]. The sphere buried in dirt was lightly rusted and the one wrapped in clay was hardly rusty at all. The magnets in scale became spiky balls of scale that swayed in waves as the magnets connected, regardless of the shape of the magnet [fig. 45].

[^1]: Rare earth magnets are permanently magnetised as they are made from alloys of rare earth elements.
[^2]: An oxyacetylene torch fuses or cuts metal. It uses two bottles, one filled with oxygen and the other acetylene gas.
Figure 46: Mary Hackett, 2013, steel scale and magnets.
Figure 47: Mary Hackett, 2013, Yolk, steel, salt water, ceramic.
When fusing and burning with the oxyacetylene torch, control of the heat was important. At first it was difficult to regulate the outcome and the forms produced were undisciplined. As time passed, the forms created were more determinable. Either way, the steel became brittle wherever the torch heated it. Obviously, holding hot steel in the hand while it was being photographed was extremely difficult. Kiln gloves did not buffer the heat and, to create the illusion of holding the sphere, a steel ring between glove and sphere was used briefly until the heat permeated the glove.

When burning the steel in the forge molten sparks poured from the fire and the iron mass that survived was burnt and blistered. Some, if left long enough, looked like metal sponge. Sometimes nothing remained from this process, although at other times, chunks of steel were dug out attached to clinkers.

During my experimentation, I contemplated the reactions that were produced. Fire is at once a destructive and creative force. It is impossible to connect with fire without undergoing some sense of change or transformation. Holding the hot sphere in the hand, for instance, was something that could be undertaken for only a few seconds. The steel, heated with the oxyacetylene torch, melted and solidified in hypnotic waves of liquid metal. Droplets of hot steel fell to the ground and solidified like splashes of raindrops. When intensely hot, the steel glowed from the inside like a meteor. The hotter that it became, the more translucent it was, like molten glass.

Clinkers are spent coke, a fuel consisting of impurities, mainly silicate.
Figure 48: Mary Hackett, 2013, sphere in fire resistant glove.

Figure 49: Fusing, 2016, image: Arthorse.
It is easy to consider steel as unyielding. Most of what steel has been subjected to is a commonplace observation. When cold and solid, steel returns to a seemingly impermeable, opaque and motionless state, my experiments with brine and magnets however demonstrate how this perception of the potential of steel is misguided. It is possible to penetrate steel, and for steel to move and shift, and my interactions with fire, rust and magnets were exciting. All of these experiments reminded me that steel was useful in blacksmithing because it interacts with other matter.

I then began to look more closely at quenching through a series of photographs and videos as it seemed to be the only way to capture that process [figs. 49] (Hackett 2015a; Hackett, Hackett & Hackett 2015). Up until that point I had not explored the quench as the activity is over in seconds and is hard to capture apart from through the lens of a video camera.

Industrially made stainless and mild steel, hand forged mild steel and tool steel spheres, along with other forms, were dropped into a glass tank filled with water or ice. Some of the objects were too small or light to register a reaction. The finest forms sunk to the bottom of the tank after a gentle fizzing sound at the top of the water level and slowly sinking while rocking from side to side as they fell.

When watching the videos it became apparent that the elusiveness of a quench, the speed with which it is carried out, and the lack of tangible evidence of it occurring, made it a compelling subject for this research. These studio-based experiments led me to ask how could I create sculpture that made tangible the material energies and agency of a quench.

Figure 50: Mary Hackett, 2013, *Quench 1*, stills.
Figure 51: Mary Hackett, 2013, *Sphere*, steel, image: Marc Morel.
Figure 52: Mary Hackett, 2013, spheroids, steel.
Figure 53: Mary Hackett, 2014, *Quench movement*,
image: Angus Hackett.
Figure 54: Quenched steel in ice, 2014.
Figure 55: Projected video, 2018, *Quench 3*, video: Angus Hackett.
Sculptural forms

Small Objects

From the quenching videos I drew and constructed small sculptural objects for the purpose of making larger steel sculptures that would capture forms evocative of a quench [figs 55, 56, 57, 58, 59]. As discussed in the last chapter, although these smaller sculptures captured the movement that I wished to convey, their scale meant that the viewer and myself are distanced from that movement. Once this problem became clear, I began to create larger sculptures. I will now turn to the principal sculptures from the Quench studies series as explanations of these impressions.
Figure 56: Mary Hackett, 2013, *Small sculptural study 1*, object, approx. 60x90x110mm; repurposed steel, image: Marc Morel.
Figure 57: Mary Hackett, 2013, Small sculptural study 2, object; approx. 80x80mm; repurposed steel, copper, vitreous enamel, enamel paint, image: Marc Morel.
Figure 58: Mary Hackett, 2013, *Small sculptural study 3*, object; approx. 80x100x120mm; repurposed steel, enamel paint, Marc Morel.

Figure 59: Mary Hackett, 2013, *Small sculptural study 3*, object; approx. 180x80x150 mm; repurposed steel, vitreous enamel, Marc Morel.
Figure 60: Mary Hackett, 2013, *Small sculptural study 3*, object; approx. 80x80mm; terracotta clay, image: Marc Morel.
Quench study (Splash)

*Quench study (Splash), 2017* [fig. 60] demonstrates the moment that the steel balls hit the surface of the water. The main section of the form is a sphere-like shape made from two woks. The splash configuration was formed from steel rods attached underneath the spheroid, twisted into shape and projected out from it. This work was developed through several iterations, during the period between 2014 and 2017, exploring the impact of gravity. Earlier versions (*Spin*) were placed on tables and pedestals, leant against and hung on walls, placed out doors and on gallery floors. With each new placement I added and subtracted steel sections, changing its configuration. The final form itself seems to defy gravity, lifting the weight above the ground while being held up at four points. It wobbles precariously and appears to be almost alive.
Figure 61: Mary Hackett, 2017, *Quench study (Splash 2)*, sculpture, dimensions varied, steel, image: Mark Ashkanasy

Figure 62: Mary Hackett, 2014, *Quench study (Spin 1)*, sculpture, steel, Material Perception II, First Site Gallery, Melbourne, image: Marc Morel.
Figure 63: Mary Hackett, 2014, *Quench study (Splash 1)*, sculpture, steel and table, Gossard Space, image: Marc Morel.
Figure 64: Mary Hackett, 2014, *Quench study (Spin 2)*, sculpture, steel and table, Gossard Space, image: Marc Morel.
Figure 65: Mary Hackett, 2014, *Quench study (Spin 3)*, sculpture, steel and table, Azimuth, image: Marc Morel.
Quench study (Pending)

*Quench study (Pending), 2017*, [fig. 65] is a representation of the moment just before the steel ball hits the bottom of the tank. The spheroid is made from two woks while the steel line attached is the imagined trajectory of the ball falling through the water. Again, this sculpture was developed through a series of physical changes and presentations as I sought a more dynamic resolution to the problem of suspension and weightlessness. This sculpture, which was begun in 2014, was formerly known as *Mars Descending* with metaphoric reference to comets falling from the sky, to Mars⁴ and to iron.

Figure 66: Mary Hackett, 2017, *Quench study (Pending)*, sculpture, approx. 1800x900x900mm, steel, gravel, image: Mark Ashkanasy.

Figure 67: Mary Hackett, 2014, *Quench study (Mars Descending)*, sculpture, steel, steel on table, Gossard Space, image: Marc Morel.

⁴Unintentionally, the name also suggested the fall of masculinity and, coincidentally, a novel, by Paul Kostininchi, Mars Descending, imagines a matriarchal history of the world (*Kostininchi 2013*). I had read the online article, *How Mars Got its Rust*, which had given me inspiration for the name (*Peplow 2004*).
Quench study (Drop)

Quench study (Drop), 2017, [fig. 68] also depicts the movement of a spheroid falling, then bouncing and rolling along the ground. At first it was a small sculpture created in 2014 and was reworked for Mars Descending, Artland, 2014, with a new length of steel. Later, a smaller sphere was added in place of Mars Descending. This sculpture, which is approximately 2000 mm tall and supported by a base, is meant for a public space rather than a gallery. Drop differs from the other sculptures in the series as it occupies more space, and is larger than the human body. This scale requires the viewer to enter the space dominated by the quench rather than occupying equal space. This causes a perceivable separation of sculpture and viewer rather than drawing them closer.

Figure 68: Mary Hackett, 2014, Quench study (Drop 1), sculpture, steel, steel on table, Gossard Space.

Figure 69: Mary Hackett, 2017, Quench study (Drop 2), sculpture, approx. 2000x100x4000mm, steel, gravel, image: Mark Ashkanasy
Quench study (Time)

*Quench study (Time), 2017, [fig. 69]* is the formation of a number of spheroids welded together which depicts the form of the movement of the steel ball through the water. Burn marks and holes in the spheroids could be reminders of the bubbles that marked the surface of the steel as it boiled away the water around it. They could also be the damage done to the surface of the spheres as they are dropped into the water continuously. The spheroids attached to each other track the movement of the steel ball through the water. The accumulated rust, which began before I had found these marks points to the steel’s natural transformation process. This sculpture refers not only to quenching itself, but also to the specific materiality of the steel in my studio-led research, and to entropy.

Figure 70: Mary Hackett, 2017, *Quench study (Time)*, sculpture, approx. 1500x800x600, steel, image: Mark Ashkanasy
Quench study (Hearth)

Finally, *Quench study (Hearth), 2017*, [figs. 70] [71] shows the steel ball at rest at the bottom of the tank, although the burn holes point to the fire that was used to heat, not only the ball that it depicts, but also the sculpture itself. Sitting on scale on the floor, it gives the impression of a hearth fire, especially in the rust forming on the outside. It is fragile, and has an ephemeral appearance, again, like fire. When the viewer walks around it there is a suggestion of a rhythmic flickering of the steel which also reflects the flames of a fire. This sculpture was developed over the period of time between 2015 and 2019. It was left to rust in outside.
Figure 71: Mary Hackett, 2017, *Quench study (Hearth)*, sculpture, steel, image: Mark Ashkanasy.
Figure 72: Mary Hackett, 2017, *Quench study (Hearth)*, sculpture, approx. 400 x 700mm, steel, image: Mark Ashkanasy.
The exhibitions: their role in forming and changing the sculptures

Unmaking, Making

Unmaking, Making, 2013, at the Artist Run Initiative, D 11 [fig. 72] was an exhibition of possibilities, exploring ways of reevaluating my established practice, as a silversmith making small objects, and turning instead to blacksmithing. I exhibited large drawings, small objects and a video, focusing on the blacksmithing process of quenching, although I also exhibited a magnetic and wire sculptural work. The exhibition surveyed the beginnings of my explorations on iron’s reactions to the energies and forces around it.

According to Renée Ugazio, I lie ‘in wait for the inimitable moments where Iron in process reveals itself, offering a glimmer of its mysteries’ (Ugazio 2013). At that time, I was testing the relevance of scale within the work with the sculptural pieces as small objects and the larger scaled works as drawings. Ugazio goes on to say that the work:

strings worlds together held with the same tension as our own, existing at the same time as infinitely small and overwhelmingly epic. Scale indeed invites us into the evolving devolving translation of material and surface through drawing and painting, rendering this echo through media. This bids us closer to this moment of change. Each work articulating qualities that collectively convey this material.

(Ugazio 2013)
Figure 73: Mary Hackett & Nick Hackett, 2013, *Unmaking, Making*, D 11, Melbourne, image: Marc Morel.
Figure 74: *Close to Hand II*, 2013, First Site Gallery, Melbourne, detail of installation, image: Rushdi Anwar.
Close to Hand

*Close to Hand*, 2013, [fig. 73] at First Site Gallery was a group exhibition exploring how makers can work with what is around them. My contribution was an image of a quench and a collection of small sculptures made from discarded kitchen utensils. The image was an early photograph of a steel sphere at the bottom of a tank of water.

The sculptures were impressions of a quench. I had forged steel cans and cheese graters and configured them in varies positions specific to how the steel ball would enter the water. They were small three-dimensional drawings of the quench, as reflections on the transformative material processes I had witnessed, which gave the impression of something that appeared to be drowning. Being small, there was a sense that the sculptures were distanced from the viewer.
Material Perception

My contribution to the group exhibition, *Material Perception I*, [fig. 74] 2014, at D11, focused on a series of photographs that I had taken of turnip peels. The photographs, which together were called *Gravity Wins*, were like a dispute between myself, the materials and gravity. I became obsessed with trying to photograph the peel in mid-flight and, within the photographic installation, I shared the search for the ideal form of the influence of gravity on an object with the viewer.

I separated the photographic series into distinct groups according to the ideas that I had when trying to recreate what I had noticed about quenching when photographing them. This moment was to be a form that would communicate the movement of the quench.

I used every photograph regardless of its quality which allowed each photograph to participate in the quest. This was in keeping with Barbara Bolt’s performative research. As I explained in my artist’s statement, I was ‘searching for the moment in-between the maker’s intention and the material’s reaction within the processes of creation’ (Hackett cited in [Carolan 2014] para 4). The series showed my explorations in representing movement in photography to my satisfaction. These photographs became the beginnings of the *Quench series* studies.
Figure 75: Material Perception I, 2014, D11, Melbourne, detail of installation.
Material Perception II

In a subsequent exhibition in 2014 at First Site Gallery *Material Perception II* [fig. 75], I exhibited three sculptural pieces demonstrating the evolution of my own responses to the studio-based research processes. *Splash*, [fig. 78] was the first that I had created. It had elements of blacksmithing, such as a jig for creating curves and a repurposed curl, attached to a spheroid, and was suggestive of the sphere within the videos entering the water. The second work, *Gyre* [fig. 76], was a metal vortex lying on its side depicting the swirling water around the sphere as it cut through the water, and consisted of spiralling steel rod with a steel ball inside what should have been its lowest point. The last, *Spin* [fig. 77], was a steel spheroid with protruding rods was intended to represent the ball as it hit the water. This piece fell apart as it was being installed and so was not presented as I had intended it to be. Within this piece, the agency of the steel contributed more than I had expected to the exhibition.

The sculptures within this exhibition were the first of the large sculptural works. Ugazio observed: ‘Mary suspends matter in a moment of time. Through her practice she examines the energy produced by process, capturing and describing that instant between renewal and decay’ (Ugazio 2014).
Figure 76: *Material Perception II*, 2014, First Site Gallery, Melbourne, detail of installation, image: Alan Weedon.
Figure 77: Material Perception II, 2014, First Site Gallery, Melbourne, detail of installation, image: Alan Weedon.
Figure 78: Material Perception II, 2014, First Site Gallery, Melbourne, detail of installation, image: Alan Weedon.
Figure 79: *Material Perception II*, 2014, First Site Gallery, Melbourne, detail of installation, image: Alan Weedon.
Artland

*Mars Descending* [fig. 79] was exhibited in the site-specific, group exhibition, *Artland*, RMIT, Brunswick campus, 2014 as part of the Melbourne Fringe Festival 2014. I was allocated an outdoor space by the curatorial team of RMIT Link Arts & Culture. There was a possibility that my planned sculpture would be unnoticeable as the space was off to the side and dark. The sculpture, too, was dark and no larger than the human body so I added a larger section which became the beginnings of a separate sculpture.

Figure 80: *Artland*, 2014, RMIT, Brunswick, detail of exhibition (*Mars Descending*), technical assistance: Nick Hackett.

A long steel post was forged on a power hammer which, while effective because it was less time-consuming, nonetheless changed the aesthetic of the piece as it was
more uniform in texture and shape. This section was attached to a plate, pegged into the soil at the site while the old section was placed close to the footpath to make it more visible.

My artist statement read:

*Mars Descending* implies motion. It could be the motion of any round object - small or large - that has been hurtling through space. Right now it is a planetoid or meteorite, a fireball spiralling out of control and falling to earth. The material that has been used to make it is steel, hard and actual. Made with force and forge it drew blood from me, bruised me and strained my muscles as I struggled to manipulate it. However, it could also be a drawing in charcoal, a gesture of movement from something completely different (Hackett 2014a)

The line dropping down from the sky suggested that this sculpture wavered between solid, three dimensionality and a two-dimensional drawing. As a public art piece, it was considered successful and won a special commendation for the Artland Award, 2014. However, the space that it occupied meant that people were less likely to interact with it physically. This was a problem because it meant that the object was not enticing the viewer to react with it as an equal rather than being just a visual art piece.
The Art of Research V: Experience, Materiality, Articulation

A further exhibition accompanied my conference paper, *Gravity Wins*, at *The Art of Research V: Experience, Materiality, Articulation*, at Aalto University in Helsinki [figs. 80, 81]. *Gravity Wins* discussed the art-based research on quench processes (Hackett 2014b). The accompanying exhibition included photographs of quenching, a photograph on gravity, *Gravity Wins*, a small sculpture and a photograph of the sculpture being worn.⁵

⁵This piece was made for an online exhibition, *San Título*, for a collaboration between the Mexican jewellery collective, San Título, and the jewellery collective, Part B. I had an idea that the viewer could be brought closer to the action of a quench, to be inside the quench. In *Keep the Ball Rolling* I was thinking through the idea that humanity is linked explicitly with nature, that we are not separate from it. The line of the water falling into the water and the form of the water wave is traced around the neck. With this piece I wanted to know what it would mean to be a jeweller in the future, and what should we make with seeing though there is now already too many things in the world (Sin Título 2014).
Figure 81: *The Art of Research V: Experience, Materiality, Articulation*, Aalto University, 2014, Helsinki, detail of installation, image: Nick Hackett.

Figure 82: *The Art of Research V: Experience, Materiality, Articulation*, 2014, at Aalto University, Helsinki, detail of installation, image: Nick Hackett.

Figure 83: *Gravity Wins, at The Art of Research V: Experience, Materiality, Articulation*, Aalto University, 2014, Helsinki, image: Nick Hackett.
The conference was beneficial as people commented on the sublime nature of the quench as I had presented it in the paper and video. One particularly useful comment revealed a correlation between my image of gravity and Gregory Bateson’s metalogues in which he discusses gravity with his daughter:

Daughter: All right—but then what does explain gravity?
Father: Nothing, my dear, because gravity is an explanatory principle.

... 
Daughter: But didn’t he (Sir Isaac Newton) discover gravity? With the apple?
Father: No, dear. He invented it.

... 
Daughter: And gravity?
Father: Is a label for what gravity is supposed to do. It’s not an explanation of how it does it.

(Bateson 1987, pp. 48-9, 50)

I realised upon reading this dialogue that I was constructing sculptures of the movement downwards that was occurring in the quench, rather than the abstract concept of gravity.
Azimuth

In the jewellery exhibition *Azimuth*, 2014 at RMIT Gallery, building 2, I included a work I had named at the time as *Spin* [figs. 83, 64]. This body-sized sculpture presented among jewellery, was rusting, shedding its skin, so to speak, throughout the duration of the exhibition. I placed it leaning up against the wall in one of the corners of the room of the gallery. As the work was of a similar size to the viewer it was in sharp contrast to the other exhibits which were placed on shelves or hanging from the ceiling at chest height. It confirmed my ideas in regard to scale and the differences between the small object and larger sculpture and how they are treated as discussed in Chapter 3.
4.1. FINDING FORMS IN MATERIAL AGENCY

Figure 84: Azimuth, 2014, RMIT Gallery, building 2, detail of installation, image: Marc Morel.
Raw Coercion

*Raw Coercion*, a collaborative exhibit by Nick Hackett and myself, was held in 2015, in the window boxes of PS50 to dissect the craft of blacksmithing. It acknowledged that blacksmithing is a craft undertaken to make practical objects while pointing to the primeval allure of its related energies.

The window boxes were conducive to narrative so each box assigned to me became part of the story of a blacksmithing quench. I placed a video of a quench, including an image of a steel ball in the fire, a photograph of the quench, a video still of the splash and the steel ball itself [fig. 84]. I also projected the video up against the building directly opposite to the window boxes of PS50.

Our opening words for the exhibition catalogue were: ‘[w]hen a blacksmith builds a forge fire they heap the fuel high. This is done to raise the heat of the fire. The steel is driven into that heart’ (Hackett & Hackett 2015). At that time, I regarded this work to be a representation of an almost alchemic process of transformation. I wrote in my artist’s statement on my work within *Raw Coercion* that it represented an obsessive focus ‘on the process of quenching, the cooling of steel to harden.’ I planned that the work would draw the viewer closer ‘to the sublime magic of a quench by isolating and scrutinising that moment. However, true comprehension seems just out of reach’ (Hackett & Hackett 2015).

Figure 85: Mary Hackett & Nick Hackett, 2015, *Raw Coercion*, PS50, building 52, RMIT, Melbourne, detail of installation, image: Marc Morel.
Gossard Space

For a trial setup at the Gossard Space at RMIT [fig. 85] I tested how the work fitted together as a whole. The sculptures that I chose to set up were *Drop*, and the works previously known as *Spin, Mars Descending* and *Vapour*, as well as *Time* and *Hearth*.

Some of these pieces have undergone further change in their physical appearance partly as changes that I am responsible for, and partly due to time. A few of the sculptures were placed on granite gravel to distinguish their space without separating the viewer from the work. This is done to indicate the processes that they underwent when becoming sculptures, and as a reminder of the scale that falls from hot steel as it enters the water. At this point in my research it became clear to me that my investigation was shifting away from the formalist emphases of my earlier sculptures towards a deeper investigation of materialism. A new focus was particularly noticeable in a work which was called Vapour at the time.
Figure 86: Gossard Space set-up, 2017, RMIT, building 49, RMIT.
The entire *Quench Study* series and exhibitions became tools to think with. In a way, these works were like exploratory drawings in space. Varying placements and additions of steel sections to each sculpture were designed to offer something more formally tangible to the viewer and helped to clarify my ideas. The works strengthened my view that the sculptures referenced, not only gravity, but notions of the connectedness of elements and energies within quenching.

In some earlier sculptures, I had included traditional blacksmithing motifs, while in others I had built frames to support the quenching form. While stylised curls represented the waves of the quench, and softened their sense of movement, the supporting frames tended to weaken the visual weight of gravity I was aiming to convey. Even in the later sculptures, it became apparent that gravity was not articulated as strongly as I had hoped. In part this was due to how gravity is an abstract idea and not a phenomenological recreation of what occurs when something is falling. The divide between the viewer’s perception of blacksmithing and the more familiar field of sculpture was wider than I had anticipated.

**Concept over matter**

Matter automatically summons idiosyncratic ideas and emotions from the observer. As discussed in the last chapter, the word ‘steel’ for example, might evoke mental images of strength such as those of city girders. I remember walking through a city ravaged by earthquakes and witnessing twisted re-enforced steel (rebar) and thinking that mangled metal was due to the power of the earthquake [fig. 86]. In reality the twists occurred after the earthquake by
workers who bent the metal to protect people from impaling themselves when climbing on the destroyed buildings. Associations are accrued through cultural history and personal experience and sometimes can be misplaced.

Figure 87: Twisted reinforcement steel (rebar), Christchurch, New Zealand, 2014.

In *Material Thinking*, Paul Carter observed that ‘[c]reative research deals in matter that signifies. It is a discourse of material signs …Matter ceases to be solid’. He objectifies matter here, rendering it almost invisible as it is laden with anthropocentric meaning. Carter’s notion of materials, as the ‘third partner’ in the making collaboration, grants materials agency, as a sort of glue that holds ideas together (Carter 2004, p. 182). His views are indicative of a conceptual approach to materiality.

This anthropomorphism also seems to be evident in Jane Bennett’s emotional response to objects that she had spotted on the street:
One large men’s black plastic work glove
one dense mat of oak pollen
one unblemished dead rat
one white plastic bottle cap
one smooth stick of wood.

(Bennett[2010] p. 4)

This particular pile of objects resonated with Bennett in her imagined links to time, memories and historical associations that work in much the same way as metaphors. Bennett explains how the rat repulsed her and how she felt disgusted with the stupidity of dumped rubbish, nevertheless, the objects provided awareness of the things themselves separately and together. On the other hand, when the sun touched the objects, they became beautiful to her and the horror of the rat, shock of the rubbish, the promise of the pollen intermingled with a realisation of the vital power of things.

It was, in short, the material state of the objects that fascinated Bennett. The rat would have begun to decompose and, along with that decomposition, other creatures would be active on its body. The presence of the plastic glove and bottle top would be evident long after our own body has turned to dust. Taken together, and without the facilitation of an artist, these objects reflected that energy and agency. In this view, material things already have agency, and the artist becomes a facilitator rather than being in control.

It could be argued that the experience of art is something that occurs from within the mind and has nothing to do with materiality. And yet bodily sensation in the
perceptual experience of art, is material agency in action. The matter around us, as well as within ourselves, influences us physically as well as having the potential to shift our perceptions or feelings. Human desire and pleasure are experienced through the affective interactions that occur between different forms of matter.

Through the Quench study sculptures, I searched for forms that represented the quench. They are stylised and formalist and, as such, still maintain a human-centric view of matter as they are my impressions of a quench. It had become apparent that a form was an inadequate representation of movement. In Space, Time and Deity the philosopher Samuel Alexander stated that ‘[m]otion is not a succession of point-instants, but rather a point-instant is the limiting case of a motion’ (Alexander [1920] p. 321). Although I persisted with the earlier, more formalist sculptures, in 2015 I began searching for ways for the elements involved to present an actual quench.

In the quenching videos series, the bubbles that cover the sphere are evidence of the water reacting to the heat [fig. 124]. When hot steel is plunged into cold water, the steam is caught around the steel, forming an air pocket of vaporised water, visible as bubbles that cover the sphere. In Finding Form in the Dynamics of a Quench, I discuss that though the blacksmith only views the quench from above the surface of the water, they are fully aware of the consequence of this happening:

Blacksmiths call this ‘steam jacketing’ … in larger workshops, using bigger pieces of steel, there are machines that agitate the water as the large steel chunks are enveloped in boiling water, and the agitation helps to break up that encasement.

[Hackett 2016a p. 9]
I had witnessed a similar situation in the kitchen when preparing to cook on the stove. If a little water is dropped into a hot pan it balls up and rolls around the pan before disappearing. It also occurs when pouring water onto hot steel that is sitting in the forge. Where the steel is the hottest, tiny droplets of water break away from the main body and roll across the surface of the steel.

One day I spent a great deal of time at the forge heating and quenching steel with a ladle while I observed how the water reacted to the heat. At times droplets danced along the edge of the steel and, at others, the water rolled back onto itself like waves at the beach.

At home I dripped water droplets into a pan on a gas stove and began recording the outcomes. The droplets moved around the pan, sometimes taking on unusual forms ranging from pulsating heart to star shapes [fig. 87]. I tried to capture the pulsing, and shape shifting by using slow motion video but it was difficult to see the changes occurring from one form to another (Hackett 2019).

The connections between water, heat and steel could be seen in the movements of this drop of water on the hot pan. The first droplet becomes trapped under a second one and remains suspended for a period of time without transitioning from liquid to steam. A vapour layer is created and captured by the water above it. The remaining drop balls up and appears to levitate over the hot vessel and propels itself around the pan using an internal rotation action that works like a wheel. If the conditions are right, it can continue to do so for minutes. This occurs at boiling temperature and is the transition of water to vapour suspended for a short period of time, and is known as the Leidenfrost effect, or film boiling [figs 87].

For an explanation of the process (Bouillant et al. 2018).
Figure 88: Mary Hackett, 2014, Leidenfrost droplets.
The Leidenfrost effect is of minor importance in blacksmithing. Moments such as the sound and force of the hammer on steel and the steel glowing in the fire are more consequential as they are loud indicators of blacksmithing. However, the water and the tiny, insignificance of the quench drew me precisely because it was not what is thought of when blacksmithing. The Leidenfrost effect is even more tiny and irrelevant as, although it is a sign that the steel is hot it is not used as a gauge. It is a superfluous, although natural consequence, of a quench.

**Fountain: Dance of the water droplet**

In 2015, an apparatus was built to accommodate the Leidenfrost effect, *Fountain: Dance of the water droplet (2015)* [fig. 2]. Water drips at regular intervals from a forged pipette attached to the glass jar that it protrudes from, into a funnel, also forged, and along a spiral [figs. 88, 89]. The steel spiral, which is welded to the funnel, decreases in size and ends millimetres from a steel dish that is heated by a hot plate that sits at the bottom of the apparatus [figs. 90]. The water drips into the steel dish which is heated at a continuous temperature to form the water bead that propels itself in a rhythmic motion across the dish [fig. 91].

When exhibited in *Momentary Force*, held at the Artist Run Initiative, WOT Studios, [fig. 93] viewers stood watching as the water traveled down the spiral and landed and danced in the dish. They stayed for long periods of time, some crouching, anticipating the moment when the droplet would fall onto the hot plate. It was placed in a small room with a video recording of the Leidenfrost

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7 For the bead of water to dance well, it is essential that the steel dish is rust free.
8 At that time, *Fountain: Dance of the water droplet* was titled *Yapour* to highlight the transformation that is undergone when heated. The name was changed to reflect the activity that was visible.
effect projected on to a wall. The intention was to have amplified or recorded sound from the noise that was made when water hit the hot plate. Technical difficulties and the problem of recording people moving around the sculpture prevented this from occurring and, in hindsight, it did help to encourage people to bend down to listen and watch. Having the viewer close to the work, even moving to accommodate it, meant that the water droplet itself was the focus.

The changes that this sculpture underwent during its creation partly defined its capacity for usefulness. For example, in earlier versions a plastic tub was used to hold the water with a tap attached [fig. 95], and then in *Momentary Force* a garden dripper was used for the water [figs. 93, 94]. Neither solutions worked well as the amount of water dispensed was difficult to regulate and, aesthetically, these objects were awkward thus disturbing the visual line of movement down to the dish. The form and its attachments were designed to draw the eye to the Leidenfrost effect.

Sculptural practice is a network of artistic and material agencies drawn together from diverse fields. My earlier thoughts were to make sculptures in steel that represented the splash of a quench to show gravity. However, the results were poor copies of what actually took place. Earlier attempts that I made to capture the form of the energy within the quench failed to produce anything more than an idea of that energy.
Figure 89: Mary Hackett, 2017, *Fountain: Dance of the water droplet*, sculpture, detail, image: Mark Ashkanasy.

Figure 90: Mary Hackett, 2017, *Fountain: Dance of the water droplet*, sculpture, detail, image: Mark Ashkanasy.
Figure 91: Mary Hackett, 2017, *Fountain: Dance of the water droplet*, sculpture, detail, image: Mark Ashkanasy.

Figure 92 & 93: Mary Hackett, 2015, *Fountain: Dance of the water droplet*, sculpture, detail, image: Mark Ashkanasy.
Levi Bryant states that there has always been a struggle thinking in terms of materiality because as soon as we do it eludes us as a thought. What he suggests is that:

the concept of matter must necessarily remain underdefined, such that the materialist must necessarily become comfortable working with what I call “anomalous concepts”. At most we can say that materialism is the thesis that being is essentially composed of physical stuff. What that stuff might be - indivisible atoms in a variety of shapes, energy, something else besides - remains open

(Bryant 2011, para. 1)

Once we start to form ideas about materiality we are positioning them as simulacrum of what materiality truly is. Form created from ideas of materiality are a reduction of that materiality which undermines its principles of vital materiality. This type of form is also a weak copy of the vitality that is inherent in the coming together of things.

Figure 94: Momentary Force, 2015, WATT Studios, technical assistance: Nick Hackett, image: Matto CLucas.

Figure 95: Momentary Force, 2015, detail of Vapour with dripper, technical assistance: Nick Hackett, image: Matto C Lucas.

Figure 96: Mary Hackett, 2015, test for Vapour, mild steel, stainless steel, water, rubber, plastic, electric hot plate, electrical cord, 1500 mm x 1000 mm x 2500 mm.
The very energies of blacksmithing processes are held within *Fountain: Dance of the water droplet* and yet it bears no real resemblance to an impression of the act of blacksmithing. The sculpture allows fire, steel and water, myself, and all entities involved in blacksmithing to connect and react, including gravity, time and the vaporisation of the Leidenfrost effect. The sculpture embodies the essence of a democratic practice.

### 4.2 Material connections

*Fountain: Dance of the water droplet* can be seen as a democratic sculpture as the energies of blacksmithing come together for a length of time as a form of social interaction. Gilles Deleuze and Felix Guattari’s notion of ‘assemblages’ or collections of unrelated matter responding to each other is also analogous to the notion of a democracy of things.

> [W]hat metal and metallurgy bring to light is a life proper to matter, a vital state of matter as such, a material vitalism that doubtless exists everywhere but is ordinarily hidden or covered, rendered unrecognizable.

*(Deleuze & Guattari* [2013], p. 479)*

Jane Bennett, Deleuze and Guattari all see collections of things as energetic, or living, as does Elizabeth Grosz. Yet, in general, human creativity is focused on metal as a material that benefits the user, and people predominantly treat materiality as the ‘other’ to the human. Grosz observes that, for the most part, materiality is something ‘against which we measured ourselves and our limits,
the mirror of what we are not’ (Grosz 2005, p. 131). It is the ‘other’ that we appear to need to master, rendering matter mute and passive. This is also suggested by Martin Heidegger when discussing humanity’s relationship with technology (Heidegger 1977, pp. 4-5). Both Heidegger and Grosz see that matter’s role is reduced to its usefulness to humans, as we gain command or sovereignty over it. ‘Material’ stabilises the thing it refers to, solidifying it and reducing it to an object. Materiality, though, is also meant to be ‘what we make of the world’ a flux of things becoming and unbecoming. In human/nonhuman assemblages there is a ‘[v]ital impulse’ that is ‘laden with all of the singularities and traits of expression’ (Deleuze & Guattari 2013, p. 474).

**Things in a democracy**

The thing has a history: it is not simply a passive inertia against which we measure our own activity. It has a “life” of its own, characteristics of its own, which we must incorporate into our activities in order to be effective, rather than simply understand, regulate, and neutralize from the outside.

(Grosz 2001, p. 169)

Bruno Latour (2005b, p. 13) also discusses the word ‘thing’ as ‘a certain type of archaic assembly’ (Latour 2005b). The Encarta World English Dictionary (1999, p. 1940), states that the English word ‘thing’ is derived from ‘time’ through the Gothic word ‘theihs’. In prehistoric Gothic the word was applied to ‘an assembly of people meeting to discuss the politics of the time’ whereas the word ‘democracy’, itself is Greek, from *démokratía*, or the ‘rule of the people’
CHAPTER 4. SCULPTING GIVING PROMINENCE TO AGENCIES IN BLACKSMITHING

(Encarta World English Dictionary, 1999, p. 504). The word ‘democracy’ combines the elements dêmos meaning ”people” and krátos meaning ”force” or ”power”, and thus means literally ”people power”. The problem, then, in using ‘democracy’ as a means to explain a joint relationship between maker, matter and the viewer is that the original meaning of the word was in regard to people only. As with the word ‘thing’, there is no reason why it should remain so.

‘Thing’ has shifted over time from representing people to mean an object with no specific name. ‘Democracy’, too, has changed from what the creator of 6th century Athenian democracy, Cleisthenes, believed it to be. Cleisthenes’s assembly, which was used to decide on the laws of Athens, was for free men only, it excluded women and slaves (Kyrtatas 1994). In a contemporary democracy, all people are eligible to vote and complex systems of counting those votes have been devised.

The problem with the word democracy as a means to explain a joint relationship between maker, matter and the viewer is that the origin of its means was people ruling. As with other words, there is no reason why it should remain so. It has been used to describe the assembly of all kinds of matter before: ‘In respect of being or reality all existences are on an equal footing. They vary in eminence; as in a democracy’ (Alexander 1920, p. 6) and ‘What would a truly democratic encounter between truly equal beings look like, what would it be - can we even imagine it?’ (Morton 2010, p. 7).

It is only recently that women have been allowed to vote in modern democracies. New Zealand was the first country to allow this to happen in 1893, while Vatican City still does not allow women a vote. America’s freed slaves were granted citizenship in 1868, although voting rights were only truly given to African Americans in 1965. Meanwhile in Australia, the First Nation People were not
given the right to vote until 1962 (Macdonald 2009, p. 14; Newell 2016; Hadebe 2016; Attwood & Markus 2007, p. 4). Democracy amongst human beings is a loose concept.

Though not quite voting rights, there is a movement that advocates for the right of personhood for Hominidae, the Great Ape. Advocates for this action include Jane Goodall, Peter Singer, Paola Cavalieri, and Steven Wise, president of the Nonhuman Rights Project, and Richard Dawkins, among others. This movement has seen captive apes given the status of a person in places such as the Balearic Islands, while India gave the dolphin personhood in 2014 (Cavalieri 2015; Fitzgerald 2015).

In 2014 Te Urewera, a national park in New Zealand, a river in Whanganui on New Zealand’s North Island, and then Mount Taranaki were all granted the status of human beings. Māori tribes fought for the right of each geographical site to be recognised as ancestors. Granting these land masses legal personality acknowledges that an ancestor cannot be owned and that humanity is part of the natural world rather than as a master. The minister for the treaty of Waitangi negotiations in New Zealand, Chris Finlayson, states that: ‘Te Awa Tupua will have its own legal identity with all the corresponding rights, duties and liabilities of a legal person’ (Sanders 2018; Roy 2017a, para. 7; Roy 2017b, para. 1).

These current historical changes draw on similar ideas to those in Jane Bennett’s discussion of what makes a life. Animals and rivers given ‘person’ status in modern thought is a gap that has been narrowing since Charles Darwin began questioning why fossils existed and contemplated natural selection.

Whereas, Elizabeth Grosz’s fluidity of connecting and disconnecting things of matter best describes the ideas of materiality that I ascribe to, ‘democracy’, is the
situation that occurs as these things come together. When we make, we meet together with the matter that we have chosen to discuss the politics of the time. This is an egalitarian model that implies collective processes should take into account the behaviours and needs of all parties involved to create the ‘poetry’ that Martin Heidegger considers to be the essence of art (Heidegger, Young & Haynes 2002, p. 44).

**Actor-Network Theory**

For Bruno Latour, Actor-Network Theory makes it possible to study the social behaviours imbedded within material culture such as sculptural practice. It does not distinguish between sentient and non-sentient actors, or actants, but is an ‘object-oriented democracy’ or a ‘parliament of things’ (Latour 2005b, p. 9; Simons 2017, p. 1-3, 10, 13-15).

Within Actor-Network Theory, material culture is defined through mapping and cannot be divided and observed in isolation of other things within that material culture. The entire culture cannot be divided, neither can the language of that culture be changed when describing it, although it is possible to connect it to other material cultural systems as nothing is neutral. It is also possible to explore it at a micro or macro level (Simons 2017, p. 6; Latour 2005a, p. 266).

For sculptural practice this would mean, as Latour states:

we don’t assemble because we agree, look alike, feel good, are socially compatible or wish to fuse together but because we are brought by divisive matters of concern into some neutral, isolated

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9 The word actant nullifies hierarchy by describing all parts of a social network.
place in order to come to some sort of provisional makeshift (dis)agreement.

(Latour 2005b, p. 13)

Material culture is a network of agencies. These agencies come together for a period of time, only to disperse.

Dance

Fountain: Dance of the water droplet is a sculptural ‘thing’ in which the energies and matter that are generally seen in blacksmithing such as fire, water, steel and gravity are brought together for a short period of time. During this time all involved react in the manner that Latour describes, working with and against each other. The physical outcome of this reaction is what can be viewed as a dance. Elizabeth Grosz extends this premise by stating that art ‘enables the emergence of pure sensory qualities, the data or material of art’. She goes on to say that:

This roots art not in the creativity of mankind but rather in a superfluousness of nature, in the capacity of the earth to render the sensory superabundant, in the bird’s courtship song and dance, or in the field of lilies swaying in the breeze under a blue sky

(Grosz 2008, p. 10)

In Grosz’s view art is primordial. Art stems from a desire to, not so much make sense of, but to respond to the world’s sensuousness through sensory perception. As excess, it is not preoccupied by survival but by energies.
Sculpture conveys effects and energies that artists draw out from their experiences of the world around them. Grosz (2008, p. 81) gives the example of a painter who paints to make the invisible visible. It would follow, therefore, that sculpture makes tangible that which is not. Sculpture is a way of framing energies within a space to relay the intensity of what Grosz calls the excesses or the forces of the world. These excesses are those things that happen as reactions between things and these reactions are what the artist responds to.

A dance is a rhythmic and social act and is a response to stimulus. The word ‘dance’ has been used as an analogy for the interactions between human and non-human entities by sociologist Andrew Pickering. Pickering references a ‘dance’ when discussing how matter reacts as it connects in a series of ‘resistance and accommodation’ actions instigated by either humans or other matter (Pickering 1995, p. 22; 2013).

In much the same way as Barbara Hepworth describes how she creates sculpture, artist and theorist Simon O’Sullivan states that we ‘are involved in a dance with art, a dance in which, through careful manoeuvres …the aesthetic is activated and art does what is its chief modus operandi’ (O’Sullivan 2006, p. 50). A dance is, to some extent, giving and taking, much like in a democracy, of all involved in the creative act, whether that act is within the disciplines of science or art.

Courtship dances are undertaken by a great number of creatures including humans. While humans perform dances like the salsa, the male ruffed grouse, *Bonasa umbellus*, competes with other males of the species for a mate by performing a dance on his own (Grosz 2008, p. 68). A dance, such as that performed by the 1970’s Australian ‘Sharpies’, on the other hand, can be seen as political acts, communicating tribal values and/or aggression, rather than
4.2. MATERIAL CONNECTIONS

traditional courtship (Beilharz & Supski 2018, 2015, p. 188).

Dances undertaken by other creatures communicate space, such as bees dancing a map to inform other bees of a food source. Though a ‘dance’ is seen as a set of rhythmic movements, or actions as a communication tool, the dung beetle dances as an ‘orientation mechanism’. [Baird et al.] have used the word ‘dance’ to describe the movements of dung beetles as they transfer their selected sections of dung to a safer place:

most beetles perform a characteristic dance – in which they climb on top of the ball and rotate about their vertical axis – before rolling away from the dung pile. The likelihood of a dance being performed increases when the beetles encounter an obstacle or lose control of the ball.

(Baird et al. 2012, p. 4)

Their research draws parallels with orientation practices of ants and sandhoppers who also use movement in this way. In the case of the dung beetles, the dance is not restricted to a literal situation, but as a response to the environment in which they find themselves.

During the initial dance at the dung pile, beetles store a compass reading of the celestial cues as they appear along the preferred roll orientation. They then try to match their stored compass reading to the cues they see while rolling, thereby allowing them to move away from the dung pile in a straight line.

(Baird et al. 2012, p. 5)
Though not necessarily a traditional use of the word, it seemed to this collection of scientists that ‘dance’ was the most appropriate as it suggests rhythm, movement and space, effects appropriate in art practice.

Within *Fountain: Dance of the water droplet*, there is rhythm. Water falls at a strict tempo due to the careful formation of a pipet by the human maker, myself. More importantly, when the water hits the hot plate it skips across it at a pace that is controlled by the heat which causes the Leidenfrost effect. The sculpture embodies Latour’s explanation of the ‘democratic (dis)agreement’ (Latour 2005b, p. 13).

The creative processes found within blacksmithing have been explored through sculptural practice within this chapter. Through the sculptures made and exhibited, and theoretical observations, I have demonstrated the significant benefits of viewing sculpture as a democratic practice where things are social orders and interactions are seen as a dance.

The final chapter demonstrates how sculptors viewed steel as a ‘new’ material in the 20th century, comparing it to my own sculptures, and then contrasting this early work with that of contemporary sculpture which has a focus on the agency of matter.
Chapter 5

Agencies of matter: establishing new way of understanding sculpture

In the last chapter I explored ways that sculpture could call attention to the nonhuman agents within blacksmithing. In this chapter, I measure the findings of my own research against the field of contemporary sculpture. First I introduce and follow the trajectory of steel as medium in sculpture comparing the sculptor’s work and motives to that of my own. Finally, I assess the work of sculptors who allow energies and matter such as earth, fire, air and water to react or respond within their work. This chapter is undertaken to affirm my research on nonhuman agency in sculpture, and to confirm that nonhuman agency is valued within contemporary sculpture.
5.1 Steel - the ‘new’ material

The artistic and material processes of sculptural practice determine the outcomes of a body of work, and shape how it is understood. As discussed in Chapter Three, carving and modelling were the traditional sculptural processes. Marble, wood and bronze produced sculptures that are solid, opaque and bound to ancient and cultural conventions within particular historical contexts.

Figure 97: Gianlorenzo Bernini, 1648-1651, Fontana dei Quattro Fiumi (Fountain of the Four Rivers), Piazza Navona, Rome, fountain, marble, ARTstor database.
When discussing traditional forms of sculptural practice in the 15th century, Adrian Stokes (1902-1972) once stated that marble, in particular, is the ‘repository of humanistic fantasies’ referring to the celebration of human agency (Stokes 1932, p. 7). He saw within marble a ‘vitality’ or ‘movement’ mainly due to its translucency and its capacity to reflect light. Even the later baroque Fontana dei Quattro Fiumi\(^1\) [fig. 96] attests to the capacity of Bernini to convey the textural qualities of human skin through marble. Stokes also saw similar qualities of mastery in the early 20th century sculptures of Barbara Hepworth and Henry Moore [fig. 97] (Stokes 1978, pp. 621, 681).

Before the early 20th century sculptors were seeking ways to shift boundaries of expression, looking deeper and further afield for materials. Steel played a significant role within the new sculptures, changing its construction and subject matter. As mentioned, historically steel was used largely in industrial constructions, yet it promised to be a material that would open sculptural space, reveal interiors in new ways and generally transcend traditional sculptural

\(^1\)Fountain of the Four Rivers.
boundaries. Other traditional materials, such as wood, could produce sculpture that addressed contrasting aspects of interests for the modern sculptor, such as movement and structural form, or formal spontaneity in making and functionality of building construction. The sheer modernity of steel and its previously undervalued status as a sculptural medium, however, made it irresistible to the modern sculptor (Ragon & Garey 1957).

The masks of Pablo Gargallo, Alexander Archipenko’s (1887-1964) cubist sculptures, and the constructivist works of Antoine Pevsner (1886 -1962) all adapt the industrialised material of steel into entirely new configurations. Though coming from a less formalist perspective, Duchamp’s readymades also relied on the pre-fabricated qualities of everyday objects he claimed as sculpture. For some sculptors, such as Pablo Picasso, scrap steel appealed as it was easy to find and cheap. It was reminiscent of the collage and assemblages of Cubism, while providing an element of rawness and crudeness.

**Drawing in Space**

Picasso engaged his friend and countryman Julio González to teach him to weld when he visited Spain. Between 1928 and 1931 both artists worked closely together, fabricating the figurative steel forms that became precursors to late 20th century steel sculpture (Legg 1967, p. 43; Ashton 1993, p. 28).

González entered the sculptural world as a blacksmith, and was also a proficient jeweller and metalsmith. Taught to forge iron and other metals by his father, he worked alongside his siblings, including his sisters. By 1926 he realised that sculpture was his preferred creative outlet and using iron as his medium, began to
make small forged sculptures such as *Le Couple* (1927-1929) [fig. 98] (Ritchie & Gonzalez 1955-1956).

González considered sculptural processes as ‘drawings in space’ and as a form of self-expression (Ritchie & Gonzalez 1955-1956). With *Le Couple*, González allowed for texture to build up on the surface using the pits, marks and rust to convey a sense of time. The immediacy of González’s fabrication techniques emphasised the transitory state of the lover’s movements, suggesting that the steel was worked with the same tempo, perhaps indicating the momentary passion of the lovers.

The American artist, David Smith, stated in *Julio González: First Master of the Torch* that ‘González’s welding technique was not of commercial efficiency but beyond it. It appears to have been developed by caution and artistic need’ (Smith 1956). His forging was distinctive within his sculptures which were ‘wrought and reduced from ore before its final shape’ (Smith 1956). González’s blacksmithing training imbued the steel with plasticity: revealing the marks of material processes in ways that suggested an intrinsic understanding of the forces of heat and age (Withers 1978, p. 66; Trimmer 2003).
By the mid-20th century, David Smith’s sculptures fully embraced the pre-fabricated nature of the material, leading his contemporary Willem De Kooning (1904-1997) to claim that his ‘guiding techniques are not those of sculpture but of industry’ ([De Kooning 2005] p. 166). Smith earned his living at first as a metal-worker in a factory where he was taught to blacksmith in 1954, an experience that gave him a solid foundation in the skills he later used in his sculptures ([Pachner 2013]).

Smith declared González to be the best sculptor who had ever lived while the critic, Clement Greenberg (1909-1994), compared Smith’s work with Picasso and Braque’s cubism. Smith was preoccupied with formal balance and implied movement and Greenberg praised the ‘openness, linearity, and the pictorial’ qualities of Smith’s sculptures ([Bissonnette 2014] p. 81). Art, in Greenberg’s view, should concentrate on materials and form. He admired Smith for the way he adapted steel to sculptural expression and regarded his best works were those in opposition to the monolithic ([Tekiner 2006] [Bissonnette 2014]).

Greenberg’s evaluation of Smith’s sculpture was purely formalist, whereas De Kooning and later Rosalind Krauss among others, saw links to political and psychological implications in his work. Not only did Smith weld and forge steel, as a process to think through form, but also as a symbolic reference point for his subject matter. Krauss made reference to the military imagery of the cannon in Smith’s work, and war machines are a feature of a number of his sculptures ([McCarthy 2010] [Smith & Krauss 1983] [fig. 99]). When discussing steel Smith stated that:

Possibly steel is so beautiful … because of all the movement associated with it, its strength and functions. Yet it is also brutal: the
rapist, the murderer and death-dealing giants are also its offspring.

(De Kooning 2005, p. 167)

Anthony Caro (1924-2013) proceeded to create his own welded steel sculptures after years of working in bronze and then discovering the sculptures of David Smith, the work of American formalist painters, and Clement Greenberg. Caro’s work shifted away from the monolithic, weighty forms reminiscent of his teacher, Henry Moore, to lighter, more linear formal planes where space, balance and gravity replaced the figurative. The steel, and at times aluminium, afforded an openness of form and a directness in expression which could not have been replicated in traditional sculptural materials. Caro welded and bolted his work together echoing techniques of industry which revealed an architectural influence.

Caro’s sculptures are hard to define as they are contrary in their delivery, and they straddle three-dimensional spaces with the element of movement and time as a fourth dimension. From the time he befriended Greenberg and understood his
aesthetic viewpoint, Caro worked predominantly in steel and yet the earliest of those sculptures are hidden under paint. He took his sculptures from the pedestal so that they would inhabit the same space as the viewer and yet his forms seem to deny the viewer a point of entry. As three-dimensional sculptures they could be viewed as two-dimensional, referencing paintings, or the flat plain as Smith’s sometimes did.

Almost in defiance of Moore’s teachings and his curvaceous sculptures, Caro worked with the planes of industrial steel. In particular, his first steel sculpture, *Twenty-Four Hours* (1960) [fig. 100] directed the viewer’s gaze in a specific direction. This formative sculpture could only be read from the front and was influenced as much by American abstract painters as by David Smith. In this and later pieces there was a ‘resolute planarity ... pictorial flatness’ (Fuller 1986, p. 918). When discussing a later piece of Caro’s, *Early One Morning* (1962), [fig. 101] in an interview the sculptor Charles Ray told Michael Fried that there was a ‘sculptural disjunction compressing and expanding space in such a hallucinogenic way’ (Fried 2005, pp. 50-53).
Caro chose steel to work with as it was ordinary. He was attempting to ‘de-artify’ his sculptures, for them to be ‘just made of stuff’ (Caro 2014, p. 32). Further, as a great deal of steel in Caro’s sculptures were hidden under paint (just as some of Smith’s were), it is, in some ways, incidental to the sculptures. Although this was purely a practical decision it worked against Greenberg’s ideal of emphasising the materiality of sculpture demonstrated in his dispute over David Smith’s sculptural estate (Cain 2017).

As the beneficiary of Smith’s sculptures, Greenberg deliberately allowed paint to peel and rust to accumulate on the work causing concern. Greenberg, who was an advocate for medium specificity believed that Smith’s sculptures should reveal the steel and rust. His position here is an attempt to allow the natural character of steel to be apparent in the completed sculpture. The paint on Smith’s and Caro’s sculptures denied this behaviour. However, although this was an important aspect in Greenberg aesthetics, he did propose that Smith’s sculptures should be lacquered once the appropriate amount of rust had developed (Cain 2017). The halting of the rust suggests that, even for Greenberg, matter should
conform to an acceptable aesthetic value.

**Research in Sculptural Motion**

Formalism was concerned with material and structure and yet Caro and Smith hid their sculpture’s steeliness under paint, González’s blacksmithing marks were subsidiary to form, and Picasso’s sculptures disappeared into space. My sculptures, on the other hand, consider the plasticity and transformative nature of steel, disregarding fine technique, while allowing the steel to rust. As far as structure is concerned, the forms of my own studio-led research, *Quench Studies*, which traces the movement of a hot steel ball falling through water, were also formal. As with a great deal of modernist art, and in particular cubism, there was a realisation that form was not one dimensional or static. In the 1930s they sought to portray the hidden forms that are not always visible within a sculpture, such as the interior, or to reveal all facets of an object in space. Just as the modernists represented a moment in one object, when I began this research project, I believed that I could capture the transformation of steel in a singular form. I searched for this form by shifting my drawing practices and through photography. As discussed in the second chapter, the early wall drawings of my small vessel enabled me to visualise the entire body of the vessel, inside and out, rather than moving it around in my hand. Further on, and in *Finding Form in the Dynamics of a Quench*, I discussed how I had used photographs to find this ultimate form ([Hackett 2016a](#)). It seemed to me that to create the right sculpture I had to make a choice. But the photographs that I captured using found objects
(turnip peels) to depict a quench could never reveal this elusive form because movement, or transformation, is not a form. Rather, it is the result of an act and once captured in a form, loses the potency of that act.

This same quality is evidenced in Caro’s Cascade series (1989-90) [fig. 102]. Caro produced a number of tabletop sculptures depicting movement. Whilst for his larger sculptures he had already dispensed with the pedestal, thus avoiding the separation between viewer and the sculptures, this series is a tumble of joined objects that fall from tabletop height plinths. They spill out into space and often finish on the floor, and although viewers occupy the same general area, there is still a psychological separation. The forms suggest movement, and yet they are literally static, and appear to exist in an alternate time frame or reality - a slowing down of time, as it were, within the space of the sculpture.

David Smith’s sculptures, such as Cubi VI (1963) [fig. 103], are more examples of the paradox of presenting movement in a sculptural form. Cubi VI performs a juggling act, where steel forms are suspended on top of each other. They appear precarious, threatening to fall if bumped, and to deny gravity, and yet they are
welded together, planted in the ground, and held there with cement unable to move. 

*Cubi VI’s* form is suggestive only of the power that gravity wields.

Further, Smith’s sculptures become a part of the landscape as evidence of his own sense of being, as the existential totems of human endeavour. In my own work *Quench Studies*, on the other hand, forms are either suspended a millimetre or two above the ground or resting lightly upon it. They are already disintegrating, dispersing back to the earth. Their apparent weightlessness and susceptibility to time and outside forces are evidence of their precarious existence, and suggest our own fragility. This is in stark contrast to *Cubi VI’s* monumental omnipotence. Further, the implied movement of the Quench Studies series draws the viewer’s eye...
downwards as if watching the ball as it falls. This differs to the visual movement of Smith’s sculptures as they implore the viewer to look up.

The works of Quench Studies are explorations of arresting movement in much the same way as the sculptures of Picasso, González, Smith and Caro. González stated that only ‘a cathedral spire can show us a point in the sky where our soul is suspended’ (Ritchie & Gonzalez 1955-1956, p. 32). I take this statement to mean that his sculptures were an apotheosis of thought which, in turn, made the artist heroic, and the one able to choose a final godlike form. In Quench Studies there is no such final form as the works are only suspended in their existing state temporarily. As such, my works attempt to dispense with sculptural hierarchy concerning maker and object, and to give greater agency to the energies found in these processes by revealing the sculpture’s transformation.

Otherness

The presence of the artist as a godlike hero is arguably evident in the sculptures of González and Picasso whereas by contrast women are depicted in domestic situations or associated with a concept of the ‘primitive’. This is most evident in Picasso’s Head of a Woman (1930-31) [fig. 104], where he uses two colanders to form a section of the head (Withers 1975-1976, p. 111).

On the one hand, Picasso’s colanders are formal devices. They are chosen as their form and texture are appropriate for the sculpture, while the repurposed object can, at a later date, again become what it was prior to his intervention. On the other hand, they are a deliberate device to inform the viewer of his belief that
the woman he is portraying belongs in the domestic space, delivering the artist’s narrative. Picasso’s colanders seem to be a deliberate statement on the lack of intelligence of women. The use of the colanders together resemble a head full of holes, suggesting that the woman has a sieve for a brain (Trimmer 2005). Symbolically, women are referred to here by Picasso as vacant, placing himself, the sculptor, in the real position of agency - the one with intelligence. In contrast, my woks are not domestic cookware but were for commercial use and, as they were plentiful and rusty when found, are not a comment on gender but rather on a commonality of origin.

On another note, and in light of Picasso’s treatment of women within his
sculptures, Julio González’s *Le Couple* can be viewed as a little more than a tryst as first suggested. The figure of the woman’s body faces slightly away from that of the man, and her expression can be read as one of despair rather than of desire. Another form of ‘otherness’ that was practiced by modernist artists was the notion of ‘primitive’ in artworks derived from misappropriated sculptural forms from other cultures. Picasso and his contemporaries were fascinated by the abstraction of form in cultures that they considered primitive. The theft of forms by the modernists represented a cultural process of colonialism that contributed to the ‘shattered state of the contemporary indigenous world that includes the dislocation of objects; the loss of land and languages; the criminalization of religion’. This resulted in ‘the asymmetries of power as they relate to gender and race’ ([Palmer] 2008, p. 189). The modernists, and especially Picasso, absorbed the aesthetics of these cultures while denying them contemporary status. The use of African masks in the sculptures and paintings fetishised that culture, and effectively imitated the real masks without understanding their significance. The duality of such sculptures, mocked both the culture they had been appropriated from and the women they portray, while at best, poking fun at European cultural institutions ([Chave] 1994; [Bhabha] 1984; [Leighten] 1990). Again, this stance places the modernist sculptor in a position of superiority. As a consequence, the sculptures of Picasso and González can be read as highly charged declarations of gender and cultural differences.

David Smith’s sculptures, too, follow and reinforce gender stereotypes. The many symbolic references to war, industry and masculinity, associated with steel were appropriated by Smith in ways that were possibly partly due to his work in the steel industry during World War II. Yet he was compared to ‘Vulcan’, connecting
the man and steel with which he worked, and his play with masculinist imagery is quite overt in his sculptures (Krauss 1971, pp. 6-7; McCarthy 2010; Bissonnette 2014).

My own studio-led research, on the other hand, explores the restlessness of the elements involved in the composition of steel and the transformative nature of blacksmithing processes. Although the woks within my work were a formal choice, they also highlight the shifting states of material, a continuation of life. My aim was to reveal how steel is a combination of strength, fragility and plasticity.

Steel is neither masculine nor feminine, it is not brutal, nor is there any justifiable need to associate it with rape or murder, in the ways that it has been depicted, despite its use in weaponry.

Serra’s Torqued Ellipses (1996-2004) [fig. 105] are comprised of large sheets of corten steel rolled into ellipse forms large enough to walk through and around in his maze-like installation. This is sculpture on an overwhelming scale which can cause a feeling of claustrophobia in the viewer. When standing inside these
passageways, the viewer cannot fail to notice how the towering walls lean as if ready to fall. The sheer size and angle of these sculptures conveys a sense of overbearing domination. Moreover, when walking through a *Torqued Ellipse* there is an awareness of its un-yielding steeliness and in following its contours with the hand is to feel the coldness of the metal, eliciting a sense of powerlessness. The scale and materiality of these works can remind us of being trapped in a formidable space or feeling threatened, and Serra and others who worked on these pieces would have had a real bodily sense of its substantial weight and size as the pieces were formed just as they would when building a ship.

Richard Serra recalls an experience of a ship that he watched being launched and describes in detail how he felt, consequentially pinpointing his obsession with process ([Serra 1994](#) p. 184; [Hackett 2016a](#)). I first regarded this experience as one where Serra shows deep interest in the intrinsic value of steel and how it behaves. Later, however, I saw a sculptor obsessed with the manipulation of steel and through it, a manipulation of his audience. Perhaps Serra’s history of working in steel mills and his father’s occupation as a pipe fitter helped to condition his thinking of working with steel as masculine. There is the suggestion of brutality, the same found in the work of David Smith, that is visible not so much through his choice of materials, but in how he uses it. Working in steel was seen at once, lowly and manly, which elevates the working man. It refers to war making, city building and industry, and [Vulcan (Serra 1994)](#) p. 184; [Chave 1990](#) p. 275).

Monika Sosnowska’s (b.1972) work has been compared to Richard Serra’s torques, and the work of Anthony Caro ([Rosenberg 2014](#) [Whitney 2017](#)).
Though appearing to follow the tradition of 20th century formalist, constructivist and minimalists sculptors and architects, Sosnowska has instead turned away from the masculine trope, and seeks to redefine these genres. For Sosnowska, the formalist structures of ‘bureaucratic buildings’ are echoes of the polish landscapes of her youth. ‘The rubble that Sosnowska painstakingly photographs consists of the bulldozed remains of Brutalist architecture from the communist era’ (Whitney 2017, p. 26). Sosnowska takes components of buildings out of context and transforms them, rendering the urban landscape unfamiliar. Far from destroying it to rubble, her work is clean and freshly painted; some works appear as fine as lace, while others are brutal comments on the decline of urban environments. Although it acknowledges and makes good use of the cultural associations connected to steel her sculptures test the boundaries of its references.

Sosnowska uses industrial building materials in her installations and interventions, and constructs armatures that appear disfigured, distorting previously understood building forms to create sculpture with an uncanny sense of familiarity. Her aesthetic is drawn from brutalist architecture, which rejects narrative in favour of form. Looking deeper, however, it is clear that her installations displace preconceived notions of materiality to express the properties of metal, to see how far a particular structure can be made to ‘approximate the effects of accident’ (Whitney 2017, p. 27).

Sculptures such as Concrete Ball (2008) [fig. 106] are explorations in altered architectural states that question the familiar narratives of everyday building materials. Steel is captured within a two metre concrete ball, but unlike the reinforcement steel (rebar) of the construction industry where it is hidden within the concrete to support it, the reinforcement steel pierces through the concrete.
Rather than strengthening the concrete it seems trapped by it, giving the impression it is exploding or trying to escape. One section shoots up like a ten-metre lightening bolt, delicately touching a gallery wall. The matter used in *Concrete Call* is charged with an energy not as material used for construction but as universal matter.

Contrary to Serra’s sculptures, *Quench Studies* are human sized in scale, and deliberately comparable to the physical scale of the viewer. They are not intended to disquiet the viewer but to suggest a sense of commensurability between human-made metal and humanity itself. This reinforces the notion that steel, like the human, has agency within the process of making. While Serra’s works tend to idealise the might of the industrialised world and its construction, he also celebrates the role of the artist and the power in the act of making. My sculptures do explore the making process, but, unlike Serra, my participation as an artist is secondary to the energies and the effects of matter - steel, fire and water.

Serra’s belief in the infallibility of the construction industry is visible within his
work, where Sosnowska’s sculptures almost mock it. Her distorted forms suggest that the building industry is not indestructible. However, her work still holds fast to the finishing practices of construction and does not question the strength of steel itself. Where Sosnowska’s steel is consistent and reliable, the steel in *Quench Studies* rusts, disintegrates, and reestablishes itself in the earth from where it came.

### Process in sculpture

Richard Serra took the materials of modern formalism, as well as other industrial materials, and focused instead on processes of working and making. Such processes are apparent in *Gutter Corner Splash: Night Shift* (1969/1995) [fig. 107] where Serra threw molten lead, a material for making water pipes in the USA up until 1980, into the corners of a room.

Rosalind Krauss, describes the image of Serra throwing lead at a wall as a man

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2See The Lead Industry and Lead Water Pipes “A Modest Campaign” (Rabin, 2008).
ready for battle (2000). Serra was photographed wearing the clothes of a labourer and holding a ladle full of lead high in the air as the other arm points at the wall. The ladle provides leverage for a powerful throw while protecting Serra’s hands from the molten lead, just as his lungs are protected from fumes by a mask. The image draws our attention to the physical properties as the weight of the lead is visible in the movement of Serra’s back. The image reveals the engaged action of throwing and encapsulates the ‘power experienced by Serra through the action’ (Hackett 2016a, p. 4). The solidified cast lead blocks, the result of Serra’s labour, were placed in rows on the gallery floor.

Just like a blacksmith at the forge, the sculptor becomes primary in the work as evidenced in Rosalind Krauss’s description of the image. Although there are a few references to lead’s materiality, Krauss has ignored its true agency within *Gutter Corner Splash: Night Shift*, and chosen to focus instead on Serra. This is in opposition to *Fountain: the dance of the water droplet* where the emphasis is on the engagements between energies.

To analyse Serra’s *Gutter Corner Splash: Night Shift* through Actor-Network Theory, Serra’s agency would be balanced with that of the lead. It could also discuss lead’s interaction with heat and the walls of the gallery, the history of lead use in civilisations and how poisonous it is. Regardless of the industrial material, lead and its potentially deadly implications, Serra is the subject of this installation as he again represents the worker as hero. Serra’s focus on maker is evidenced in his compiled *Verb List*. Even though the list was a series of ‘actions to relate to oneself, material, place and process’, the verbs connect the maker and material hierarchically, where the maker chooses an action and the material complies (Buchloh 2000, p. 7-9).
Symbolic iron

In contrast to Serra’s celebration of industry, Joseph Beuys and Louise Bourgeois (1911-2010) explored the symbolic use of steel within their installations to create an emotional response from the viewer.

Joseph Beuys was born in Krefeld in 1921 and his works cannot be separated from his historical experiences of the period between the two world wars. Beuys studied botany and set up a laboratory in his family home. Like others of his generation he joined the Hitler Youth in 1936 and, in 1941, began training as an aircraft radio operator for the Luftwaffe. In 1943, his plane crashed over enemy lines after being shot by Russian gunfire. Beuys tells a story of being rescued after the crash by Tartar shamans who wrapped him in fat to heal him of his wounds. Though discredited as a myth, components of the story, such as the use of fat, repeatedly appear within his sculptures throughout his career (Adams 1992; Gandy 1997; Ottomann et al. 2010). Beuys’ sculptural installations and performances were imbued with myth and metaphor and he regarded the role of the artist together with the materials used, as a healer.

Figure 109: Joseph Beuys, 1968, Iron Chest from Vacuum-Mass, installation, iron, fat, and bicycle pumps, 559 x 1092 x 540 mm, © 2019 Artists Rights Society (ARS), New York / VG Bild-Kunst, Bonn, MoMA.
In one performance, *Vakuum-Masse*[^3] (1968) [fig. 108] Beuys welded closed a large steel box. He had assembled his students in a basement behind a protective screen, and lay down onto the floor spreading out his arms in the shape of a cross: a gesture suggestive of Christ’s crucifixion. He then proceeded to fill a steel box in a t-shape with fat filled bicycle pumps and sealed it by fusing the steel with a welder. This performance, and the use of the steel box in the shape of half a cross, filled with fat are material metaphors connecting the corporeal and the natural world with spirituality.

The steel used in such work carried symbolic references to masculinity and war. This is also true of Beuys’ conference installation, *Feuerstätte I* (1968-74) and *Feuerstätte II* (1978–9[^4] [fig. 109] where steel was juxtaposed with the ‘female’ material of copper as a gender counterpoint (Adams, 1992). The hearth, which Beuys referenced in both works, traditionally served as a family meeting place though it also reminded the public of the Holocaust:

the numerous rods and small wagon of Hearth I visually echo the small wheeled car on rails which fed the bodies to the ovens in the crematoria. This sense is only reinforced by the German title of Beuys’ piece: Feuerstätte, which literally means, place or scene of a fire.


These sculptures were the genesis of Social Sculpture which was established by Beuys in the early 1970’s as an attempt to address problems that he saw within

[^3]: *Vakuum-Mass*
[^4]: *Hearth I and Hearth II*
social systems, including in art which was discussed in Chapter 3. However, while Beuys’ artist was at the centre of art as orchestrater, matter was a tool to connect people.

Like Beuys, Louise Bourgeois’ own life is integral to her work, but where the steel in Beuys’ installations subscribed to masculine and war-like motifs, Bourgeois created her own visual language to represent more diverse aspects of her life. This is visible in her Cells installations which are voyeuristic, surrealist ‘brainscapes’ portraying her thoughts, torments, dreams and fears. The Cells suggest moments of isolation, but also recall a literal sense of brain cells as vehicles of consciousness. They are porous, like skin. Her thoughts are trapped in the cells, and are places that Bourgeois can neither leave, nor completely see again.

In Bourgeois’ earliest cell, Spider (Cell) (1997) [fig. 110] a spider surrounds a cage and egg sac, while from outside the viewer can see a chair and tapestries within. The chair is inviting and the tapestries comforting, suggesting a place from which

David Adams (1992, p. 31) argues that Beuys’ aim was to rebalance the masculine and feminine principles.
someone sitting in the chair is able to see out. For Bourgeois, the spider represents her mother, the protector; the steel referencing her mother’s strength. There is a deliberate ambiguity about the steel mesh, which could be lace or a spider’s web, partially revealing and partially concealing. The cell is porous and reminiscent of a captured fly with no means of escaping. Though Bourgeois sees it as a place of safety, the cell is ambiguous as it can also be a trap and a place impossible to leave (Coxon 2010, pp. 68-9).

Bourgeois’ Cells series do not fit easily into the tradition of sculptural practice. Movement is not implied through formal devices indicating stability or mass, and space is considered in relation to a mobile viewer. It is plain that Bourgeois
realised that steel, as matter, is not gendered as Beuys’ appears to be. The symbolic references of both artists, however, are evocative of the history of material as a product of collective cultures mentioned in Chapter Three.

In contrast to the use of steel to represent aspects of humanity, the *Quench Series* aims to present the material of steel as itself, as matter that engages with, and pulls away from, other matter. A sculpture in the *Quench Study (Hearth)*, is the direct result of fire with two woks welded together and burnt by the same welding technique. It is rusted and, as a viewer walks around it, the remaining strands of the spheroid suggest the flickering of a flame which engages with ideas of our cultural beginnings.

### 5.2 Environmentally responsive practice

While Joseph Beuys and Louise Bourgeois used the materials of their sculptures symbolically, by contrast, the sculpture I now discuss portrays the experiences of matter itself. If for Beuys matter was emblematic, he also acknowledged that in his sculptures matter was still reactive. Even now in his sculptures there are ‘chemical reactions, fermentations, colour changes, decay, drying up. Everything is in a state of change’ ([Beuys & Harlan](2004) p. 9).

Beuys was not alone in acknowledging the innate energies of matter. Within this section I have gathered together artists who have worked with nonhuman agents which I have grouped in the Classical elements of earth, fire, air and water.
Earth

For centuries fountains have been used where public and practical solutions were needed to hold water. A fountain quenched the thirst, cooled the immediate environment and soothed the mind. Fountains were also demonstrations of wealth and power. A case in point is the baroque sculptor, Bernini’s fountain, *Fontana dei Quattro Fiumi*[^6] which was commissioned by Pope Innocenzo X[^7]. Just as sculptors were commissioned to make water fountains, Alexander Calder (1898-1976), whose modern works focused on form and movement[^8], was commissioned to create a sculpture that enabled the flow of mercury. *Mercury Fountain* (1937) [fig. 111], was built for the World’s Fair in Paris and placed in the Spanish Republican Pavilion, along with Julio González’s, *La Montserrat*, and Picasso’s *Guernica* and was commissioned by the Spanish Republican government to commemorate the battle between the Almadén mercury mine workers and the fascist troops of General Franco during the Spanish Civil War ([Taylor 2012](#)). Calder’s fountain is now housed in a glass room due to the toxicity of the mercury. Calder fabricated *Mercury Fountain* in steel and aluminium. It was painted black in contrast to mercury’s silvery sheen, and steel

[^6]: *Fountain of the Four Rivers*.
[^7]: Bernini had expressed an affinity with water and several water fountains including ones that mimicked water, using paper to replicate the sound ([Boucher 1998, p. 89](#)).
[^8]: The most well-known of Alexander Calder’s body of work are abstract, kinetic sculptures now referred to as ‘mobiles’. These sculptures were made of steel and aluminium which was fabricated and then painted. Along with the sculpture, Calder had produced a large body of jewellery in silver, brass, glass and other materials for friends, family and his wife. In 1927 he began making figures from wood and metal for a miniature circus to entertain himself and friends. He experimented with brass wire creating likenesses of famous people. From these small figurative pieces he experimented with sculptural form, ‘stables’, exploring balance and weight, increasing his interest in the kinetic as he progressed and grew more confident as a sculptor. As he had studied engineering, some of these sculptures become mechanised ([Sweeney 1943, pp. 15-38, 56](#)).
troughs were lined with pitch to protect the work from being damaged by the mercury (Sweeney 1943, p. 50). The mercury that flows through the fountain is kept at room temperature in a liquid state that moves in similar ways to water. As it flows around the fountain it bumps a red circle mobile section which moves in characteristic Calder style. It becomes a warning of the danger held within the fountain.

Although Mercury Fountain was a memorial, it highlighted the particular qualities of mercury and ‘concentrated on one thing only: on the beauty of the mercury’ in

Calder said of this piece: ‘The fountain proved quite a success, but a great deal was due, of course, to the curious quality of the mercury, whose density induced people to throw coins upon its surface’ (Calder 1938 pp. 2-3,7).
its mysterious fluidity’.

[The] strange construction of black iron, graceful and precise like a great insect, allowed the mercury to flow slowly, to collect itself into a mass, to scatter, to roll from time to time in melting pearls, to play perpetually by itself, to the delight of the public which was present for the first time at the delicate spectacle of mercury moving in a fountain.

(Andre Beucler, cited in Sweeney 1943, p. 50)

_Mercury Fountain_ demonstrates that metal is not steadfast but is constantly moving and can flow. This movement and interaction with the outside environment actually occurs in all metals, although it manifests in a variety of ways and at differing rates. The fountain allowed the energies that affect mercury, such as temperature, and mercury itself to engage. In other words, the fountain becomes a social space where all that was involved in its being were afforded articulation in a democratic process resulting in the rhythmic flow of mercury. Mercury was allowed a platform on which to dance and demonstrates clearly Actor-Network Theory.
5.2. ENVIRONMENTALLY RESPONSIVE PRACTICE

Figure 113: Tracey Clement, 2015, *Post-Premonitionism* 2, installation, salt, rusty steel, cotton, dimensions variable, source: Tracey Clement.
Just as the metal of *Mercury Fountain* is an example of transformation, the steel in the work of Australian artist Tracey Clement’s *Post-Premonitionism 2* (2015) [fig. 112] and *Metropolis Experiment* (2016-17) [fig. 113 & ] rusts and disintegrates. Clement allows rust to gather on her steel structures from the salt solutions that are attached. In three such iterations the steel shifts from small skeletal structures to oxide stains on the remaining cotton pinnacles. The architectural references in the steel structures of *Metropolis Experiment* are coated in salt which eats away the steel. Clement draws attention to salt as a ‘destructive force’, eroding the fragile steel structures that represent the skeletal remains of a ruined city perched on a landscape of corrosive, glittering white peaks’. Clement’s installations were
inspired by the novel by J G Ballard, *The Drowned World* (1962) which was written in response to the Cold War and is an apocalyptic tale warning humanity of its impending doom. Clement endorses this sentiment by drawing analogies with our own time (Clement 2017).

Through the political message, these works ask us to witness iron’s responsive nature. Rust is a visible sign of electrons moving within the metal, and iron rusts quicker in salt water as salt is conductive, and this causes electrochemical and anaerobic corrosions. Artist, Robert Smithson reflects on rust stating that ‘[i]n the technological mind rust evokes a fear of disuse, inactivity, entropy and ruin. Why steel is valued over rust evokes a technological value not an artistic one’ (Smithson 1968, p. 86). As stated previously, steel’s ability to ‘decay’ is the manifestation of the interaction of steel with its environment.

Another Australian artist who explores nonhuman agencies within his work is the artist Sean O’Connell who references the reactive power of steel and other matter by photographing objects subjected to high voltage electricity. O’Connell captures the ‘flow of energy through form and matter’ by means of photography when exploring ‘ghosts’ of his family life (O’Connell 2017, p. 4). O’Connell first photographed the wedding rings of his grandparents, a pair of his grandmother’s scissors and a tool that his grandfather had made as an electrical current was passed through. After that, he made rings from various materials, including steel, and then placed these rings on top of a photographic emulsion and passed an electric current through each one [fig. 114]. The resulting images captured the forms of the electricity as it ran through the rings.

These experiments in ‘energies and matter’ explore the ‘world through the transmission of energy’ to demonstrate how porous and vibrant matter can, not
solid and opaque as we assume (O’Connell 2017, p. 4). The photographs reveal unseen energies involved with each ring and are evidence of a transient exchange of electrons to ions. The images are, in a way, a visual record of metal’s interaction with its environment. Although the subject matter of their installations and photographs relates to social or personal interests, both artists have shown that they are responsive to the matter with which they work.

The paintings of yet another Australian artist John Wolseley (b.1938) are often cited as examples of artworks engaging with the nonhuman environment. Wolseley is concerned for Australia’s natural environment, which he understands
is being degraded by human intervention (McLean 2002; Grishin 1998). He uses traditional drawing techniques, adapting them to collaborate with the natural world, allowing the Australian bush a voice of its own. His drawings are part observations, part story-telling, and poetry in physical gestures.

Wolseley describes ‘dancing’ with trees as he scraped paper held on boards against the fire effected bush (NGV 2015). I experienced a similar dance when I twisted the steel for my sculptures rather than using a hammer to form it. And, in the 2015 exhibition *Heartlands and Headwaters* [fig. 115] Wolseley imprinted plants directly onto his paintings and rubbings of borer beetle marks which were like visual diaries of the beetles themselves. There are similarities with this body of work and the experimentations within my own studio-led research where I immersed steel in salt or left it to burn in the fire. Again, it can be seen in the Quench Study sculpture drawings where I relinquished a certain amount of control as a blacksmith. Here I engaged with the steel more on its own terms, letting the metal burn in the forge.
Fire

Natural processes and forces tend to be understood in particular, culturally specific ways. The presence of fire, for example, can be witnessed as a destructive force, or an energy harnessed to destroy. It is this destructive energy that the artist collective, Claire Fontaine (founded in 2004) use in a series of political installations using fire. In the earliest iteration *P.I.G.S.* [fig. 116] in 2011, maps of Portugal, Italy, Greece and Spain are represented in matches stuck in thousands of holes in a wall (Claire Fontaine 2011).

These matchstick maps refer to the derogatory acronym for those countries that could not repay money owed during the European debt crisis of the late 2000s. The maps were set alight to suggest ‘burning debt’ and to protest the destruction of South European economies (Desingisthis 2013 para. 2). In other installations Claire Fontaine performed the same ritual for the United Kingdom and the United States of America in *Burnt Unburnt* (2011-17).10

10 In one performance of America (Burnt/Unburnt) held in Queens Nails Gallery, San Francisco, so much accelerant was used that they were unable to put out the fire and the
The fires in these installations were used as political metaphors. Claire Fontaine has stated that: ‘[w]ords are in charge of bringing the spectator to the metaphysical wasteland located between metaphors and metonymies’ (Claire Fontaine 2014, p. 59). She claims that her status as a ‘readymade artist’ has dehumanised art, meaning that her work no longer holds human feelings (Claire Fontaine 2014, p. 61). Although fire within the work reacts as fire does, here it has become nothing more than a symbol.

The artwork, *Autoxylopyrocycloboros*, 2006, [fig. 117](#) by Simon Starling, also gives an account of the consumption of matter by fire. Starling had rescued and restored a steam powered smack or fishing boat, *Dignity*, from Lake Windermere, England, and, with a friend, relaunched it on Loch Long, Scotland. As the steam boat relied on fire to create the steam, Starling used the wood from the boat as fuel. The wood was fed into the boat’s own fire stove which, effectively ate the boat around it until Starling and his friend were left swimming in the Loch.

The name of the project describes the process within the work. The meaning fire brigade was called. Claire Fontaine was banned from setting another installation alight within American galleries (Bricker 2013).
‘auto’ is self, while the definition of ‘xylos’ is wood, ‘pyr’ is fire, and ‘cycles’ is cycle’. The ‘boros’ at the end references the ‘mythical serpent that eats its own tail’, Ouroboros (Roelstraete, Manacorda & Harbord 2012, p. 59). The fire that generates the energy that propels the boat was also its destroyer. Starling relinquished any claim to his own agency, handing it over to fire as they are propelled across the lake. This creates a type of circularity within the work, though one with a defined ending, which, in effect, leaves the artist out of the loop as a minor agent in the process. As all that is left from the fire are slides, there is a suggestion of refinement that only fire can bring.

Starling’s work has been referred to as ‘ecologic-economic parables’ (Roelstraete, Manacorda & Harbord 2012, p. 59). *Autoxylopyrocycloboros* comments on anti-nuclear demonstrations at the time of its making, while the boat, and the projector used to present the artwork, were from an earlier era. The entire performance and presentation references power as a means to an end as well as demonstrating the transformative energy of fire and is echoed in the circularity of the slide show. However, in this work, fire’s agency is not symbolic, but rather, it holds fast to its true character without becoming a metaphor.
**Air**

Using nonhuman agency to discuss the human condition is also a feature of Anish Kapoor’s sculptures, *Ascension* (2003) [fig. 118]. Rather than being overtly political he directs the viewer’s perception through the dramatic manipulation of matter.

*Ascension* is a column of smoke installed as a site-specific sculpture in a variety of places, including the San Giorgio Maggiore church, Venice in 2011. In this iteration the smoke spins and rises from a base from where it is generated and is drawn up into a ventilator. Kapoor has likened it to a spiritual vortex or whirlwind that he suggests prophets such as Moses followed through the desert.
as a sign from God of safe passage to a promised place. Anish Kapoor has described *Ascension* as an object made from non-material although, this description is misleading (Hirshhorn 2015). As smoke is matter, *Ascension* is formed from the reaction of one matter connecting with another.

![Image removed due to copyright restrictions](image_url)

Figure 120: Berndnaut Smilde, 2012, *Nimbus D’Asperemont*, digital c-type print, 750 x 1120 mm, source: Ronchini Gallery.

Berndnaut Smilde’s (b.1978) *Nimbus* series (2010-18) [fig. 119], which captures water in its gas state also suggested the unsubstantial. *Nimbus* is a photographic series of clouds in interior spaces such as galleries, churches, dungeons and castles. Smilde photographs this process by first creating a humid room and then spraying a mist of water into the air. He blows smoke through a smoke machine which sticks to the water in the air, causing a cloud to form long enough to photograph. The name *Nimbus* refers not only to clouds, but to how they are associated culturally with the supernatural and divine, including their sometimes threatening nature. The actual clouds in the photographs are more cumulus-like, low forming and light which do not threaten like the storm clouds of the Nimbostratus. Smilde remarked that he ‘wanted to make an image of total disappointment. Like there was nothing to see in the space - it was just a cloud’ (Taylor 2015).
With the work of both Kapoor and Smilde we are meant to perceive what is occurring as immaterial, as a slippage from something that is matter, to what is not. Kapoor assumes that human thought is separate from matter - loftier even. Kapoor, here, is an alchemist or magician in the tradition of Beuys where he presents his art as metaphysical questions. Matter is exploited rather than engaged with. Smilde’s photographs are said to be ‘balancing on the edge of materiality’ (Punj 2014). His clouds are seen then, just as Kapoor’s smoke, as immaterial rather than evidence of materiality. This differs from Fountain: *Dance of the water droplet* as it presents water as water, and the transition from liquid to gas as an interaction between heat and water.

**Water**

Kapoor’s installation, *Descension* [fig. 120], is a bottomless whirlpool and would be comparable to sitting at the edge of a void (Kapoor 2014). It is another site-specific sculpture which was exhibited in the grounds of Versailles in 2015. In its seemingly perpetual movement downwards and the noise that it makes as it is churned by a mechanical devise, it evokes thoughts of the terrors of falling into its descent. It suggests our own human propensity for despondency. However, the water, too, is trapped in a hell with no escape. Kapoor is concerned with the human condition and matter becomes a physical emblem for his thoughts, therefore his matter conforms to the topic of each work.

Olafur Eliasson’s series of *Ice Watch* [fig. 121] installations are collections of glacial ice gathered from Greenland and presented in public spaces between 2014 and 2018. These sections of glacial ice were installed in cities hosting climate
change discussions, and were placed in public spaces to be experienced before they melted. The public were invited to feel, watch and listen to the ice. Although it could be argued that taking the ice from the ocean was irresponsible, through the installation Eliasson was drawing attention to the melting of glaciers, and therefore climate change. In this work the ice creates the same distress as beached whales and the viewer has no option but to witness their demise. *Ice Watch* is indicative of Eliasson’s oeuvre where he, as the artist, works collaboratively with scientists, architects and others to realise a body of work. His work is experiential, with political or scientific connotations (Boisclair 2017).

Rebecca Horn’s *Das gegenläufige Konzert*[^11][12] is a site-specific installation created in the Zwinger ruin, Skulptur Projekte, Münster in 1987. The Zwinger ruin is a tower that was built between 1528 and 1536 as a prison and, later, was used for Gestapo executions of Russians and Polish prisoners in World War II. Horn was invited to respond to the site. The installation is comprised of clanging mechanised hammers, grave candles, a mechanised snake, a goose egg and a glass funnel where

[^11]: The Contrary Concert or Concert in Reverse.
water drips down into a basin. This last feature is of most interest to this research, although the other objects are more typical of Rebecca Horn’s practice.

Within her practice, Horn has used performance and symbolic imagery to create theatrical installations that are influenced by the work of Joseph Beuys and Marcel Duchamp. Her work shares similarities to that of Louise Bourgeois as her symbolism references both personal and universal concerns, including sexuality and anxiety, although Rebecca Horn broaches these subjects gently. "Das gegenläufige Konzert" explores Horn’s topics of creation and destruction while reminding the viewer of the buildings bloody past. The hammers beat a torturous time and the candles are memorials to the dead. The snake could be a symbol of rebirth, masculinity or of poisonous defeat, while the egg points us to birth. Each emblem moves the viewer through a sculptural poem that culminates in the dripping of the water.

The glass funnel is suspended over the ruined tower catching the rain which drips down into a basin at the bottom of the tower, where ferns and other plants grow. The basin and the growing garden hide in the ruin which was the scene of so
much death, while the funnel drips measured tears or is a breast dispensing nourishment. The funnel’s dripping contributes to Das gegenläufige Konzert by giving a rhythmic like sound that could be interpreted as torture (Myzelev 2001).

Eliasson and Horn create art for differing reasons, this can be said also of their use of water in the art discussed. Eliasson brought ice into a human centric space so that the ice can contribute to a discussion on climate change. Horn, on the other hand, invites water to contribute to a concert who’s subject matter is life. Although both artists create their installations with specific agendas and aesthetic values, water, and other things that it interacts with, are contributing instead of being manipulated. Their voices are heard.

The sculpture, Fountain: Dance of the water droplet is not the grand political gesture of Eliasson. It does not ask the viewer to think of the destruction of the
planet and the water droplet is not a tragic figure causing the viewer to weep. Neither is it a component of a line of poetry devised by the artist, even though the artist has made a contribution, the intrinsic aesthetics of the water droplet as it dances above the heated steel plate is intact.

The first section of this chapter examined the rise of the use of steel during the 20\textsuperscript{th} century into the 21\textsuperscript{st}. Through this section I argued that the modernist artist used steel as a metaphor for masculinity with the artist as the prime subject of the work. Their steel sculpture either objectified the other or were affirmations of their own masculinity rather than portraying steel as an energetic, reactive matter.

The second half of this chapter discussed how contemporary sculptors worked with matter and energies such as earth, fire, air and water. Through this discussion, I posited that not all sculptors who work with matter did so to highlight the characteristics of nonhuman agents, but rather used matter as metaphor to discuss humanity itself. In some cases where matter’s energies were exploited, matter became mute within its emblematic state. However, where matter was truly allowed equal agency, it added to the quality of the work.
Conclusion

At the commencement of this dissertation, I recalled a unique moment that occurred in a silversmithing classroom when a vessel levitated above vapourised water. It caused me to stop and reflect on what was happening, and to marvel at the magic of it. I kept coming back to that moment throughout my research as a touchstone of an ideal where the energies of metalsmithing would play out without expectations of them being required to serve me. This touchstone was realised in the sculpture, *Fountain: Dance of the water droplet* [fig. 2].

In this sculpture water travels down a steel funnel and spiral into a hot dish below where it hovers backwards and forwards in the dish. The water droplet is framed by the fountain, and yet it is unimpeded until it disappears, and another takes its place. It was sculptural evidence of the energies in blacksmithing processes and an example of a democracy at work within the social practice of blacksmithing.

Figure 124: Mary Hackett, 2017, *Quench study (Time)*, detail, sculpture, steel, image: Mark Ashkanasy.
The idea compelling this research was the awareness that blacksmithing, due to its anachronic standing, was in need of redefinition. In my view, this required a turn from the anthropocentric to a focus on nonhuman forces. Blacksmithing in the past was like sculpture, a creative practice employed to convey human identity and as a measurement of ourselves in relation to everything else. My own question, however, was to ask if it was possible for sculpture to convey the identities of other agents, or other than human actants within blacksmithing.

The questions that were formed around these ideas were:

• **What are the creative connections between contemporary sculpture and traditional blacksmithing practice?**

• **How can sculptural practice reveal the dynamic interactions between artistic and material processes?**

Following these questions, I produced a body of work that led to the sculpture, *Fountain: Dance of the water droplet*. This extensive body of work consisted of drawings, videos and sculpture that explored ways to capture the agencies and energies within a blacksmithing practice.

In this dissertation I gave a brief history of blacksmithing in Chapter One, and an introduction to material agency as it relates to blacksmithing in Chapter Two. In Chapter Three, I sought the creative links between blacksmithing and sculptural practice following creativity through the history of both processes, and then through the transitions that occurred within my practice. I explored how I could create sculpture that expressed the energies within blacksmithing practice in Chapter Four and argued for democratic representation of nonhuman agents in
blacksmithing. While in Chapter Five, I compared the use of blacksmithing and metalwork throughout the 20th century and then the contemporary sculptors who have conveyed energies such as fire and water within their sculpture with my own findings.

What is understood is that blacksmithing owed its existence to an early fascination of the lustre of metals and the inquisitive, and exploitative nature of human beings. Blacksmithing as a craft was vital to the growth of European cultures. It played a large role in the creation and maintenance of boundaries, and in the making of superior domestic tools that caused greater cultural exchanges. However, with modernity industrialisation led to a decline in the need for blacksmithing.

In early modernity the emergence of alchemy and the experimentation of blacksmiths led to the scientific knowledge of metallurgy which is of considerable industrial importance. By contrast, blacksmithing has inspired poets. It has been used as a mythopoetic process, particularly since the energies that have created steel also shaped the creation of deities. These deities, it was believed, were the creators and teachers of fire use and metalsmithing. In this tradition blacksmiths were both ridiculed and feared. The importance of blacksmithing lay in how it fulfilled a fundamental need in how cultures made sense of the world around them. It shaped social situations, and how social groups distinguished themselves from their neighbours.

While blacksmiths accrued a reputation for practicality, sculptors built monuments, memorials and fetishes. The symbolic ideals and social contexts embedded in sculpture manifested shared rules and rituals. These practices continue to shift as social orders do.

Through my own experiments I found that transitions in habit, such as a change in
scale, gender focus, or tool use created new ways of thinking about links between blacksmithing and sculpture. I became aware that the idea of gravity within a quench cannot entirely be explained in forms such as those that my experimental Quench Series revealed. On the other hand, Fountain: Dance of the water droplet, was a direct engagement of those energies.

The findings revealed in this practice-led research affirmed the relevance of my work to the creative fields of steel sculpture and sculptures using natural energies. This is particularly so in the shift towards sculptures that allow room for matter to behave and react to natural forces. My aim was to demonstrate a more material engagement with matter within sculptural practice allowing matter to exhibit expressiveness through creativity.

Through Bolt’s commentary on performative research and Latour’s Actor-Network Theory this research reassesses the value of the historical connections of blacksmithing through the repositioning of my studio practice. It contributes to the discourse on how artistic materiality decentres humanism while emphasising matter as a dynamic agent. Thus, it acts as an advocate for a more democratic interaction between human and nonhuman agencies.

I have aimed to build an argument both through performative research and by following the transformative nature of metalsmithing throughout history. Earlier research on blacksmithing has focused on the history of metalsmithing or metallurgy. My own approach prioritises periods of transition within historical accounts of metalsmithing combined with a personal practice as a means of assessing blacksmithing processes.

While sculpture has already embraced the nonhuman as a creative contributor, this research has produced a rethinking in blacksmithing, and therefore of craft
practice. The practice of making things can no longer bind itself to the idea that the maker is primary in the creative process.

**Postscript**

As the smith waits for the orange glow of hot steel to begin the rhythmic pounding of the hammer, colour is accentuated and the smith is counting time while people’s chatter becomes a distant noise. All that can be heard is a pulsing hiss as the object is pushed into the water. There is the heat that is felt - dirty, salty, sweat. In the back of the mind is a longing for the same fate as the steel - to be plunged into the water and body heat quenched. Most of all there is the understanding of the weight of the metal as it sinks, and gravity wins.

At the end of this research I revisited Hannah Arendt’s reference to how materials acquire the characteristics of humanity (1998, p. 9). Her words hold true, for blacksmithing and sculpture are human generated practices. However, it is also true that, as humans are made of matter, we reflect the characteristics of that matter.

Figure 125: Mary Hackett, 2013, *Quench study (Quenched)*, digital image.
List of Completed Works

*Steel Can Study I (Fragility and Preciousness)*, 2013, vessel, steel, approx. 130 mm x 8 mm.

*Scale Study 1*, 2013, Charcoal and conté, approx. 2200 mm x 1200 mm.

*Scale Study 2*, 2013, Charcoal, approx. 2200 mm x 1000 mm.

*Scale Study 3*, 2013, Charcoal, approx. 2200 mm x 1200 mm.

*Scale Study 4*, 2013, Charcoal, conté and acrylic paint, approx. 3000 mm x 1500 mm.

*Scale Study 5*, 2013, Charcoal and conté pastel, 2200 mm x 1200 mm.

*Scale Study 6 (Rust)*, 2013, Charcoal and conté pastel, 2200 mm x 1200 mm.

*Small sculptural study 1*, 2013, object, repurposed steel, approx. 60 mm x 90 mm x 110 mm.

*Small sculptural study 2*, 2013, object, repurposed steel, copper, vitreous enamel, enamel paint, approx. 80 mm x 80 mm.

*Small sculptural study 3*, 2013, object, repurposed steel, enamel paint, approx. 80 mm x 100 mm x 120 mm.

*Small sculptural study 4*, object, repurposed steel, vitreous enamel, approx. 180 mm x 80 mm x 150 mm.

*Small sculptural study 5*, object, terracotta clay, approx. 80 mm x 80 mm.
Scale Study 7, 2014, Charcoal and acrylic paint, approx. 2400 mm x 4300 mm.

Quench no.13, 2014, digital image, black and white.

Quench no.78, 2014, digital image, black and white.

Quench no.132, 2014, digital image, black and white.

Quench study (Spin 1), 2014, sculpture, steel.

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Quench study (Spin 3), 2014, sculpture, steel.

Quench study (Mars Descending), 2014, sculpture, steel.

I burn for you, 2015, digital image, steel in the forge.


Fountain: Dance of the water droplet (prior Vapour) 2017, sculpture, mild steel, stainless steel, water, rubber, glass, electric hot plate, electrical cord, 1500 mm x 1000 mm x 2500 mm.

Quench study (Splash 2), 2017, sculpture, steel, dimensions varied.

Quench study (Pending), 2017, sculpture, steel, gravel, approx. 1800 mm x 900 mm x 900 mm.

Quench study (Drop 2), 2017, sculpture, steel, gravel, approx. 2000 mm x 100 mm x 4000 mm.

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