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Massey University

**Entanglements and Disentanglements:
A Posthuman Approach to Mercury Use in
Artisanal and Small-Scale Gold Mining in
Antioquia, Colombia**

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in Social Anthropology at Massey University, Palmerston North, New Zealand

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Abstract

This research uses qualitative research techniques and posthuman theories to investigate the dynamic relationship between artisanal and small-scale gold miners and mercury in the context of Antioquia, Colombia. This is done to contribute to understandings of, and inform potential solutions for, the global environmental problem that is mercury pollution from artisanal and small-scale gold mining (ASGM). Miners come to know mercury through practices, and through these practices, mercury comes to be co-constitutive of an informal ASGM industry. Mercury provides an easy yet profitable mode of gold extraction with limited capital expenditure. Eliminating the use of mercury means a re-constitution of ASGM as a formal industry with higher levels of capital investment, new actors and a shift to a more representational approach to knowing materials. The use of toxic mercury and an increase in the enforcement of mining legislation are framing miners as illegal. Formal, responsible mining is becoming a dominant reality, and informal miners who resent being labelled illegal are working to transition to this reality. Miners' experiences of this transition vary greatly, and this variation can be explored through the lens of ecological habitus. Many miners are using mercury elimination to perform good citizenship by mining responsibly, introducing a performative aspect to formalisation. Nevertheless, miners still face significant challenges to formalisation. As a result, many miners have had to become subcontractors for large-scale mining companies, entering exploitative relationships with which mercury, through its absence, is complicit. Taking this approach towards understanding the relationship between miners and mercury has helped to resolve the conflict between material and social deterministic views of the practice of mercury use, and linked mercury to a wider political context, which is a necessary consideration for a collaborative approach with miners to eliminate mercury.

Keywords:

Artisanal and small-scale gold mining; ASGM; mercury; Colombia; anthropology; posthumanism; entanglements; politics of materiality; performativity; informality.

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Chapter 1: Introduction

In this thesis, I will provide an anthropological perspective on the changing relationship between artisanal and small-scale gold miners and mercury in the department¹ of Antioquia, Colombia. This research contributes towards understandings of the problem of mercury use in artisanal and small-scale gold mining (ASGM), and has the potential to inform practical solutions. This research is guided by posthuman theories which illustrate the relationship between humans and materials. By taking this approach, I will be addressing a lack of social science research on mercury use in ASGM, a gap which has been widely identified but inadequately addressed.

Mercury pollution is a global environmental problem, with severe consequences for human health. ASGM has been identified as the largest anthropogenic source of mercury pollution (UNEP, 2013a). Mercury can form an amalgam with gold, providing a cheap and easy mode of gold extraction. The resulting amalgam can then be heated, vaporising the mercury and leaving near pure gold. This mode of gold extraction is used in ASGM in over 50 countries (Veiga, Maxson, & Hylander, 2006). ASGM is a large industry, yet it is poorly defined. Most international reports list the characteristics of ASGM, instead of providing fixed definitions. These characteristics generally include gold mining that is informal (without a mining title), conducted by small or micro-enterprises, highly labour intensive, uses low levels of technology or industrial mining equipment, and uses mercury for gold extraction (Barry, 1996; Eftimie et al., 2012; Hinton, Veiga, & Veiga, 2003; ILO, 1999; UNEP, 2006, 2012). Other characteristics cited less frequently include a low number of workers employed, a small claim, a low volume or value of extracted gold, and low wages for the workers. Barry (1996, p. 1) defines artisanal mining as “the most primitive type of mining, characterised by individuals or groups exploiting deposits-usually illegally-with the simplest equipment.” Small-scale mining refers to slightly larger scale operations with more mechanised equipment, which are

¹ In Colombia departments are roughly analogous to states.

nevertheless informal. Despite being vaguely defined, ASGM is significant global industry, providing 90% of all employment in gold mining, a total of some ten to fifteen million people (UNEP, 2012; Veiga & Barker, 2004). While ASGM is an important source of employment, its environmental impact must be addressed. As technical attempts to do so have failed, many experts in the field have called for more attention to be paid to social, cultural and political factors (Clifford, 2014; Spiegel, Keane, Metcalf, & Veiga, 2015; Spiegel, Keane, Metcalf, Veiga, & Yassi, 2014).

This thesis is a response to the call for attention to be paid to these factors, an anthropological analysis of what is no longer a technical problem. I chose to locate my research in the department of Antioquia, Colombia. In 2011, Colombia was named the worst mercury polluting nation per head of population, with Antioquia being disproportionately responsible (Cordy et al., 2011). As I had a number of close friends in Antioquia, had previously spent time there, and speak Spanish, I chose this as my fieldwork location. I was initially led to posthuman theories as a way of accounting for both human and material factors. It has been clearly identified that mercury pollution is not purely a technical problem, as evinced by the calls for a consideration of social factors. However, the problem cannot simply be a social one, as mercury is used in ASGM in over 50 countries across most continents, with no unifying social commonality. Mercury use must then arise from both social and material factors, although the nature of this relationship was initially unclear. I therefore investigated this relationship by using posthuman theories and qualitative fieldwork.

I conducted my qualitative fieldwork by talking with various types of artisanal and small-scale gold miners, gold processors, gold buyers, and others working with ASGM throughout Antioquia. These conversations happened both informally, and as semi-structured interviews. Through 'deep hanging out' and purposive observation (Geertz, 1998; Stewart-Withers, Banks, McGregor, & Meo-Sewabu, 2014), I was also able to observe people actively working with materials. It is through this fieldwork and the theoretical approach I used that I was able to clarify

aspects of the relationship between miners and mercury. I approached the relationship between miners and mercury as something inherently dynamic and changing, and not as a constant. I was regularly and repeatedly told how mercury use was a practice that had existed for a very long time, and working without it represented a complete change in mentality. My interpretation is that the change in 'mentality' is not purely cognitive, but a change in knowledge informed by practices. Eliminating mercury does not represent a simple change in practice, but a change in how miners approach mining which is constituted by practices. Much of this thesis is devoted to investigating the nature of this change, as I found that it was here that that the relationship between miners and mercury became most apparent. I also paid significant attention to the politics surrounding this change. I did not want to view the problem of mercury use in isolation, but wanted to take a more holistic approach that considered the wider concerns that miners have. I found that miners were facing a number of political challenges, and that mercury, a highly political material even in its absence, was entangled with these challenges.

The first three substantial chapters of this thesis are: Chapter Two: Literature Review; Chapter Three: The Context of Antioquia Colombia; and Chapter Four: Methodology. In the literature review, I present the problem of mercury pollution as a global issue with severe consequences for human health, and show how ASGM has been identified as the major culprit. I also briefly consider ASGM from a development perspective. While researchers have noted that ASGM has the potential to contribute to national development, its environmental contamination and informal nature must be comprehensively addressed for this to be achieved. Having presented this problem, I provide a theoretical toolkit which I will draw on throughout this thesis to address it. While this toolkit is diverse, it primarily draws on posthuman theories to comprehend the relationship between people and materials. I then move to Chapter Three to describe the local manifestation of the global problem of mercury pollution in the particular context of ASGM in Antioquia. This chapter will cover not only Antioquia's 'shameful' legacy as a world leader in mercury pollution, but also their admirable and relatively successful recent initiatives to change this. This chapter introduces the national and regional context,

the specific fieldwork sites of this research, and introduces the relationship between mining and the government, as well as to illegal and armed groups. In the methodology chapter, I describe how I conducted this research, investigating the dynamic relationship between miners and materials through a qualitative methodology. This chapter also covers my own positionality, the ethical considerations of this research, and introduces my key participants. It is these chapters which ground the body chapters and allow them to give meaning.

The three body chapters of this thesis are: Chapter Five: Entanglements with Mercury; Chapter Six: Disentangling Mercury; and Chapter Seven: The Politics of Disentangling Mercury. Alternatively, these are the chapters referring to continuity, change, and the politics of change respectively. In Chapter Five, I describe the way in which mercury is used for gold extraction in ASGM in Antioquia. Mercury has been used by ASGM in Antioquia for a long time, and while the practice of mercury use has been evolving, mercury's physical presence gives continuity to these practices. This chapter is somewhat retrospective, as by focusing on how mercury is or was used, I temporarily defer discussing the major contemporary initiatives being made to reduce mercury use. These initiatives are described in Chapter Six, which has a contemporary focus. This chapter deals with the industry as it exists today, and covers how it is in a heightened state of turmoil or flux. It is a central argument of this thesis that mercury has been co-constitutive of ASGM, and so its disentanglement means a reconstitution of the industry that has implications which go far beyond mercury. Here, I argue that mercury's disentanglement has had an important role in pushing the industry into this heightened state of flux. Both of these chapters allude to (in)formality, with Chapter Five arguing that the ASGM co-constituted by mercury is a fundamentally informal industry, while Chapter Six describes how disentangling mercury means a constitution of a formal industry. These chapters introduce the concept of mercury's political entanglements.

In the final body chapter, Chapter Seven, I discuss the political entanglements of mercury and the concept of formalisation in more depth. It is in this chapter that I examine in detail the concept that mercury, and the absence of mercury, are highly

political, mediating the way miners relate to the state. Mercury has been used to frame informal miners as 'criminals', and therefore to subject them to state discipline. Some miners are attempting to become good citizens by eliminating mercury, or performing formality through eliminating mercury. In other cases, miners have been forced into exploitative relationships with corporations which take on a state-like role with regards to miners, and mercury's absence is complicit in the formation of these relationships. As so many of miners' concerns are political and relate to formality, Chapter Seven is dedicated to a more comprehensive discussion of how mercury and its absence impact on the wellbeing of miners.

Chapter 2: Literature Review

In this chapter, I will introduce the global problem that is mercury pollution from ASGM, and provide a theoretical toolkit to address this problem. The levels of mercury in the world's oceans are increasing rapidly due to human activity, posing a serious threat to human and environmental health, and ASGM is the primary anthropogenic source (Lamborg et al., 2014; UNEP, 2013a). This problem has been widely recognised, yet far more effort has been made towards categorising the problem than resolving it. The efforts that have been made to eliminate mercury pollution from ASGM have met with limited success, despite the existence of technical solutions for mercury-free gold extraction. Key themes identified for achieving mercury reduction are 'appropriate technology', education and formalisation. Finally, many experts in the field have called for a consideration of the social, cultural and political factors behind mercury use. This demonstrates a clear need for an anthropological perspective, yet to date anthropology has paid limited attention to ASGM. This is the gap which I am addressing. To do this I have provided a 'toolkit' of theories that I will use to address this problem, primarily based on posthuman theories which are capable of understanding socio-cultural factors and the materiality of mercury simultaneously. In this chapter, I do not apply these theories directly to the problem of mercury pollution, but provide them as a toolkit to be drawn upon throughout the thesis in conjunction with my fieldwork data.

The Global Problem of Mercury Pollution

In 2014, Lamborg et al. published a study in the journal *Nature*, which showed that mercury levels in the surface waters of the world's oceans had tripled from pre-anthropogenic levels. The study estimated that the total volume of anthropogenic mercury in the world's oceans was 290+/-80 million moles (58,000 tonnes, roughly the same weight as 600 blue whales). This result is startling considering mercury's deleterious effects on human and environmental health.

Mercury is a relatively unique metal, in that it is the only metal that is liquid at room temperature. It is found as elemental mercury, inorganic mercury (forming compounds with other inorganic substances), or as organic mercury (forming compounds with organic substances) (WHO, 2007). Each form is toxic to varying degrees, through oral, dermal, or respiratory routes. The World Health Organisation (WHO) has given a tolerable intake of 2 µg/kg bodyweight/day (WHO, 2007). Mercury is primarily linked to neurological and behavioural disorders, but is also harmful to the digestive and immune systems, the lungs, and the kidneys (WHO, 2007). Small children and pregnant women are particularly vulnerable, with the possibility for the retardation of various mental functions of the child or foetus (Ekino, Susa, Ninomiya, Imamura, & Kitamura, 2007).

Severe methylmercury (organic mercury) poisoning is also referred to as Minamata poisoning, after the Minamata tragedy in Japan. Industrial methylmercury pollution around the Minamata township led to mass poisoning, with many cases of paralysis, loss of motor control, vision and hearing loss, memory loss, behaviour change, and even death (Ekino et al., 2007; Lasdon, 1974). The consumption of mercury contaminated fish and seafood is the most common form of exposure for those not directly working with mercury (WHO, 2007), and the international trade of seafood makes mercury pollution a truly global environmental problem. As of 2014, over 60 studies in 19 countries have shown dangerously high bodily levels of mercury for those living in ASGM areas (Gibb & O'Leary, 2014). Mercury pollution has manifested itself through “tremor[s], ataxia, memory problems and vision disorder[s]”, with symptoms experienced by children a particular cause for concern (Gibb & O'Leary, 2014, p. 670). Mercury contamination and the resulting health effects from ASGM seem to be chronically over-studied in comparison to the number of studies investigating how to resolve this serious global problem.

ASGM is the primary anthropogenic source of mercury pollution. Mercury is released as a by-product from other industrial processes such as coal burning, cement production, mining for minerals other than gold, and oil refining (UNEP, 2013a). Intentional uses of mercury in production processes include gold extraction,

the production of thermometers and batteries, catalysing reactions such as vinyl chloride monomerisation, the production of chlorine and caustic soda, and producing dental amalgams (UNEP, 2013a). ASGM is estimated to be responsible for 37% of anthropogenic emissions of mercury into the atmosphere, compared to 24% from coal burning, the second largest source (UNEP, 2013a). This mercury mostly originated in European countries, from where it was sent to over 50 developing countries for use in artisanal gold mining (Veiga et al., 2006), although this situation is changing due to an increase in regulation. ASGM is, then, a priority area for reducing mercury pollution.

Mercury amalgamation is the preferred method of gold extraction in ASGM worldwide. According to Veiga et al. (2006, p. 438), this is because mercury is so “easy to use, available, inexpensive, and miners are not aware of, or choose to ignore, the health risks.” Mercury has a lower surface tension than gold, but higher than water, which allows it to adsorb onto gold particles to form a dense amalgam (Veiga et al., 2006). This amalgam can be separated from the ore either by mechanical means, such as a mill powered by something as basic as a motorbike engine, or through sluice boxes operated by hand. Once the amalgam has been extracted, a blowtorch or open fire can be used to evaporate the mercury, due to its low boiling temperature, leaving concentrated gold (Veiga et al., 2006). A recent trend starting in the 1990s has been the rise of processing workshops offering gold extraction services for miners (Veiga, Angeloci-Santos, Hitch, & Velasquez-Lopez, 2014). These workshops use both mercury and cyanide based extractions sequentially. This means that the mercury reacts with the cyanide, forming the particularly toxic methylmercury which is typically released into streams (Veiga, Angeloci-Santos, Hitch, et al., 2014). These practices can be observed globally, with some local variations.

The Minamata Convention

Mercury pollution is a global problem, and the Minamata Convention is the primary international mechanism for addressing this. Signed in 2013 after ten years of negotiation, the Minamata Convention is a global agreement for the purpose of reducing mercury pollution, the first of its kind (Kessler, 2014). Recognising that ASGM is the key human contributor to mercury pollution, the sector is given significant attention in the document. The 92 signatories to the convention agreed to arrive at action plans to reduce their mercury pollution, and to have progress reviews every three year (Spiegel et al., 2015). However, no date was set for mercury elimination (Kessler, 2014).

With relation to ASGM, the principal approach agreed upon was the formalisation of miners, along with restrictions on the supply of mercury (UNEP, 2013b). This was to be combined with public health strategies and awareness raising in mining communities. In addition, baseline monitoring was to be implemented to quantify the success of these attempts. The specifics of some of these attempts will be discussed later, but they have been criticised as being unworkable or lacking in clarity (Clifford, 2014; Veiga, Angeloci-Santos, & Meech, 2014). It has also been noted that monitoring the progress of mercury pollution reduction is difficult with currently available scientific techniques (Selin, 2014). Despite these problems, mercury pollution is receiving significant global attention as a result of the Convention. The global nature of the problem of mercury pollution could be an avenue for further research, by drawing on the significant body of anthropological work on globalisation. Anthropologists such as Anna Tsing (2005) have investigated the interactions of the local and the global, or how global forces are locally experienced. What an artisanal miner does in the remote jungle of Colombia has become of significant interest to confederations of the world's superpowers, and miners are experiencing the power of such groups through the local application of global forces.

Mercury Reduction Themes

The discussion around mercury-reduction initiatives has centred on several key themes, including technical alternatives, appropriate technology, education, and formalisation, as well as social, cultural and political factors. The literature has generally shifted from seeking a 'silver bullet' approach to appreciating the complexity of the issues at hand and recognising solutions will come from a combination of these themes. I am presenting the themes here separately, but when discussing my own research in Colombia it will become clearer how they interlink.

Alternatives to Mercury for Gold Extraction

From a technical perspective, there are a number of viable alternatives to mercury based gold extraction. Cyanide extraction is the normal technique used by large-scale mining (LSM) companies, and can achieve a 90% gold extraction rate, which is far higher than the 30% mercury can achieve (UNEP, 2012). Cyanide is commonly recommended as a preferable alternative to mercury, although, as it is also toxic, it is an imperfect solution (Davies, 2014; UNEP, 2012; Veiga et al., 2009). The environmental impact of cyanide can be minimised by following the guidelines established in the International Cyanide Management Code (Akcil, 2010). Unlike mercury, which is an element with bioaccumulative properties, cyanide is an organic compound, which means that the environmental effects are reduced by dilution, and that the correct treatment of cyanide can facilitate its decomposition (Johnson, 2015). This is in contrast to mercury, which as an element does not decompose, and as it can bioaccumulate, dilution does not ensure human or environmental safety. The majority of the problems with cyanide arise from its mismanagement, rather than from inherent problems with its correct management (Hilson & Monhemius, 2006), whereas mercury cannot be satisfactorily managed. One problematizing factor is that cyanide pollution is a local problem, whereas mercury pollution is a global problem. The potential to have global health impacts has likely changed how mercury is perceived relative to cyanide by global actors.

Other suggested alternatives to mercury include gravitational, flotation, borax, magnet and activated carbon based extraction methods (Davies, 2014; UNEP, 2012). Some of these methods will be discussed in this thesis. While there are technically feasible alternatives to mercury for gold extraction, these have not been widely adopted within ASGM for reasons that this thesis explores.

Appropriate Technology

Many of the proposed alternatives to mercury are not necessarily appropriate for ASGM. Hilson (2006) argued that many of these are impractical in terms of inputs, maintenance, cost, mobility *etc.* Instead, 'appropriate technologies' have been argued for (Jønsson, Charles, & Kalvig, 2013), a concept drawn from Schumacher (1993). One example of this was the distribution of iron retort stands² in Tanzania that were cheap and efficient, yet could be easily made and repaired from local materials and be modified by the user, and were therefore considered more appropriate for that context (Jønsson, Appel, & Chibunda, 2009). Jønsson et al. (2009) nevertheless assert that appropriate technology must be accompanied by education and continuous support to be implemented successfully: despite a positive initial reception to their retorts in Tanzania, follow up visits revealed that miners had not continued to use them (Jønsson et al., 2013). While appropriate technology holds promise, it is clear that a broader understanding of the way miners relate to technology is necessary.

Education

Education has been seen as a core strategy for reducing mercury pollution by many of those working in the field. The need for education does imply a lack of knowledge, and researchers have identified ignorance and tradition as key reasons for the continued use of mercury, noting that many miners are illiterate and lack formal education (Veiga, Angeloci-Santos, & Meech, 2014). There is significant evidence that many miners and mining communities do not necessarily recognise

² Retorts are devices that can be placed over the mercury-gold amalgam during burning to capture the mercury vapour given off, reducing mercury use and pollution.

mercury to be toxic (Hilson, 2006; Hilson, Hilson, & Pardie, 2007; Novais & Câmara, 2009). Education initiatives aim to teach miners about mercury's toxicity, clean mining techniques, and business skills. Pioneering work in education and training is being done at an educational facility in Portovelo, Ecuador, where miners from Colombia, Ecuador and Peru have received training in each of these fields (García et al., 2015; Veiga, Angeloci, Ñiquen, & Seccatore, 2015). More creative and engaging public awareness campaigns have also been utilised, for example, street theatre has been used to disseminate information on mercury and the use of retorts in Zimbabwe (Metcalf & Veiga, 2012).

Formalisation

Formalisation is the key strategy outlined in the Minamata Convention, and is prominent in the literature for reducing mercury pollution from ASGM (Clifford, 2014; Hinton et al., 2003; UNEP, 2013b). However, this approach has been criticised as lacking in clarity and being ineffective without accompanying education and technical assistance (Spiegel et al., 2014; Veiga, Angeloci-Santos, & Meech, 2014). Siegel and Veiga (2009) found the most commonly discussed definitions of formalisation included consistent legislative frameworks, the registering of mining activity and the assigning of property rights. Siegel and Veiga (2009) also use the work of Peruvian economist Hernando de Soto (2000) to argue that formalisation should involve the incorporation of customary rights into a unified, formal system of property rights. Attempts at formalising ASGM around the world have largely been unsuccessful, for various reasons (Clifford, 2014; Güiza 2013; Mosquera, 2006; Veiga, Angeloci-Santos, & Meech, 2014). Regulatory approaches are also being used to restrict the trade in mercury, although there are predictions this will merely result in a black market (Clifford, 2014; UNEP, 2006). Even if formalisation could be implemented, it is unclear how it will lead to an elimination of mercury pollution.

Social Dynamics

As attempts to find technological solutions have failed, many authors now feel that the problem is as much social as it is technical, and therefore social, cultural and political factors should be considered. Clifford (2014, p. 109) writes, “It is also essential that such projects [mercury reduction initiatives] contain an explicit consideration of the sociological dimensions of mercury use and pollution.” Spiegel et al. (2014) draw attention to how many mercury elimination policies are top down rather than grassroots ones, and are problematized by a lack of trust. They argue for policies based on solidarity, participation, empowerment, fairness, and social justice. Spiegel et al. (2015, p. 765) argue that “a paradigm shift is needed to address intertwined technological, political, and socio-economic challenges facing marginalized communities in mining populations”, and for an appreciation of local knowledge and collaborative approaches. While this approach is certainly admirable, there is a lack of clarity about what exactly is meant and a clear methodology for achieving these goals. This thesis is then a response to these recommendations from an anthropological perspective.

The Artisanal and Small-Scale Gold Mining Industry

Artisanal and small-scale mining of gold and other minerals is a significant industry throughout the developing world. However, no single uncontested definition exists, and the sector is usually described by reference to a series of characteristics or essential qualities. Typical characteristics listed include informality, disorganisation, small or micro-enterprises, labour intensive, low levels of technology, the use of mercury, low wages, low numbers of workers employed, low volumes or value of production, low levels of capital investment, and small-sized claims (Barry, 1996; Eftimie et al., 2012; Hinton et al., 2003; ILO, 1999; UNEP, 2006, 2012). Many reports use ‘artisanal’ and ‘small-scale’ interchangeably, further problematizing the possibility of a precise definition. The lack of widely accepted definitions and the informal nature of the industry have significantly hindered precise quantification. Estimates of the number of people employed globally in ASGM have ranged from

ten to fifteen million (UNEP, 2012; Veiga & Barker, 2004), and possibly as many as 80-100 million are dependent on small-scale mining of all mineral types (ILO, 1999). The most comprehensive estimate of gold production from ASGM was given as 380-450 tonnes of gold per annum by Seccatore, Veiga, Origliasso, Marin, and De Tomi (2014), or 19.9% of global production. These figures have earlier been estimated to be 15% of global production in 2011 by the United Nations Environment Programme (UNEP, 2012), or a total of 500-800 tonnes per annum by Swain et al. (2007). UNEP (2012) also reports that ASGM represents 90% of the global gold mining workforce, making the industry's impact in terms of employment far more significant than its impact in terms of gold production would suggest. While the size of the industry is apparent, how it contributes to development is less clear.

The contribution that ASGM makes to development is a subject of complexity and ongoing debate. As Hilson (2005) points out, this is further problematized by a lack of quantitative census data. There are a number of studies that argue that ASGM reduces poverty, providing an additional source of income when others fail (Bryceson, Fisher, Jønsson, & Mwaipopo, 2014; Maconachie & Hilson, 2011). In an analysis of the Tanzanian situation, Fisher, Mwaipopo, Mutagwaba, Nyange, and Yaron (2009) begin by distinguishing between poverty and vulnerability. They argue that, at least in the short term, artisanal mining reduces poverty and that miners were relatively well off. However, due to the informal or even illegal nature of the industry, it increased their vulnerability as they were marginalised in favour of LSM projects. The informality of the industry is therefore problematic with regards to development. Siegel and Veiga (2009) used de Soto's (2000) work to argue that the only way for ASGM to contribute to economic growth is by formalisation, as by that theory capital in an informal industry is dead capital and therefore unproductive.

There are also divergent theories on the role artisanal mining and state formation. Typically, artisanal mining has been seen as a source of weakness for the state, in that as part of the informal economy they usually do not pay taxes and may contribute to alternative power structures and violence (Le Billon, 2001; Nordstrom, 2000). However, more recent work has demonstrated that artisanal

mining may in fact strengthen the state, and when placed into a quasi-legal framework, it can be a key resource for local 'strong men' politicians (Verbrugge, 2015b). While ASGM may strengthen the state in this mode, it is a set of relations based on at least moderate corruption, which in turn can hinder long-term development. No consensus has been reached on the relationship between ASGM and development, but the subject is receiving more attention. Any investigation into the ASGM-development relationship must consider the environmental impacts of ASGM and how the sector relates to the government. I aim to illuminate these aspects in this thesis.

The Anthropology of Mining

Mining anthropology is a small sub-discipline that has taken diverse approaches to a complex phenomenon. Perhaps the classic texts in the anthropology of mining are Michael Taussig's (1980) *The Devil and Commodity Fetishism* and June Nash's (1993) *We Eat the Mines and the Mines Eat Us*. Nash (1993) describes the indigenous work force of tin mines in Bolivia, using thick description for a bottom up view of mining. She explores the relationships between society, culture, labour relations, and capitalism, describing the lives and world views of those working in the mines. Taussig (1980) takes a strong Marxist approach, investigating the way that Bolivian tin miners and Colombian peasants from non-capitalist societies make sense of capitalism. He notes they usually refer to capitalist relations through the metaphor of the devil, revealing problematic aspects of capitalism. The classical anthropology of mining has, then, largely focused on the political economy of mining.

In a 1995 review of the anthropology of mining, Godoy stated that anthropology had arrived to mining late, and had not yet systematised its approach. After introducing the business of mining, Godoy then discusses studies of the demographics of the workforce, its political organisation, labour relations, economic impacts, and then ritual and ideology (drawing heavily on Nash and Taussig). A more recent review is provided by Ballard and Banks (2003), which goes

past the tripartite model of states, mining companies and communities, arguing that these entities are not as monolithic as they appear. The background they give to the review is a mining industry increasingly operating in remote indigenous areas, a more powerful indigenous rights movement, and an increase in the use of institutionalised impact assessments. The review shows a diversification of anthropological perspectives, analysing mining companies themselves as well as their workforces, covering issues relating to the transnationalism of the industry, investigating the links between mining and conflict, and providing a more nuanced understanding of 'communities' and the ways in which they may benefit or be marginalised by mining operations. Crucially, they show how the role of the anthropologist is now political, and that anthropologists can no longer think of themselves as a 'distant observers'. Anthropologists have worked for mining companies, states and communities, often clashing in the process, and have found their work being employed in various political enterprises. Both of these reviews are, however, focused on larger scale mines, which have a fundamentally different nature to ASGM.

The Anthropology of ASGM

ASGM has been investigated by anthropologists, or more broadly those researchers using ethnographic modes of analysis, although there has been less research on the subject than could be expected considering the size of the industry and the challenges it presents. The current research is almost exclusively composed of ethnographies of miners, as opposed to ethnographies of mining. These studies are the reverse of many of the articles previously mentioned in this review, which discuss mining but not miners. Many anthropological studies have focused on gender in ASGM communities, from both masculinist and feminist perspectives (see Bryceson, Jønsson, & Verbrugge, 2013; Cohen, 2014; Cuvelier, 2014). Other topics covered by the anthropology of ASGM include friendship (Grätz, 2004), morality (Grätz, 2009), perceptions of risk (Soemarwoto & Ellen, 2010), decision making (Tubb, 2015), the relationship between mining and state formation (Verbrugge, 2015b) and mining as an economic livelihood (Heemskerk, 2002). Taussig (2004) has

more recently written on ASGM in the Chocó department of Colombia in *My Cocaine Museum*, a work I found highly alternative yet inspiring. In his own extremely unique style, Taussig considers the materiality and mysticism of mining through a series of vignettes and recollections of sensorial experiences. While the anthropology of ASGM has provided a number of fascinating insights, to be able to address the problem of mercury pollution I feel greater attention must be paid to the materiality of mining. Taussig's (2004) work provides not so much a guide, but an inspiration to doing so.

A Theoretical Toolbox

What I am presenting in this section is a 'tool box' of the different theoretical concepts that I will be using in this thesis, rather than a theoretical framework in its own right. So far, this chapter has presented a problem, and from here on are the theoretical tools I will use to address that problem. While I will begin to discuss the way these theories interrelate with each other, drawing attention to overlaps and contradictions, I will not necessarily resolve these contradictions at this stage. This differentiates the tool kit from a theoretical framework, as the theories are presented individually to be used as needed, as opposed to a framework in which they are integrated into a coherent whole, ready for normative application.

I first want to clarify how I will be engaging with theory in this thesis. The approach that I have taken towards theory has been largely inspired by perspectives from *The Ground Between: Anthropologists Engage Philosophy* (Das, Jackson, Kleinman, & Singh, 2014). I agree with Singh's (2014) argument that concepts are present at the point of impressions, rather than impressions leading to concepts, and so our conceptual understandings make the world around us appear different. Singh locates himself within non-dialectic thought, which he loosely describes as the school of thought which appreciates negation as being potentially productive, and, therefore, does not consider all negations as needing resolution. Singh further describes this as 'antagonistic intimacy', the idea that contradicting concepts can productively coexist. Building on these concepts, I would say that I do not consider

theory simply as an objective description of the world, but rather a subjective way of viewing the world, and that these subjective ways of viewing the world should be evaluated on their utility towards addressing the problem at hand. This argument needs some clarification and qualification. First of all, when I say that theory is a subjective way of viewing the world, this does not mean that empirical evidence is irrelevant. Rather, the theoretical approach must be supported by the empirical data. However, different theoretical perspectives may be taken from the same empirical data, each drawing attention to different aspects of the situation. In the same volume, Biehl (2014) also speaks to this approach, critically comparing the insights provided by Foucauldian and then Deleuze and Guattarian theoretical perspectives with regards to the same ethnographic work. I am selecting the theoretical perspectives that are most useful in relation to the problem at hand, the problem of mercury use in Antioquia, Colombia.

Deleuze and Guattari

The philosophical work of the French thinkers Gilles Deleuze and Félix Guattari has been a large inspiration for the approach taken in this thesis. In addition to their direct influence, their philosophy has been drawn on by other theorists that I am using, in particular Tim Ingold. Deleuze and Guattari's theoretical work is vast, complex, and unstructured, and so it is near impossible to summarise. It has been described as a restructuring of Western thought, of moving from a dialectic tradition focused on structure to a non-dialectic mode of unstructured and decentred thought³ (Holland, 2013; Singh, 2014). Perhaps one of the most important contributions is the shift in focus from 'being' to 'becoming', a recognition that the world is not static by nature, but rather in flux. Therefore, what should be considered is not what things *are* but what they are *becoming*. Deleuze and Guattari (2014) describe two models of space, namely 'smooth space' and 'striated space'. Smooth space is space which changes and varies, but it does so continuously and without clear boundaries marking the change in space. Striated

³ This is best described as rhizomatic thought, although the concept of the rhizome will not be discussed here.

space is space with clear boundaries marking the change in space, and relative homogeneity within those boundaries. Deleuze and Guattari (2014) argue that states tend to operate in striated space and actively striate previously smooth space, while 'nomads' operate in smooth space. The modes of space described here are not absolute, but rather a spectrum, and in reality situations are relatively more or less striated.

While Deleuze and Guattari's concepts are useful, they are notorious for a lack of fidelity to empirical data. For example, their use of the term 'nomads' has been heavily criticised for having little relation to actual nomads (Jensen & Rödje, 2010; Miller, 1993). Deleuze and Guattari's work is very much philosophical and largely based on thought experiments, as opposed to social science which is accountable to empirical data. Nevertheless, Deleuze and Guattari's philosophical project is useful in making the world look different at a more abstract level, essentially becoming useful through an application to empirical data rather than from their own use of such data. Their concepts have provided a change in perspective that has been essential for this research.

Posthumanism

In this thesis, I will be drawing heavily on posthuman theories, which is a loose term for theories which consider both humans and nonhumans. As both human and material factors seem to contribute to mercury pollution, posthuman theories allow an understanding of the relationship between these factors. Recent trends in anthropology have tended to reduce the world to the socio-cultural and the linguistic. Posthuman theories introduce materials and materialities which are not reducible to social determinations or linguistic representations. These posthuman theories also link into the 'practice turn', which recognises practices, instead of societies, as the core driver of knowledge production (Calvert-Minor, 2014). It is these theories I find most useful for understanding the relationship between materials and society.

The calls for attention to be paid to the social, cultural and political aspects of mercury implicitly seem to be built on a socially deterministic understanding of mercury use. The implication is that mercury use is a function of social or linguistic factors, and not the materiality of mercury. For example, Clifford (2014) argued that not using mercury is simply a matter of behavioural change, like quitting smoking if we were to ignore the addictive nature of tobacco. However, the flaw is present in his own argument: "...omitting the addictive elements of these [cigarettes]..."(Clifford, 2014, p. 109). The addictive element is the materiality of tobacco, and any anti-smoking initiative that ignored tobacco's addictiveness would surely be a failure. What I want to emphasise are the materialities of mercury that encourage its use and that are not reducible to social factors. The only study that I have found to deeply consider mercury's human entanglements, although not using the same language or theoretical basis as I do, is Hilson's (2006) work on mercury's role in trapping miners in Ghana in debt. Mercury is used in ASGM throughout Latin America, Africa, and Asia, historically in the gold rushes in the USA and Canada, and as late as 1988 in ASGM in New Zealand (Gibb & O'Leary, 2014; Newcombe, 2008; Nriagu, 1994). Mercury is used in geographically and ethnically diverse contexts, and as these contexts lack common socio-cultural factors, socio-cultural explanations alone are insufficient. A theory of mercury use in ASGM must be able to consider both human and material factors, and this is what posthumanism provides.

For a robust and well-grounded theory for ontological and epistemological understandings of materials, I have relied upon the work of Karen Barad. Barad has a background in theoretical particle physics (Barad, 2007), and her deep understanding of science gives her work on materials a theoretical depth lacking in some other accounts. Her work integrates quantum physics with philosophical and feminist theories of materials, arriving at key concepts such as 'entanglements', 'intra-actions' and 'performances' (Barad, 2003, 2007). Barad's work is locatable within a relational ontology, whereby the relationship between entities is prioritised over the existence of the individual entities. Barad describes entities as coming into existence through their mutual entanglement, stating that existence is

not an individual affair. She avoids the term 'interactions', which implies two separate entities interacting, instead preferring 'intra-actions', which she describes as objects acting through each other, not on each other (as the latter would presuppose individual existence). Finally, Barad argues that we do not come to know the world by representing it, which she demonstrates to be the key flaw in realist/constructionist debates of science. Rather, we come to know the world through practices/performances, or by intra-acting with it. Barad does not limit her concept of entanglements to materials, and one of her prime examples is the entanglement of materials and meanings, and she argues that all matter is material-discursive. Barad achieves this by simultaneously redefining discourse as being both material and linguistic. Barad's work is invaluable, and provides a solid theoretical base for much of this thesis. Posthuman theories are often lacking in their ability to deal with politics⁴, and Barad provides a conceptual, if not practical, basis for doing so. I say conceptual as her work is based on quantum physics, and is located within science and technology studies, and therefore needs to be adapted for application in a social science context.

From a more anthropological perspective, Tim Ingold provides a theoretical framework based on a relational ontology directly applicable for social science. While he and Barad rarely cite each other (see Ingold, 2012, for exceptions), their work has a number of key similarities. Ingold draws our attention to 'things', by which he means materials in motion, or a continual process of form-making. Things exist in relation to other things: a relational ontology with clear similarities to Barad's work. Ingold (2010a, 2012) describes what he refers to as the 'meshwork' of life, or the flow of materials continually interacting with each other. Ingold (2012) develops this by considering the industrial production of various materials, examining how production is the entanglement of different materials in a mutual process of becoming. This draws attention to both the dynamic nature of matter, the fact that it is historicity, or in a constant state of becoming not being, and how

⁴ See Cudworth and Hobden (2013), Drake (2015), and Hawkins (2009) for some exceptions. While Bennett (2010) is recognised for considering the politics of materials, in my opinion she able to ask the right questions but her overreliance on philosophy instead of natural science limits her ability to answer them.

this becoming occurs in conjunction with other materials. Ingold (2010a) explicitly rejects the use of the term 'agency' with regards to materials, as he sees this as locating the capability of a material to act within that material. Conversely, he argues that this property emerges from a meshwork of materials. Barad (2007) does use the term 'agency', but defines it as a collective property of matter's intra-actions. The difference here is purely a semiotic one. In this thesis I have generally opted not to use the term agency, as I found that it tends to mystify the ability of materials to act, whereas using entanglements allows for a more accurate, relational understanding.

Ingold's work is also locatable within the 'practice turn'. His essays on practices, and on walking in particular (Ingold, 2000, 2010b, 2010c), explore ways of knowing the world by engaging with it rather than by simply representing it. This perspective is remarkably similar to that of Barad (2007), despite being developed in a different context. Ingold (2012) furthers this perspective when he contrasts alchemic science, where the practitioner learns what materials *do* through using them, to chemical science where the practitioner learns what materials *are* through studying them. In his work, Ingold (2000, 2010b) draws on the cyberneticist Gregory Bateson's⁵ (2000) notion that the mind is not restricted to the body, but extends across different sensory pathways into the world. Ingold also draws on dance philosopher Maxine Sheets-Johnstone's (1999) research on the kinetic nature of thought and thinking in movement. Again, these perspectives are based on a relational ontology, whereby practices involve the intra-action of people and materials. Ingold's work complements Barad's work on materialism, but offers more practical avenues for implementing these theoretical perspectives in Antioquia.

A more recent development within the posthuman literature is the concept of 'absent presence', which has been discussed by authors such as Farrelly, Stewart-Withers, and Dombroski (2014); Frers (2013); Hetherington (2004) and Meyer (2012). These accounts ascribe an agency or materiality to the absence of a material, as absence itself can affect social relations. This is an important

⁵ Bateson was also a major influence on Deleuze and Guattari's work.

development for this context, as current posthuman theories are appropriate for understanding the entanglements of mercury, however, in this thesis I wish to go further and examine the implications of eliminating mercury. This could be described as the ‘negative entanglements’ of mercury, or ‘entanglements with mercury’s absence’. This concept is appropriate within a relational ontology. If ‘agency’ is situated in a meshwork of materials (Ingold, 2012), or in materials interacting through each other (Barad, 2007) and not materials themselves, it is reasonable to expect the removal of a material from a material configuration will change that configuration’s agency. A relational approach to materials, as opposed to an essentialist one, is productive for this research.

Bourdieu and Ecological Habitus

Finally, I have included in this toolkit the theoretical work of the sociologist Pierre Bourdieu and the concept of ‘ecological habitus’, which extends Bourdieu’s work to environmental concerns. Bourdieu’s theoretical work is vast and complex, and as I am only making auxiliary use of it here I will not go into it in the depth it deserves. Bourdieu’s work bypasses the structure/agency debate between the relative importance of determining social structures and individual free choice or agency (Hage, 2014). Bourdieu writes that individuals and structures are co-constitutive, rather than determinative of each other. Individuals are located in specific fields, and deploy strategies which work effectively within those specific fields. Bourdieu does not, however, subscribe to rational choice theory or the idea that individuals always act to maximise their profit, but instead argues that they act to augment their social being (cited in Hage, 2014). The worlds that people inhabit are identified as “real constructed realities”, in that they are socially constituted, but this does not detract from their reality (Hage, 2014, p. 150). One crucial concept I will be drawing on in this thesis is the relationship between different realities. The effectiveness of strategies is reality-specific; however, these realities can be dominated by other realities. For example, Bourdieu (1990) conducted much of his original fieldwork with the Kabyle people of Algeria. As their world changed due to French colonialism, their strategies ceased to function as well, not because the

strategies were ineffective in their reality, but because the reality in which they were effective was dominated by another dominating reality (Hage, 2014).

Bourdieu's work is very popular amongst anthropologists, however, it does stand in contradiction to some of the other theories I am using in that it is locatable within the social turn. For Bourdieu, human behaviour is seen as a function of the social (a composite of individuals and structures), while the material is not given due consideration. Furthermore, Bourdieu is focused on *being*, not *becoming*, and while his work has been powerful in explaining inertia, it has been problematic at explaining change. One extension that has been made on Bourdieu's work is the concept of ecological habitus (Haluza-DeLay, 2008; Kasper, 2009; Smith, 2001). In short, this describes an extension of the field to include the environment. This means the development of a habitus which privileges ecological concerns and works effectively within that enlarged field (Haluza-DeLay, 2008). This can be achieved by engagement with or sensorially experiencing the field. This has been employed to theorise social change with regards to environmental sustainability. Ecological habitus offers the possibility for extending Bourdieu's work to comprehend the material world and the potential for change.

Conclusion

In this chapter, I have presented both a problem and a theoretical toolkit for addressing this problem. Mercury pollution is a major international environmental challenge that poses a serious risk for human health, and ASGM is the largest anthropogenic source. ASGM is a large industry in developing countries, and a significant source of employment. However, its potential contribution to development outcomes has been hindered by its environmental degradation and troubled relationship with governments. A number of attempts have been made at reducing mercury use in ASGM, focused on themes of education, appropriate technology and formalisation, but these have largely been unsuccessful. Many early attempts were crippled by a search for a 'silver bullet' approach, but now most experts understand the situation is more complex, and that solutions are likely to

arise from a combination of the factors given above as well as paying attention to social, cultural and political factors. However, it is unclear how this is to be achieved. In response to this, I have provided a theoretical toolkit primarily based around non-dialectic philosophy and posthuman theories. What these allow is an unstructured approach to an informal industry and an understanding of how people engage with materials. In considering mercury use in ASGM, I argue that both 'human' factors and materiality should be considered, but they should be considered as entangled. That is, they exist through relating to each other, a relational ontological perspective. Relational posthuman theories provide a powerful tool as part of an anthropological perspective on the social and material entanglements of miners and mercury.

Chapter 3: The Context of Antioquia, Colombia

In this chapter, I will discuss mercury use in ASGM in the specific context of Antioquia, Colombia. In 2011, Colombia was identified as the highest mercury polluting country in the world per head of population, with much of that pollution originating in Antioquia (Cordy et al., 2011): a strong local manifestation of a global problem. I will firstly discuss the scale and nature of the problem of mercury use in ASGM in Antioquia. Then, I will introduce the country of Colombia, the department of Antioquia, and finally my fieldwork sites. I will give a history of mining in Colombia, both in terms of ASGM, LSM, and the tensions between the two, as well as briefly discussing the government's extractivist mining policies. I will also consider the economic significance of ASGM, and links between ASGM and illegal armed groups. I will give a brief discussion of informality and ASGM, and of previous attempts at formalisation in Colombia. I will then discuss specific initiatives implemented to address mercury pollution. This chapter presents the problem of mercury pollution from ASGM in Antioquia, the attempts at fixing the problem which have pushed the ASGM industry into a heightened state of flux, and the wider national context and political environment within which miners must navigate a changing world.

Mercury Use in Antioquia

The naming of Colombia as the world's worst mercury polluting country per head of population in 2011 was a shameful reminder of a major problem centred on ASGM. Until recently, mercury was used almost ubiquitously for gold extraction in ASGM in Antioquia, while LSM has ceased to use mercury in preference for other industrial methods (Güiza & Aristizábal, 2013). I have been unable to determine when mercury use began in Antioquia, but it must have been present for a number of generations, as no one I spoke with could recall how it arrived. The use of mercury has already been observed to have negative local health impacts, in addition to contributing to global mercury exposure.

A number of studies have established mercury levels to be high in the mining areas around Antioquia, and this mercury pollution is causing negative health impacts. Olivero, Mendonza, and Mestre (1995), from the University of Cartagena (*Universidad de Cartagena*), found dangerously high levels of mercury in the hair of fishermen and miners in the Bolívar department, down river from the mining areas in Antioquia, and established that eating fish was a major route of mercury exposure for segments of the population not involved in mining. The study also recorded symptoms linked to mercury poisoning, reporting high incidences of headaches, memory loss, metallic tastes in people's mouths, irritability, shaking in hands, nausea, oral peeling and bleeding gums.

Cordy et al. (2011), from the University of British Columbia, estimated the amount of mercury being lost to the environment from gold processing workshops in Colombia to be 150 tonnes per annum. This value was extrapolated from a small number of processing workshops that were investigated, and the actual figure could therefore be significantly higher. Cordy et al. (2011) also took atmospheric readings in the urban areas of Segovia and Caucasia, two gold mining towns in Antioquia, reporting background levels of 300 ng Hg/m³, a common reading of 10,000 ng Hg/m³ in residential areas, and up to 1,000,000 ng Hg/m³ inside gold buying shops, far higher than the WHO limit of 1,000 ng Hg/m³. In a later study, Cordy et al. (2013) found that residents of Segovia who were not involved in mining were being exposed to unsafe levels of mercury and were at risk of neurological and renal defects. The authors stated that while moves to use retorts to capture mercury vapour would be positive, no known system was efficient enough to bring the mercury vapours down to safe levels, and mercury burning must be moved outside of the towns (Cordy et al., 2013; Cordy et al., 2011). Mercury pollution is therefore a serious problem in Antioquia.

Colombia

Colombia is a Spanish speaking country in South America (Figure 1). While still facing issues of poverty, crime and violence, Colombia's development has progressed significantly. Colombia was rated 97 in the 2014 Human Development Index, with a gross national income of \$12,040 USD per capita (UNDP, 2015). Colombia's HDI ratings have increased steadily over the past 5 years. However, Colombia does have a high coefficient of human inequality at 24.1⁶, a 37.4% inequality in income and a 13.5 year inequality in life expectancy. Both the human inequality index and the income inequality are above higher than global averages (22.7 and 24% respectively) (UNDP, 2015). 30.6% of the population live below the national poverty line. While a number of these statistics are negative, they must be qualified by noting that the situation in Colombia is improving (UNDP, 2015). Historically, Colombia has experienced significant amounts of violence, perpetrated by communist guerrillas, paramilitaries, the army, and criminal gangs. Fortunately, this has lessened significantly, with many armed groups being disbanded, and the largest guerrilla group is currently in peace negotiations with the government (Bushnell, 2002; Carlos Andrés, 2015; Luis Fernando, Santiago, & Héctor José, 2015). National development is significant as poverty has often been considered as a factor driving people into ASGM (Heemskerk, 2003; Hilson & Banchirigah, 2009).

Colombia was previously a Spanish colony, and achieved independence by revolution in 1810 (Bushnell, 2002). Spanish (Castellano) is the official language, and is spoken almost universally in Colombia (Banco de la República, 2015). There are 65 recognised indigenous languages, none of which are widely spoken (Banco de la República, 2015). The majority of the country (86%) are 'non-ethnic' according to the census, a vague term referring to those of European or mixed European and Amerindian descent (Hudson, 2010). There is a significant minority of Afro-Colombians who are descended from African slaves (10.5% of the population), and over 80 indigenous ethnic groups (3.4% of the population). Ethnic politics are linked to property rights, with Rivera-Sotelo and Pardo Becerra (2014) noting that the

⁶ "Average inequality in three basic dimensions of human development" (UNDP, 2015, p. 219).

'non-ethnic' population was frequently denied the possibility of claiming traditional mining rights or a connection with the land.



Figure 1: Map of South America, with Colombia highlighted (Google, n.d.-b).

Antioquia

Antioquia is a central and mountainous department, densely populated, industrialised, morally conservative, Catholic, and has a distinct regional identity. Colombia is divided into 32 departments, which are administrative regions roughly equivalent to states. Antioquia is the second most populous department in the country, with over 6 million inhabitants, of a national population of 48 million (ProAntioquia, n.d.). It has a varied geography, mostly mountainous as it is in the

Northern end of the Andes, but it also has swamps, forests and a small section of Caribbean coastline (Figure 2) (Hudson, 2010). The people of Antioquia have been noted as having a distinct regional identity, emphasising hard work and morality, standing out from their wider Colombian identity (María Teresa, 2006; Uribe de Hincapié, 1998). Antioquia is an economic and manufacturing centre in Colombia, with 13% of the country's manufacturing located around the departmental capital of Medellín alone (Camara Medellín, 2012). A large portion of the ASGM activity in Colombia is centred in the sub region of the Bajo Cauca (the lower region of the Cauca River), where I conducted some of my fieldwork⁷. The particular context of Antioquia within Colombia is important, as the mining I investigated appeared to be of a different character to that found by anthropologists working on mining in other Colombian departments (i.e. Taussig, 2004; Tubb, 2015).



Figure 2: Map of Colombia, with Antioquia highlighted (Google, n.d.-a).

⁷ The Bajo Cauca is comprised of 6 municipalities; Cáceres, Caucasia, El Bagre, Nechí, Tarazá, and Zaragoza.

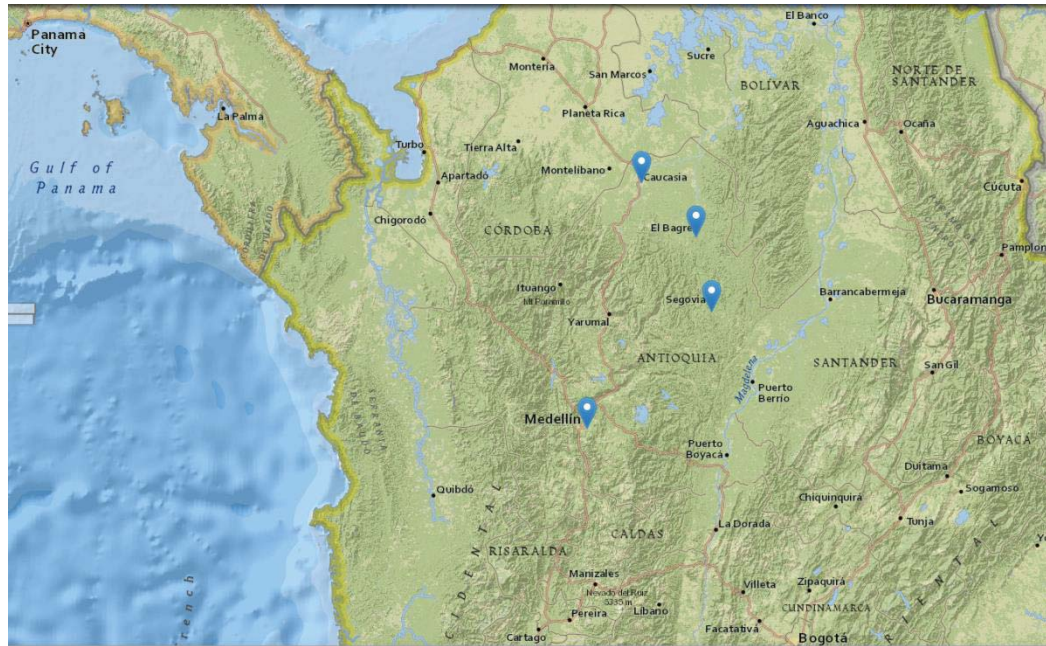


Figure 3: Map of Antioquia, with fieldwork locations marked (National Geographic, n.d.).

Medellín

Medellín (Figure 3) is the largest city in Antioquia, and the departmental capital. It has two and a half million inhabitants (DANE, 2015), all located in a single valley in the Northern end of the Andes. The city contains geographically segregated extremes of wealth and poverty. It is at once progressive, and in 2013 received the global ‘most innovate city of the year’ award (del Pimar Camargo, 2013), while still grappling with high levels of poverty. Despite its problems, to me it has always seemed a beautiful place, and one that has come to feel like home. While Medellín is several hours drive from the nearest mining site, it does have significance as the major regional hub. It is where many of the large mining companies, NGOs, and relevant government departments maintain their offices, and so I had a number of meetings and interviews within the city. It is where I based myself, staying with a close friend, and from where I made my field trips.

Caucasia

Caucasia (Figure 3) is the mining town in which I spent most of my time, located in the municipality of the same name. Caucasia is not solely dedicated to mining, and also has a strong agricultural industry. Visitors to the town are greeted by a large monument of a gold pan, above a sign saying the ‘Land of the Barequeros’ (gold panners) (Figure 4).



Figure 4: Monument outside the bus station in Caucasia.

The first thing I noticed on arrival was the heat. After Medellín’s more moderate mountain temperature, the thick humidity of Caucasia is something of a shock. The city is set in an agricultural area, which is green and wet. The surrounding landscape is a mix of thick forests, large swamps with wallowing buffalos, lush grassland, and rice plantations. The mining is mostly placer mining⁸, including open-pit mines, dredges and gold panners, and many of these mines are easily visible from the main road into town. The town itself is flat and sprawling, with a population of around

⁸ The mining of alluvial gold.

80,000 (Alcaldía de Cauca, 2012). Official statistics from 2004 showed that 91% of the population have unsatisfied basic necessities and 58% live in precarity (Alcaldía de Cauca, 2004), yet the town is nevertheless busy and active. It has wide roads full of motorbikes, basic and ramshackle housing, and a lively and active atmosphere. Mining certainly seemed an attractive option to locals, with many telling me about the good money to be made from gold. I based myself in a cheap hotel on the edge of the city near the bus station, but would frequently head in to the centre. The central area contained a bustling market, some lively bars and clubs and a number of gold buying shops. Security was not a major issue in the town. A good friend of mine from Medellín took on a job just outside of Cauca before I arrived, giving me a social contact there. I enjoyed my time in Cauca, and was able to make lasting social contacts.

Segovia

Segovia (Figure 3) is a town of 50,000 people, and it is completely based around mining. The effects of this, both positive and negative, are evident. It is located in a mountainous area, and has a moderate climate. The mining is all hard rock, which is very different from placer mining. A monument of a miner working a subterranean tunnel, with a chained naked woman above (who I was told represents mother earth) is located in the town plaza (Figure 5). LSM was introduced in the area in 1852, although there is evidence of pre-existing ASGM (José Hoyos, 2012).

The long history of mining in Segovia is accompanied by a long history of violence. The town was the site of a massacre in 1988 by a paramilitary group in which 43 people were killed (Radio Santa Fe, 2013). This violence has continued until today, with one miner being fatally shot in the surrounding rural area during the period I was conducting fieldwork (Isaza Giraldo, 2015a). The violence has increased since I completed my fieldwork, as one processing workshop was attacked with a grenade leaving two wounded, another miner was non-fatally shot, and the 'Los Urabeños' paramilitary group, who were presumed responsible for the attacks, announced their 'pistol plan' (*plan pistola*) to extort more money from local mines using

violence (Esteban Vásquez, 2015; Isaza Giraldo, 2015bb; Martínez Arango, 2015a). I certainly noticed a strong presence of armed police during my fieldwork period. I discussed all my travel plans with my contacts in the field (as stipulated in my personal risk management plan), and only proceeded with the advice these contacts provided, which meant staying within the urban centre. The majority of the commercial shops were related to mining, including processing workshops, gold buyers, and sellers of mining equipment. The other commercial premises were largely bars, restaurants and some shabby casinos. Prostitution was obvious and common, with many sex workers on the streets at night. While there is certainly money present in the town, it would appear to be unevenly distributed, as expensive cars are juxtaposed against an otherwise run-down town. Despite the town having a number of negative characteristics, the people were generally friendly and welcoming.



Figure 5: Monument in the central plaza of Segovia.

El Bagre

While Segovia feels rough, El Bagre (Figure 3) feels like the ‘Wild West’. Literally meaning ‘The Pike’ (the fish), El Bagre is located in the middle of a jungle and in incredible heat and humidity. The town is only accessible by a dirt road with numerous military checkpoints or through a small airstrip. El Bagre is also based completely around mining, the presence of which is very obvious. Large dredges are easily visible on the river, and most of the stores are related to the gold industry. It is also the location of a recently built government training centre for miners (García et al., 2015; Martínez Arango, 2015bc). The town is full of narrow streets, ramshackle buildings, and everything seems to have been hastily built. I discussed security concerns with my contacts from the training centre who had invited me to visit. They recommended only staying during the day, and insisted on picking me up from the bus station and taking me directly to the training centre, which was monitored by security guards. While these precautions were sensible and ensured my safety, I was unable to spend time ‘hanging out’ in the town itself.

Gold Mining in Antioquia

Gold mining has a long history in Antioquia, with gold mining and advanced gold smithing occurring in pre-Columbian times (Bushnell, 2002; Labbé, 1998). Many incredible pieces of pre-Columbian gold work can be found in the Gold Museum (*Museo de Oro*) in the capital, Bogotá. This museum was a focus of Taussig’s (2004) *My Cocaine Museum*, where he observes that the museum neglects to mention the work of contemporary Afro-Colombian gold miners, something also noted by Tubb (2015). Since the arrival of the Spaniards, the history of ASGM has been highly entangled with that of LSM, with which it has often had an antagonistic relationship (Echavarría, 2014; Urán, 2013). This is not surprising considering that an estimated 90% of ASGM occurs in areas already under concession to LSM (Güiza 2013). LSM was introduced by the Spanish, and was made possible by large volumes of slave labour (Poveda Ramos, 1979), giving the industry an unsavoury history. As of 2009, mining companies had applied for titles for over 35% of the surface area of

Colombia (Fierro, 2012, in Rivera-Sotelo, 2012, p. 59). A large number of the titles applied for are in areas with pre-existing mining activity, raising problematic questions regarding property rights (Sintramincol, 2004). Foreign investment in mining companies comes primarily from Canada, which contributes 43% of total investments (Fierro, 2012, in Rivera-Sotelo, 2012, p. 60). Since the economic liberalisation in Colombia of the early 1990s, the government has considered mining to be a key method for achieving economic growth, which has been referred to as an 'extractivist' agenda (Urán, 2013; Vélez-Torres, 2014). The relevant mining and environmental legislation has been adapted to encourage mining, although potentially at the cost of indigenous groups and the environment (Rivera-Sotelo, 2012). That ASGM is dominant within the mining sector has been seen by the government as a barrier to the economic growth of the sector, and therefore to the national economy (Güiza & Aristizábal, 2013; Rivera-Sotelo, 2012).

Scale and Economic Significance of ASGM

As with all ASGM, the informality of the industry in Antioquia and the lack of clear definitions have hindered its quantification. According to the 2011 census on mining activities (cited in Güiza & Aristizábal, 2013, pp. 39-40), 49,889 people are employed in gold mining in Colombia, with 80% of workers in illegal mining operations. The census further shows that 12% of the workers are Afro-Colombians, 1% are from indigenous groups, 5% are women, and 137 are children. However, estimates by Cordy et al. (2011) indicate that the total number of workers is closer to 200,000, and Antioquia alone has 15,000-30,000 artisanal gold miners (Veiga, Angeloci-Santos, Hitch, et al., 2014). Most people I spoke to expressed extreme scepticism of the official figures.

Between 2010 and 2014, Colombia officially produced an average of 58 tonnes of gold per annum (Giraldo-Ramírez & Muñoz-Mora, 2012). This amounted to over 2% of global production across the same period (calculated from USGS, 2012, 2013, 2014). Internally, Antioquia's contribution to national gold production was 62.4% in 2010, making it the primary gold producing department, although Antioquia's

contribution has decreased since 1990 (Giraldo-Ramírez & Muñoz-Mora, 2012). In terms of municipalities, in 2012 Cauca was the most significant, contributing 9.04% of total production (Giraldo-Ramírez & Muñoz-Mora, 2012). However, this figure may be inflated due to the high concentration of gold buyers purchasing gold mined elsewhere (Cordy et al., 2011). While Antioquia remains the largest contributor of gold to national output, Giraldo-Ramírez and Muñoz-Mora (2012) qualify this by noting that gold is of relatively less significance to the total economy of Antioquia than it is for other departments. This is a more recent change, as historically gold production was the key driver of the Antioquian economy (Giraldo-Ramírez & Muñoz-Mora, 2012; Poveda Ramos, 1979).

Colombia has a very high percentage of total gold production arriving from ASGM relative to LSM when compared against other Latin American Nations. In 2011, 72% of total national gold production arrived from small-scale mines, 26% from medium-sized, and 2% from very large mines (Güiza 2013). I have not found equivalent figures specific to Antioquia. While ASGM is a significant contributor to the regional and national economy, it is not always treated as such, presumably because of its informality, links to illegal groups, and because many operators do not pay taxes.

Mining and Armed or Criminal Groups

Due to an increase in gold prices, which peaked in 2013, and a crackdown on coca growing and cocaine processing, gold mining became an attractive option for various illegal armed groups and criminal organisations (Giraldo-Ramírez & Muñoz-Mora, 2012). The Colombian President, Juan Manuel Santos, has claimed that mining earns illegal groups \$7 billion USD a year in Colombia (from all minerals): significantly more than drug trafficking (El Tiempo, 2015c). It should be noted that while mining has become entangled in the Colombian conflict, it has not been the central cause (Cortés, 2008; Idrobo, Mejía, & Tribin, 2014). The miners linked to armed groups are often distinguished as recent entrants, and are euphemistically named 'emergent miners' by Giraldo-Ramírez and Muñoz-Mora (2012, pp. 75-76).

Giraldo-Ramírez and Muñoz-Mora (2012) found that these new and illegal miners primarily work alluvial deposits, and their operations are characterised as more mobile, hurried and environmentally destructive than traditional or informal mining. The 2015 arrest of a Kazakhstani citizen, dubbed “one of the Tsars of illegal mining in Chocó”, who is believed to have had paramilitary support, illustrates the international aspect of illegal mining (El Tiempo, 2015a, p. 1). In addition to direct exploitation by illegal groups, many informal miners are forced to pay protection money (colloquially called ‘vaccinations’) to illegal groups (Giraldo-Ramírez & Muñoz-Mora, 2012). However, many legitimate businesses in the same areas are also required to make these payments. In the area in which I was working, this was paid primarily to the paramilitary groups Los Paisas, Los Urabeños, and Los Rastrojos (Giraldo-Ramírez & Muñoz-Mora, 2012). In other parts of Antioquia, protection money is paid to the guerrilla groups FARC and ELN (Giraldo-Ramírez & Muñoz-Mora, 2012). These links to illegal groups seem to have damaged public and governmental perceptions of ASGM.

Informality

ASGM in Antioquia is highly informal, and recent government administered formalisation processes have had very poor success rates. In 2013, it was reported that 87% of Colombian gold mines did not have a legal mining title, and 97% did not hold the correct environmental licenses (Güiza & Aristizábal, 2013). While defining a legal mining operation is complicated, a common working definition is the possession of both a mining title and an environmental license (Cardona-Valderrama, 2015). There are contradictions within the Colombian legal system as to whether informality is legally recognised. While the majority of legal documents relating to mining do not recognise informality, there are exceptions (Echavarria, 2014). In Colombia, the state is the owner of all the minerals in the soil and subsoil, which Rivera-Sotelo and Pardo Becerra (2014) refer to as a hangover of colonialism. Mining titles in Antioquia are issued by the department’s Mining Secretary (*Secretario de Minas*), while in other departments they are issued by the central government. The environmental license is issued separately by Corantioquia, the

departmental government's environmental regulator (Cardona-Valderrama, 2015). The high level of informality is a major problem for the government's planned development of the mining sector, as well as the elimination of mercury (Rivera-Sotelo, 2012; Rivera-Sotelo & Pardo Becerra, 2014; Vélez-Torres, 2014).

Formalisation Initiatives

The Colombian government has attempted to formalise the sector several times, with only limited success. An ASGM formalisation initiative started in 2001 had less than a 1% success rate over 7 years, while a 2011 attempt resulted in 4% of the mines entering the formalisation process, but some reports indicated that not a single mine was actually formalised (Güiza & Aristizábal, 2013). This has been attributed to a range of factors, such as a lack of differentiation between ASGM and LSM operations in mining legislation; a lack of mining areas not already under title or held in reserve; high entry barriers in terms of excessive bureaucracy and licensing requirements; low levels of education; limited access to finance; and a "longstanding culture of informality" (Echavarria, 2014, p. 9; Urán, 2013). A more carefully planned formalisation process started in 2013 appears to be having more success, with the government committing more resources, consulting with miners and other stakeholders, and recognising that it will be an ongoing process rather than a quick transition (Echavarria, 2014). Part of the success is due to the introduction of various laws permitting ASGM miners to sign contracts with LSM operators, which allow them to mine within the LSM operator's title. Under all the available legal devices, it is the LSM operator who gives the ASGM miner permission to work, receives some form of payment from the ASGM miner, and is responsible for the ASGM miner complying with the relevant mining, environmental, labour and taxation legislation (Echavarria, 2014). While formality has often been identified as a key strategy for mercury elimination (Clifford, 2014; Eriksen & Perrez, 2014; Kohler, Morgera, Ripley, Schabus, & Tsioumani, 2013), achieving formalisation itself has been highly elusive.

Legality and Supply of Mercury

Between 2000 and 2011, Colombia officially imported an average of 74 tonnes of mercury per annum, peaking at 130 tonnes in 2009 and 2011, with an estimated 75% destined for ASGM (Giraldo-Ramírez & Muñoz-Mora, 2012; Telmer & Veiga, 2009). The mercury was primarily imported from European countries, including Spain (37%) Germany (34%), and the Netherlands (22%) (Giraldo-Ramírez & Muñoz-Mora, 2012). While legal regulations of mercury use existed pre-2013, these do not seem to have been applied (Güiza & Aristizábal, 2013). In 2013, the Law 1658 (2013), commonly known as ‘the mercury law’, was passed, stating that mercury would become illegal in ASGM by 2018, leaving five years for mining operators to change their processes. In the meantime, mercury can only be sold to those who hold a mining license. However, there have been widespread reports of a black market in mercury, both in the stages of sale to miners and in importation (Cordy et al., 2011; Giraldo-Ramírez & Muñoz-Mora, 2012). This is supported by the fact that the volume of mercury legally imported into the country is significantly smaller than the estimated amount of mercury pollution from ASGM.

Enforcement of Mining Legislation

Until 2010, there seems to have been little to no enforcement of mining laws. However, this situation has since been reversed with increasing arrests of miners. No arrests of miners were reported in the second term of the penultimate Colombian President, Álvaro Uribe Vélez (2006-2010) (Güiza & Aristizábal, 2013). Since the election of the current president Juan Manuel Santos in 2010, there was an average of over 1,100 miners arrested and over 300 mines closed a year from 2010-2013 (Güiza & Aristizábal, 2013). In 2014, this had increased to 1757 arrests, 655 mine closures, and the seizure of 739 kilograms of gold (El Tiempo, 2015b). It is unclear how many of the arrests resulted in conviction. Güiza and Aristizábal (2013) argued that this increase in arrests was in response to the failure of formalisation attempts, among other factors.

Mercury Reduction Initiatives

To its credit, Antioquia has been proactive in reducing mercury use and pollution, and can now proudly claim the first reported case of large scale mercury reduction in the world (García et al., 2015). This has largely been achieved through the Colombia Mercury Project. Focused on Antioquia, this was a collaborative project between Corantioquia, the National University of Colombia (*Universidad Nacional*), and the University of British Columbia. The project goal was pragmatic, to reduce rather than eliminate the amount of mercury lost to the environment. The main strategy employed was the education of miners and gold processors through lectures, awareness campaigns and technical demonstrations. In technical terms, this involved the use of activated mercury, reducing the speed of the ball mills⁹, stopping whole ore amalgamation, and encouraging the use of efficient retorts. Other factors mentioned were a reduction of supply and an increase in the price of mercury, an increase in enforcement by the government, as well as the use of the cyanide plant of the Gran Colombia Gold Company for extracting gold on behalf of small-scale miners. The effectiveness of the programme was evaluated through quantitative measurements and interviews. The results were exemplary, with a 63% decrease in mercury pollution reported, a total volume of 46-70 tonnes. This represents a 6.3-6.9% reduction in total global mercury pollution from ASGM (calculated from UNEP, 2013a), a notable achievement.

Following on from this project, the government of Antioquia and the Colombian Ministry for Mines and Energy (*Ministerio de Minas y Energía*) spent \$6.5 million USD on the construction of a training centre in El Bagre, with support from the Canadian International Resources and Development Institute (CIRDI) (García et al., 2015). The Centre for Environmental Miner Training in the Bajo Cauca (*El Centro de Formación Minero Ambiental del Bajo Cauca*), opened in February 2015 with 456 students (Martínez Arango, 2015b).

⁹ A rotating mill containing a metal ball, used to grind gold-bearing rocks.

In a separate initiative, the National University of Colombia received a three year contract from Corantioquia to run training programmes throughout Antioquia (CIMEX, 2014). The project is administered by the University's Minerals Institute, CIMEX. While this work has been productive, the University is careful not to describe it as a final solution. So far, the programme has worked with a select group of mines in the formalisation process, and some gold processing workshops. The University has developed individualised plans for each of these mines/centres to work without mercury, and has assisted in the technical education of the workers to achieve this (CIMEX, 2014).

Another major player in mercury reduction in Antioquia is Bioredd. Bioredd is a Colombian division of USAID, working towards the environmentally responsible use of natural resources. In the Bajo Cauca, Bioredd has been working towards formalising miners, improving areas degraded by mining and reducing mercury pollution by eight to ten tonnes a year (Bioredd, n.d.; Echavarría, 2014). Bioredd works through partnerships with LSM, often working with miners on areas already under title (Echavarría, 2014). They are also working on a pilot project to create a mercury-free community extraction plant. Bioredd has placed a large emphasis on education, working with the National Occupational Training Service (SENA) (Echavarría, 2014).

Conclusion

Antioquia has received negative attention for its significant contribution to global mercury pollution, and the local population is already experiencing the negative effects of this. Recent initiatives have made significant progress in reducing mercury use, although full elimination is yet to be achieved. This reduction was achieved by partnerships between the government, NGOs, and universities, who used education, the promotion of new technologies, regulation and the introduction of legal tools allowing the subcontracting of mining titles. These initiatives should not be considered in isolation from the wider political context. In this chapter I have introduced the context in which mercury is used and mercury reduction initiatives

are occurring, and throughout this thesis I will further develop these links. ASGM is facing a range of political problems. The Colombian government is pushing extractivist policies which seek to develop the mining sector primarily through LSM, making informal ASGM a potential barrier to development. ASGM is also stigmatised over presumed connections with illegal armed groups. As a result, the government has pushed for the formalisation of ASGM, although these initiatives have not been successful to date. Therefore, the government has begun to enforce mining laws more strictly, leading to a large number of miner arrests. These political factors, as well as the mercury eliminating initiatives, have pushed the ASGM sector into a state of turmoil. In this thesis I will build on the links between mercury and politics established here, and analyse the changes these initiatives have brought about.

Chapter 4: Methodology

In this chapter, I will describe the qualitative anthropological methodology that I used in this research. While in many ways, this research bears some resemblance to the traditional mode of anthropological inquiry, with a researcher from a first world country conducting fieldwork in a foreign field, this is only partly an accurate representation. My research participants are not a cohesive ethnic or indigenous group, but rather a diverse group, united by a shared profession and regional identity. Throughout this research, I aimed to capture the dynamic relationship between people and materials, which are engaged in a mutual process of becoming. In this chapter I will discuss the methods employed and reflect on their utility with regards to the aims and theoretical framework of the thesis. I will also discuss the ethical challenges that arose during fieldwork, which were important considerations in this research, and I will consider my own position in the field. Finally, and importantly, I will introduce my key participants, who are co-producers of this thesis.

Fieldwork Methods

My primary techniques of observation and interviews are nothing revolutionary, yet it is a testament to their robustness that I found them amenable to the theoretical concepts that I draw on throughout this thesis. This is partly possible due to the way that I have theorised materials. I am investigating entanglements of mercury and miners, but I am approaching the human face of these entanglements. One implication of this approach is that I never elevated mercury to the status of a research participant, as is common in nonhuman research projects (i.e. de Laet & Mol, 2000), and in particular, humanimal research projects (McTavish, 2015). While mercury is central to this thesis, it is humans that I have an ethical responsibility towards, and so I have centred my attention on how they intra-act with mercury, and how mercury intra-acts with them as seen from a human perspective. This approach provided ample rich data for a thesis of this size, but there is room for further methodological improvement. This subject has the potential for productive

transdisciplinary research, or for a social scientist and physical scientist to approach both faces of the entanglement, simultaneously tracing the physical and social flows of mercury. Furthermore, a transdisciplinary approach could offer the greatest potential for change. While I have discussed what is happening, more could be done to describe what could be.

I conducted fieldwork in Antioquia over a three month period in 2015, working in-depth with a small number of people who were involved with ASGM in very different ways. Where possible, I selected participants based on the differing levels to which they were engaging with mercury elimination and formalisation, in an effort to capture the different levels of change occurring in the field. I also spoke to people involved in different types of mining and gold processing to capture the wider meshwork of mercury and not simply mercury in one location. In addition to these participants, I also interviewed representatives of the miners' associations, who could speak more authoritatively on the political issues facing miners. Other participants were those working for NGOs or private companies whose work related to ASGM. This wide selection allowed me to give a broader picture of mercury's entanglements, but at the same time limited my ability to include extensive thick data. This was partly overcome by focusing on a small group of key participants, allowing me to maintain an analytical style while keeping people present in the research.

I made contact with my participants through introductions, with only one exception. The initial introductions came from a Colombian journalist who had written on ASGM, from Oseas García of Bioredd, and from my Colombian friends. These initial introductions temporarily introduced a selective bias into my research. As I note in this thesis, interacting with outside actors such as NGOs is itself a new way of approaching mining. As these introductions were provided by my contacts in the 'formal sector', I was, to an extent, excluding those who were not engaging in change. This limitation was overcome by a 'snowballing' technique. Having established initial contacts who worked in ASGM, these contacts then introduced me to others. One participant, by his own initiative, actively introduced me to

miners who were not involved in formalisation or mercury reduction. This allowed me to talk to those miners not engaging with the externally driven changes in the industry.

While this approach was valuable, I cannot claim to have interviewed all the myriad of different types of miners. Some types of miners were inaccessible, for example those directly associated with illegal armed groups. Additionally, interviewing all accessible groups would be beyond the scale of this thesis. Figure 6 shows the number of interviews or significant meetings conducted. 'Significant meetings' are defined here as conversations with someone in the ASGM sector to whom I was introduced to as a researcher, and in which we discussed ASGM or mercury use for over 45 minutes. I took audio recordings of a number of these meetings. Only the more relevant recordings were transcribed, yet even this resulted in over 70,000 words of transcription data. This allowed me to reach a point of 'data saturation' (Kirby, Greaves, & Reid, 2010, p. 229). This was the point at which key concepts were being repeated often enough that I could be confident in stating them, and additional repetitions were no longer adding significant new understanding. From this larger group of participants, I classified six miners and two gold processors/buyers as my key informants. These are the people I became most familiar with in my fieldwork, and who the chapters are structured around. The others that I spoke to gave me a greater feel for the field, and additional verification, but are not directly referred to here. This fieldwork was not comprehensive, but provided ample data for a research project of this scale.

Occupation of participants	Number of participants whom I interviewed/had a significant meeting with.
Gold miners	16
Miners' Association representatives	2
Gold processors	5
Mining Students	5
Workers in relevant NGOs & universities	9
Workers in private companies working with ASGM	8

Figure 6: Interview/meeting numbers and types of participants.

In terms of social research techniques, I firmly advocate the benefits of qualitative research in this context. ASGM is an informal industry, and formalisation involves the registering and recording of mining activity (Siegel & Veiga, 2009). Hilson and Maponga (2004) note that the shortage of quantitative data as a barrier to formalisation, but what this perspective misses is that the collection of quantitative data is formalisation. Quantitative research is not neutral, but is in itself a part of the formalisation process. While quantitative data may give the impression of reliability, this may be nothing more than an impression. In Colombia, I was

constantly struck by the gap between what might be recorded and what happened in reality. A qualitative approach based on in-depth information gained from a smaller number of participants on a basis of trust can be far more reliable and informative than quantitative data, as the lack of quantitative data is part of the problem.

Interviews

Interviews were the primary research method for this project, and occurred in conjunction with purposive observation and 'deep hanging out'. The interviews were semi-structured, a common approach within anthropology, as overly structured interviews may reveal more about the researcher than the researched (Okely, 2015). The most productive approach I found was to conduct two separate interviews where possible, or a single interview of two parts. The first interviews were largely unstructured, and I asked a few broad initial questions about mercury, and then focused on keeping the discussion flowing. This allowed the interviews to shift organically to other issues such as technology, education and formalisation that would have been missed in structured interviews. This allowed me to establish how mercury was linked to other aspects of my participants' lives and occupations. Once these links had been established on my participants' terms, I was able to ask more specific questions on these subjects. The questions were not standardised, but were tailored to each interviewee's particular situation and experiences. All the interviews were recorded, with one exception where I took written notes instead at the participant's request. The interviews were generally held in public locations, or, where possible, in my participants' workplaces. This allowed them to demonstrate their work and to feel comfortable. All of my interviews were conducted in Spanish, the native language of all my participants. I am a native English speaker, and at times I worried that I might have missed some nuances. However, having audio recordings of the interviews provided reassurance, as I was able to review the conversations for any details I might have missed. These interviews provided me with the majority of my fieldwork data.

In addition to the formal interviews, I had around thirty informal meetings with various people involved in the field. These differed from the formal interviews in that I did not ask all the people I met with to become formal research participants by signing consent forms, and these informal meetings were not recorded. This information is therefore not used directly in this thesis, yet I mention them because these were a crucial part of the research process. In the early stages of fieldwork, these meetings allowed me to orientate myself in the field, to gain an initial feel of what the key issues were and therefore what questions I should be asking. Many of these informal meetings proved productive in that they resulted in further introductions, and many of my formal participants were introduced to me by someone with whom I had first met informally. I was also given large amounts of invaluable secondary resources and grey literature in these meetings. While not directly referenced here, these informal meetings were essential to the research process.

Purposive Observation and Deep Hanging Out

While I consider the interviews to be my primary research tool, it has been astutely pointed out by researchers such as Okely (2015) that the interview is most effective when used in conjunction with participant observation. Participant observation, famously developed by Bronislaw Malinowski (2014), has become the defining research technique of social anthropology. The observations I conducted could be described as purposive and non-purposive observation. I was not truly a participant in my observations, in that I was not actively involved in mining or processing gold, due to risk management concerns. Purposive or 'purposeful' observation, as used by Stewart-Withers et al. (2014), is an appropriate description of the observations I carried out, as it captures intentionality without implying that the observations occurred in an artificially structured environment. Other observations were non-purposive, similar to what Geertz (1998) called 'deep hanging out', referring to passing time with a group in a highly informal or social way. This captures some of the participant observation ethic, without inaccurately implying that I was actually participating in practices. The distinction between purposive observation and deep

hanging out is admittedly vague and qualitative. An example of what I would call purposive observation would be spending time with a participant in their workplace, potentially while recording the conversation or taking photos. Non-purposive observation or hanging out could involve having a beer with a participant while not necessarily talking about mining. This meant a careful negotiation of the boundaries of what did and did not constitute research, as it was not always clear if I had permission to directly use information that came up while hanging out. I generally negotiated this by bringing up subjects that had come up informally later during a formal interview, both giving me a digital recording and ensuring I had consent to use that information. Deep hanging out also helped me to get to know my participants, and to build trust and rapport. While interviews were my primary research tool, these occurred in conjunction with purposive observation and deep hanging out whenever possible. As a key concept I have drawn on is the importance of practices as sources of knowledge production, participant observation would be important to further develop this research.

Legal Seminars and Miner Training Centre Visits

While in the field, I visited the training centre for miners in El Bagre, as well as attending seminars on mining law. The training centre in El Bagre was established by the Antioquian government and other partners for the training of miners in environmentally and generally more responsible mining practices. I visited at the invitation of one of the tutors, a connection established through a mutual contact at Bioredd. I was shown around the facilities, and spent time hanging out with the students. I also spent time in the mining engineering department of the National University of Colombia in Medellín, which runs a miner training program. In Medellín, I attended two seminars on mining law run by Caval Asesores, a legal consultancy firm specialising in mining law. This assisted by helping me understand the relevant mining legislation, which is very dense. More importantly, these seminars provided me with an understanding of the legislation as it functions, which can differ from how it is written. This pragmatic approach helped me to understand the workings and significance of the legislation. Finally, it provided an

opportunity to network and meet others in the field. I was invited to these seminars by Carolina Arbelaez from Barbosa Gold¹⁰.

Ethical Considerations

Ethics were a primary consideration in this research. I received ethical approval from the Southern B Massey University Human Ethics Committee (MUHEC), and complied with the Association of Social Anthropologists of Aotearoa New Zealand's (ASAANZ, 1992) *Principles of Professional Responsibility and Ethical Conduct* and the Massey University (2015) *Code of Ethical Conduct for Research, Teaching and Evaluations Involving Human Participants*. The primary issues identified with regards to my participants were oral consent, and the potential vulnerability of miners. Due to limited miner literacy, I was granted ethical permission to obtain consent orally. I nevertheless left printed information and consent sheets with all participants. Miner vulnerability did not appear to be an issue. The miners I contacted were generally very happy to talk to me, but in some specific instances they declined to answer questions, demonstrating their comfort at refusing my requests. I have protected the identities of all miners and gold processing workers through the use of pseudonyms, and I have changed or excluded some details where necessary. Employees of organisations working with miners have been named, with the participants' explicit permission. In the interest of complying with the ASAANZ (1992) ethics code, I will not provide any unpublished findings to any person or group. To disseminate the findings to my participants, I provided summaries in Spanish, and where possible contacted them by phone or email to talk about the project.

The ASAANZ (1992) principles also recognise the post-procedural dimension to ethics, or what Ellis (2007, p. 4) described as the "unpredictable, often subtle, yet ethically important moments that come up in the field." In my research, I found relational ethical issues arising primarily around a lack of distinction between informal and formal parts of the research process. In particular, this included

¹⁰ Carolina is a consultant I interviewed who works with formalising small-scale miners.

statements made or practices observed outside of formal interviews, where it was unclear if I was provided that information to use in my thesis. Relational ethics to me begins and ends with transparency, and these issues were resolvable with open discussion.

Research in Colombia necessitates a consideration of personal safety, particularly when investigating an industry at the margin of the law. I prepared a risk management plan to obtain both MUHEC approval and the appropriate personal insurance. This plan stipulated avoiding areas labelled as 'high risk' by the New Zealand Ministry of Foreign Affairs and Trade's (MFAT) 'Safe Travel' service, and always seeking advice from the relevant contacts before travelling to areas with potential security concerns, such as mining towns. Mercury poisoning was also identified as a risk. I familiarised myself with procedures for reducing this risk, handling accidents, using the correct personal protective equipment and being aware of mercury poisoning symptoms. I confirmed options for assistance should I have had any symptoms, and explicitly clarified with my insurance company that any mercury poisoning occurring as a result of my fieldwork would be covered. While these safety measures were important, they had negative consequences in that they precluded genuine participant observation, due to dangers inherent in the practices I was observing. They also meant that I had to decline a number of invitations to visit the mines themselves. If I continue this research, I would seek to make some amendments to the risk management plan to allow mine visits, as I believe this could be achieved without compromising my personal safety.

Positioning Myself within the Field

I came to the topic of mercury use in ASGM in Antioquia for both academic and personal reasons. Academically, Antioquia is certainly a unique region in which to study the use and elimination of mercury. Personally, I have a number of close friends from Antioquia, who I had met while working overseas when I was younger. I had visited these friends twice in Antioquia since then, and so I had some knowledge of the area, local connections and a support network. Medellín in

particular never truly felt like 'the field' to me. I stayed with a close friend of mine and his family, as I had done previously, and so for me this was more like returning to my second home than entering an exotic unknown. Anthropology as a discipline is largely defined by fieldwork, and it has been argued that fieldwork has become almost a rite of passage, a liminal space for becoming an anthropologist (Killick, 1995). However, as Killick (1995) notes, the field comes to be artificially constructed in anthropological narratives as a fixed space inhabited by the Other. Like Killick, I found defining the field was not so simple, and the boundaries were somewhat blurred. In my time 'in the field', I never felt that I had come to inhabit that exotic space of the Other. While some of the mining towns were quite different to the parts of Colombia I had seen previously, they still only seemed to be on the edge of the field, which I came to imagine as the remote mining sites. This feeling became stronger as the more I made myself at home in these towns, the less like the field they seemed. Digital technology has also worked to deconstruct the field, as from my desk in New Zealand I can easily call or message my participants through a range of smartphone applications. In short, I agree with Killick's (1995) argument that the field amounts to nothing more than a social construction.

Anthropology does not generally align with the positivist view of science that considers reliable and reproducible research being premised on it being carried out by impartial and distant observers. Rather, data is seen as emerging from, or being coproduced through, the relationship between the researcher and the researched (Bourdieu, 1996; Lopes, 2015; Okely, 2015). It is therefore imperative that the researcher is reflexive (Omohundro, 2008). While it is not always clear to the researcher what the participant thinks of them, reflexivity is achieved by self-reflection and open discussion of the researchers' positionality. These elements are crucial for conducting robust and reliable ethnography. This contributes to a level of transparency in the research process, as opposed to scientificism which creates a false impression of objectivity by ignoring the interpersonal aspects of social research.

In the field I held multiple identities, such as being a male, a foreigner from New Zealand, a native English speaker, relatively wealthy, and university educated. While I have worked a number of labouring and truck driving jobs, I have never worked in mining. Many of these identities differed from my participants, who were primarily working class, informal miners, who earned relatively small amounts. They were all Colombian nationals and native Spanish speakers. This necessarily created some gaps. Despite the gap in education levels, my participants generally seemed to (accurately) recognise me as a student who knew little about mining, and that I needed everything explained to me. I was not asked for my expert opinion. Generally, I found the people I talked with very proud of their work, and passionate in explaining it. There were a few occasions when participants politely refused to share information, showing they were comfortable refusing my questions when needed.

There were also political aspects to their eagerness to talk to me, which many mentioned explicitly. The miners I spoke to considered themselves hard workers, and resented the fact that they were being branded as criminals. By explaining their work to me, they were able to demonstrate this point. This served a political goal in the hope I would talk about this, a fact explicitly referenced by a number of miners telling me to make sure to include certain information. I explained that I would be writing a thesis, and while I aim to publish on this research, in both English and Spanish, I avoided making promises with regards to publications that I could not guarantee. The benefits of foreign coverage of miners' rights related issues have been demonstrated previously, particularly with regards to the miner protests that occurred in Cauca. Ramiro Restrepo, of the miners' association of the Bajo Cauca, said the protests were able to impact government policy by the presence of foreign journalists who covered them. I hope I can support them in this by directing attention to the voices of miners, but without speaking on behalf of miners, as I have no mandate to do so (an ethical issue identified in ASAANZ, 1992). While there were certainly large gaps between my position and that of my participants, a reflexive analysis allowed the research to maintain rigour.

While miners had political reasons for speaking to me, I did not have cause to doubt their accounts. As I will argue later in this thesis, mercury use is political and mercury elimination appears to be a key method for framing oneself as an informal miner and not a criminal. Had people told me that they never used mercury, I might have been suspicious. However, most miners I met frankly explained that they were using mercury, but they gave the reasons why they found it hard to stop using it, giving me more confidence in their accounts. I was also able to triangulate information, comparing the information of different miners against each other. Often miners would be explicitly mentioned each other in interviews, or while informally hanging out, providing validation of other accounts. This also occurred with regards to workers from NGOs and other groups who worked with some of my participants. This did present relational ethical issues, in that it felt unnatural not mentioning the other miners I knew, but I had to avoid disclosing my participants' identities, or revealing information I had been given in confidence. I was also able to compare my research data against published and grey literature for further validation. I therefore felt that I could be confident in the information I was provided.

Trust was important in the relationships between me and my participants, and was attained by openness about my interests and the social rapport building outside of the interviews. Many of the conversations I had with participants were not about mining. They were curious to know about New Zealand, and to learn what I thought of Colombia. I was regularly asked about my impressions of the country, of the food, the weather, whether I found Colombians friendly, what I did in my spare time, and, invariably, what I thought of the Colombian women and if had I met any yet. Jokes about me marrying and settling down in Colombia always seemed to be slightly more than just jokes. In this way, the distinctions between my working life and social life in Colombia came to be broken down significantly. I believe that the times I had to decline invitations to visit mines, due to my risk management plan, did cost me some rapport. In particular, one miner (Juan) suggested that if I really wanted to know what mining was like in Antioquia, I needed to visit his mine and go down a 100 metre deep mine shaft. This mine was located in a remote area, well

known for paramilitary activity, and so I had no choice but to politely decline. While Juan accepted this and did not press the point, I had the strong impression that I would have been respected more had I said yes.

Introducing my Key Research Participants

In this section, I will introduce my key research participants to the reader, as they are both recurrent characters in and co-creators of this thesis. I hope this will help give a human face to the industry, something sorely lacking in most publications. While I have written this thesis in an analytical style and focused heavily on materials, people are absolutely central to this work, and it is to the miners and gold workers of Antioquia that my primary ethical responsibility lies. It is therefore very important to introduce my key participants here. Furthermore, Chapters Five, Six, and Seven are structured around these participants and the types of mining in which they are involved. All names used here are pseudonyms, unless otherwise indicated. Here I will provide personal introductions, describe the type and legal status of their mine, their use of mercury, and the selection criteria where relevant.

Carlos

Carlos is a placer miner operating around the municipality of Caucasia. He owns a small dredge, on which he works with one other miner. His operation is informal, and he has stopped using any mercury. Carlos has worked in mining for a number of decades in various parts of Colombia, which is reflected in his strong build and weather-beaten appearance. About 20 years earlier, he married his wife and settled down with her, and now has three children. He and his family are strong practising protestant Christians, an ever increasing minority in a Catholic country. While he is certainly not rich, he makes a moderate living by Colombian standards and is able to provide for his family. He was worried about the environment his mining was leaving to his children, which is why he ceased using mercury. Carlos is relatively exceptional, in that he has eliminated mercury without being in the process of formalisation, and so is uniquely positioned to discuss the challenges this involves.

Esteban

Esteban is the owner of an alluvial open-pit mine in the municipality of Caucasia. He employs over sixty workers, making it the largest operation I researched, although still technically small-scale. Previously, Esteban's operation used large quantities of mercury, but he has since reduced this greatly, and now uses only a small amount in a controlled manner. He is in the process of formalisation, having applied for a mining title over five years earlier but is still waiting for an outcome. Esteban has been working in mining for 32 years, proudly telling me that mining is in his blood. He takes pride in his work, and is offended that some might consider it illegal. He has a progressive outlook, and frequently spoke of the need for miners in Colombia to be more open minded in their thinking.

Miguel

Miguel is the senior charge hand of Esteban's mine, and explained most of the mine's day to day functioning to me. Miguel is very proud of his work, proud to be a miner, and talked passionately about how he was working to minimise the mine's environmental impact. He was extremely offended at being labelled illegal, arguing that while the mine did not yet have a title, it was an honest occupation and he was making significant efforts to mine responsibly. I hope I can assist him in conveying this message. While Esteban was able to tell me much about the more governance level aspects of his mine, Miguel was able to explain more of the operational level to me.

Felipe

Felipe is the senior charge hand of an alluvial open-pit mine in the municipality of Caucasia. The mine employs a dozen workers. The mine does not use any mercury directly, but contracts out some processing to an operator who does use mercury. The mine has obtained a legal mining title, and has recently applied for an environmental license. In his late twenties, Felipe is relatively young for the position, but is nevertheless knowledgeable and responsible. He has worked with

heavy machinery since entering the workforce as a teenager, and worked in mining in the relatively remote and wild Chocó department. He spoke with passion about his current work, and is evidently proud of the environmental improvements being made at the mine. He also speaks of transitioning from traditional to modern mining.

Mateo

Mateo was a hard rock miner from Segovia, but he has since been hired by an NGO working with artisanal and small-scale miners and now lives in a nearby municipality. Nevertheless, he still identifies himself primarily as a miner, saying mining was in his bones. As a miner, he had worked informally and used large amounts of mercury, but has since worked towards miner formalisation and mercury elimination. Mateo is incredibly knowledgeable and passionate about mining, so much so that our formal interview lasted for three hours (excluding meal breaks) without Mateo's enthusiasm waning. His in-depth knowledge was invaluable, and he was able to give first-hand information both of working in hard rock ASGM, and with NGOs to improve the mining.

Juan

Juan is a self-described traditional hard rock miner from Segovia, who proudly told me that his ancestors were also miners. He had previously worked informally, and used large quantities of mercury. He has since signed a subcontract with a larger company, and now uses their cyanidation plant instead of mercury. He had heard of mercury's toxicity, but seemed unconcerned and ambivalent about these claims. Juan talked briefly about superstitions around mining, although he did not say to what extent he subscribed to these beliefs. Nevertheless, the way he talked about these superstitions gave me the impression they were very important but rarely discussed.

Juan was introduced to me with a rather unflattering description. I was told by a processing workshop owner that I should speak to a traditional miner who thinks of

nothing but women, alcohol and gambling, and he took it upon himself to introduce me to such a miner (not at my request). While my first introduction to Juan was in a shady casino, I soon realised the description was a poor one. While Juan certainly was fond of all those vices, he was not the ignorant miner who spoke of nothing else. He was very proud of his profession, and spoke knowledgeably and astutely about the issues facing mining. He was aware of the challenges that the industry faced, and was negotiating them as best as he could. In terms of participant selection, Juan offers a valuable perspective. I had been concerned about selection bias, in that I was largely contacting miners who were willingly attempting to be more responsible. Juan was actively identified as being the opposite by those in the industry, and while this description was problematic, he does offer a different perspective.

Santiago

Santiago is the owner of a gold processing workshop in Segovia. He was the only one of my participants to assert that mercury was not harmful, although he was aware of the claims made to the contrary. He is still using mercury in his processing workshop, but has plans to change to a mercury-free operation, primarily for reasons of regulatory compliance rather than environmental or health concerns. As gold processing workshops are not covered by mining law, Santiago operates in a legally grey area. Santiago's position as a processing owner gave him a level of respect and standing in the community, and he is relatively wealthy. He seemed to genuinely care about miners' welfare and identified with them. He would regularly introduce me to miners he knew, and tell me about the challenges they faced. Santiago is direct and opinionated; nevertheless, I greatly enjoyed my conversations with him.

David

David owns a gold buying shop in the township of Caucasia. David buys mercury-gold amalgam from miners, and sells them mercury. He saw no way miners could operate without it. He is aware that mercury is harmful, and has taken some

precautions such as using a fume hood and personal protective equipment. David began to work in the gold buying industry after being forced to leave his previous rural employment by the paramilitaries. While proud of his work, David did not seem to identify with it as strongly as miners did with mining. David is a devout protestant Christian and a family man. He did, however, have a number of good luck charms and other fetishes around his workshop, and worried about black magic. I was fortunate to meet David, as I was not introduced to many gold buyers by other participants, and those I did speak to were generally less interested in participating.

Other Participants

The other participants who are mentioned by name in this thesis are: Carolina Arbelaez, a consultant with Barbosa Gold in Medellín, whose work involves the creation of subcontracts of formalisation for ASGM operators; Jairo Emilio Vélez, the general manager of the Mining Organisation Ltd. (*Organización Minera Ltda.*), a privately owned company that provides technical and legal services for ASGM; Ramiro Restrepo, the President of the Miners' Association of the Bajo Cauca; Marco Antonio, the President of the Miners' Association of Segovia; and Oseas García, who works for the USAID funded Bioredd. Both of the miners' associations mentioned here are formalised organisations run by miners, with the purpose of advocating for miners' rights and political interests. All of the names provided in this paragraph are real names, used with the participants' explicit permission.

Conclusion

To approach the human face of the entanglement between miners and mercury, I have found interviews, non-purposive observation and deep hanging out effective tools for the scale of this thesis. These allowed me to consider how my participants connected mercury elimination to wider issues, showing how it was entangled throughout the industry. At the same time, there is room for improvements through interdisciplinary research to approach the entanglement from both human

and material faces, and for participant observation to better understand practices. By selecting participants from different parts of the ASGM industry and who were engaging with the changes occurring in the industry to varying extents, I was able to describe the meshwork through which mercury flows and to imagine this meshwork as being in a state of constant change. By allowing participants to connect mercury to other aspects of mining, I was able to understand how mercury was entangled throughout the industry. These methods which are the basis for the findings of this thesis were coproduced with my participants, with whom my ultimate ethical responsibility lies.

Chapter 5: Entanglements with Mercury

“When they told us that we couldn’t use mercury, I thought the mining was finished, because if we can’t use mercury, how could we extract gold?”

Carlos, a placer miner from Caucasia.

“To be entangled is not simply to be intertwined with another, as in the separate joining of entities, but to lack an independent, self-contained existence. Existence is not an individual affair.”

Karen Barad (2007, p. ix).

This chapter is about mercury and its entanglement with gold miners that has given rise to the ASGM industry in Antioquia. It is here that I will provide the ‘thick description’ of the practices of mercury use. Temporally speaking, this chapter deals with relative continuity as mercury has been used in gold extraction for generations, although practices of mercury use have evolved over time. I will deal here with the question of ‘tradition’, which is a dominant trope in explaining mercury use in ASGM. As mercury use is decreasing in Antioquia, this chapter is somewhat retrospective. The following chapter deals with the changes currently occurring in the industry, but the significance of these changes cannot be explained without first understanding the strength of mercury’s entanglements.

In the introduction, I said that most attempts at defining ASGM are not made by giving fixed definitions, but rather by providing a list of common characteristics or essential qualities of ASGM. What I will argue here is that in Antioquia, these characteristics can be linked back to mercury, effectively meaning that mercury is co-constitutive of the particular local mode of ASGM. Miners, mercury and gold¹¹ are entangled, existing and intra-acting through each other, and mercury is co-constitutive of an informal ASGM industry. To show the nature and depth of the

¹¹ To say that gold is co-constitutive of ASGM is a truism, as it is the material being sought. However, discussing miners and mercury necessarily involves considering gold.

mercury-miner entanglement, I will be discussing a number of different aspects of mining, including the levels of investment, types of technology, mechanisms of establishing trust, and education, all culminating in the modes of approaching mining used by miners. Miners have historically acquired knowledge of mercury by *using* it, and not by *representing* it, and their modes of approaching mining have been structured around this material. This chapter is structured around different types of mining, and these themes will be explored in relation to these different modes of mining. These points will be reinforced in the following chapter, which discusses the challenges associated with working without mercury.

In writing a thick description of mercury's entanglements, I have had many inspirations, only some of which I will mention here. They include Primo Levi (1984), the Jewish-Italian chemist, and his book *The Periodic Table*, in which he writes the story of the periodic table and the story of his life simultaneously. Each chapter's title is the name of an element, but the contents are not the elements' physical properties, but the story of that element entangled with the story of his life. Another inspiration was Michael Taussig's (2004) *My Cocaine Museum*, where he tells the gritty story of gold in the Chocó department of Colombia. The title is a reference to the famous Gold Museum in Bogotá, and it is the official and sanitised story of gold presented by the museum that Taussig wishes to counter. Marianne de Laet and Anne-Marie Mol's (2000) *The Zimbabwe Bush Pump* was also on my mind as I wrote the chapter, but more as a contrast. The story of mercury is not a solitary story, but a collective story, shared with miners and gold, among others. While mercury is the central theme of this chapter, I have tried not to isolate mercury as de Laet and Mol (2000) did with the bush pump, but to allow the intersections of these other stories to remain visible.

Alluvial Open-Pit Mining

Alluvial open-pit mining is the extraction of gold by digging a large open pit to access river deposited gold bearing sand. Esteban, Miguel and Felipe are all alluvial open-pit miners around the municipality of Caucasia, where this mode of mining is

common. Esteban's mine is relatively large compared to the other operations studied, employing 60 workers. The earth is dug by five excavators and loaded onto three tip trucks. These trucks carry their load from the mining front to a hopper for washing. From here, three men use high pressure hoses to wash the load firstly across a metal grating, which excludes the larger rocks, and then into a long sluice box. As the earth is washed along the sluice boxes, the heavier gold bearing material sinks down, and catches in rifles along the bottom. Previously, mercury was placed in cloth bags which were placed below the metal rifles to trap the fine gold particles. This represents the start of what Ingold (2012) would refer to as a 'half-chain', or the section of the production chains of two materials which become temporarily entangled in a mutual process of becoming. The cloth bags would be removed later and the unamalgamated mercury squeezed out by hand, leaving the mercury-gold amalgam inside. This was a wasteful process, and large amounts of mercury would end up being washed out of the sluice boxes into a drainage system, ultimately leading to the nearby river. Fortunately, this practice has been discontinued (to be discussed in the following chapter). The washing process continues almost around the clock, with two ten-hour shifts a day. A regional newspaper, *El Colombiano*, produced an excellent set of pictures demonstrating this process (Saldarriaga, 2014), which Esteban said were very similar to those used in his own mine.

While Esteban has ceased using mercury in the sluices, it is still employed for the final extraction. Mercury is mixed with the concentrated material from the sluices to produce an amalgam in the mine's gold extraction workshop. This amalgam is then burned on-site using a gas blowtorch, leaving a 'cake' of near pure gold. The mercury is vaporised by the intense heat and dispersed into the environment. The same process was applied to the mercury-gold amalgam extracted from the sluice boxes when that method was used. This is the separation of the half chain or the mercury-gold entanglement. The gold now takes on its own life as a 'valuable commodity' within the sphere of human meaning, while mercury is discharged as 'waste'. Mercury does not end its entanglement with the miners, but continues to

remain in or re-enter their bodies (and the bodies of non-miners), causing adverse health effects that may exist beyond human perception.

Felipe's mine works in a similar fashion, but on a smaller scale. There are a dozen workers, three excavators and no trucks. The workers typically mine to a depth of 19 metres below the surface. The excavators move material to the hopper directly, which is only used when full, usually after every 100 hours of mining. The hopper is moved regularly to remain close to the exploitation area. The mine previously used to use mercury in the sluice boxes, but this process has since stopped. The final extraction occurs off-site with a third party, and so there is no mercury used at the mine at all. Felipe told me this third party used mercury, but he was unable or unwilling to give me any details.

The entanglement of miners and mercury goes far further than the physical entanglement of bodies, as entanglement is not a purely physical process. What the entanglements with mercury have allowed in this case is a mode of mining which operates with moderate profitability, but without legal mining titles or large investments. All that is required in this mode of alluvial gold extraction are sluice boxes, hoses, cloth bags, a gas torch and mercury, all of which can be cheaply and easily fabricated or purchased locally. This process is estimated to have a 30-40% gold recovery rate, which is moderate, but relatively lower than the 45-60% rate that CIMEX (2014) has claimed should be easily achievable for a mercury-free system, with the key caveat that *certain investments* are made. What mercury has allowed is a system of moderate efficiency that does not require significant investments. This is more important when recognising that miners do not have ready access to large amounts of credit. Esteban told me that no bank would lend to a miner, especially if they lacked a mining title. I was told that credit could be obtained from shady lenders who would either demand high interest rates or a share of the mine, but this was generally considered to be ill-advised. The lack of investments is also a legal precaution. In a mine operating without a title, there is always the risk of equipment being seized by the police. The ability to work without

investments is an effective strategy in an informal environment, while a mercury-free system would be less effective despite higher extraction yields.

As the mines have expanded and increased their production, more investments have become necessary. In these cases, this has come in the form of a number of excavators and tip trucks. However, it is this expansion that has made formalisation an issue, and so Felipe's mine has formalised and Esteban's is in the process. While this shift to formal mining is complex, and will be discussed in the following two chapters, one aspect of this shift is that Esteban and Felipe want to achieve the larger extraction yields from industrial, mercury-free technology. However, doing so is difficult in an informal reality, and so mercury remains an effective option for informal miners.

Dredge-Based Placer Mining

Mining can be conducted from floating dredges, which gather gold bearing sand from the river bed. These dredges can be very basic, consisting of little more than flotation, a suction device, a motor, and a sluice box. These dredges are common around Caucasia and El Bagre. Carlos works on a small dredge with one other miner, although previously up to four people have worked on the same dredge. Carlos has stopped using mercury, but explained to me how the process worked and told me that the majority of dredge miners still use this practice. Carlos would wash the sand taken from the river in a sluice box with mercury, in a similar manner to the system used by alluvial open-pit miners, although on a much smaller scale. Carlos would then take the resulting amalgam to a gold buyer who would burn the amalgam to produce gold.

Similar entanglements with mercury and miners can be observed in dredge mining, resulting in efficiency without investment. As the dredges are themselves very low cost, and no extraction technology or plant is needed beyond the sluice, cloth, and mercury, a system of moderate efficiency has been created without any investment. Carlos describes the mining as a subsistence activity, in that he earns a

small amount of money on a week by week basis without making long-term investments. Carlos never told me what he earned, but from his lifestyle I could see that while he was not living in abject poverty, he did not seem to have a high cash income. He lived in a basic concrete house, with few furnishings, and owned an old motorbike for transport. However, it seemed he was always able to provide food for his family.

When small amounts of credit are needed by dredge owners, it can be obtained through routes entangled with mercury. The gold buyers, who are also the mercury sellers, are often willing to provide credit, both to make money off the loan as well as to ensure further custom for their gold purchasing/mercury selling¹². The financial system is entangled with mercury: mercury has eliminated the need for large investments and provided a route of obtaining credit for small ones. In one of the few studies to realise the human entanglements of mercury, Hilson and Pardie (2006) noticed mercury being linked to flows of credit in Ghana, which kept miners trapped in poverty. While there are a number of key differences between Antioquia and Ghana, it seems mercury has a tendency to entangle itself amongst financial flows. In Antioquia, this again makes mercury an appropriate option for small-scale informal miners such as Carlos. For Carlos, mercury was so essential to his operation that when he was first told that he should not be using it, he thought that this meant the end of mining, as he could not imagine any other way of extracting gold.

Hard Rock Mining and Gold Processing Workshops

Juan and Mateo are hard rock miners, cutting underground tunnels into the rock to access veins of gold. This is the main mode of mining in Segovia. Explosives are often used to blast the rock to create these tunnels. The gold is of a larger size than the very fine particles found in alluvial mining, but the rock needs to be broken apart to access it. Mercury is generally not used in the mining areas, but in

¹² This credit is for smaller amounts. While it is appropriate for small dredge owners, I am told it would be insufficient for larger operations such as Esteban's or Felipe's.

specialised gold processing workshops to which the material is bought for extraction.

Juan described hard rock mining as a subsistence activity, a loose term which seemed to refer to the lack of investments and the low income earned. Hard rock mining is, however, a medium term activity, as it can take several years of constructing tunnels to reach the gold bearing veins. This is in contrast to placer mining which has a near continuous period of exploitation.

The miner is proud of his work ... I as a miner, when I find, perhaps five grams of gold in a vein, after one or two years working the tunnel, without pay, obtaining food in whatever manner. Then I arrive at the vein. We arrive at the vein, and then it's a song. We can make money, we leave the tunnel, and go to drink a few beers, and fall in love with a woman, whichever woman. This is the idea of mining, this is how we miners do it. Gambling, drinking and women. Gambling, drinking and women.

This account given by Juan represents both a different material practice of mining and a different mode of approaching mining which is linked to the material conditions of mining. Upon further description, Juan makes it clear that what he takes pride in is not just the mining but the entire process of extraction. He describes mining the gold bearing rocks, grinding them, amalgamating the gold, watching the amalgam being burned, and finally the elusive gold is revealed. It is a process that is practiced and sensorially experienced, not observed, and the satisfaction and pride invested in this are significant. The sensorial experience and practice stand out as a way in which the materiality of mining links to a miner's mode of approaching mining, an entanglement of miners and materials.

The gold processing workshops¹³ are where miners bring gold bearing material for extraction, and they are the primary sites of mercury use in hard rock mining. Santiago is the owner of one such workshop in Segovia, located a few blocks from

¹³ Colloquially known as *entables*.

the centre of town. The process is divided into two stages. The first stage is whole ore amalgamation in the ball mills, also called *cocos*, which are round drums containing a metal ball which gives them their name (Figure 7, Figure 8). The gold bearing rock is placed into the rotating *cocos*, allowing the ball inside to break up the rock exposing the gold. Mercury is also added into the *cocos*, which traps the gold as it becomes freed from the rock. This process takes about four hours, although it may be repeated if needed, depending on the material being processed. This process is carried out completely by the miner, and neither Santiago nor his employees are involved at all. The miners pour out the resulting mercury into a cloth, squeezing it to release the unamalgamated mercury, then repeatedly washing the amalgam in a bucket until a hardened ball of amalgam is produced (Figure 9). Whenever I observed this process, it was always carried out with bare hands. The miner then takes this amalgam to sell to a gold buyer. The miner does not pay Santiago anything for the extraction service¹⁴.



Figure 7: The ball mills in Santiago's workshop.

¹⁴ I did not see fees being charged for the extraction service. However, another study in Antioquia reported that many workshops would charge miners a nominal fee of \$0.50 to \$1.00 USD (Cordy et al., 2011, p. 155).



Figure 8: A closer view of the ball mills.



Figure 9: A disappointingly small ball of mercury-gold amalgam.

The condition for the miner to be able to use this facility freely is that he leaves all the leftover ground material in the *cocos*. The mercury process is relatively inefficient, with previous research on these workshops in Colombia showing miners may recover only 30% of the gold (Cordy et al., 2011; Veiga, Angeloci-Santos, Hitch, et al., 2014). Santiago then takes these remaining tailings and proceeds with a cyanide extraction. Santiago keeps 2,000 tonnes of cyanide in two tanks outside of his workshop (Figure 10). This is then pumped into concrete pools inside the workshop where the tailings are left to soak for approximately four to five days (Figure 11), or into pools dug into the tailings themselves outside the workshop (Figure 12). The means of crossing these pools to reach the back entrance of the workshop is by walking over them on a series of rickety wooden planks. The workshop is located within a residential area of the town, and houses are visible in the background of Figure 12.

The street outside the workshop has three restaurants/bars. Mercury that is leftover in the tailings reacts with the cyanide to produce mercury cyanides which are easily converted to methylmercury in the environment. This is a more pernicious form of mercury that is easily taken up by biological systems (Veiga et al., 2006). All the cyanide waste is deposited in the nearby stream, which is completely lifeless. Santiago was reluctant to talk about how the gold is extracted from the cyanide, and I was unable to see this part of the process. However, descriptions are available elsewhere of workshops in Segovia using a zinc and acid based extraction, which releases heavy metals into the environment (Cordy et al., 2011). This process has been estimated to retrieve 80% of the gold in the material being processed at this stage (leftover from the whole ore amalgamation), or roughly 56% of the gold in the material before the first stage of whole ore mercury extraction (García et al., 2015), making this a profitable enterprise for Santiago, but at a significant environmental cost.

This entanglement of miners, workshop owners and materials has produced a system of trust between all parties, and provides a free extraction service to miners who do not have to purchase their own equipment. As the miner is solely

responsible for the amalgamation using the ball mills, the miner has full confidence that they have their fair share of gold and have not been cheated. There seems to be significant amounts of distrust within the gold industry in Antioquia, which one NGO worker I met attributed to the ongoing violence surrounding gold. The informality of the industry prevents government oversight to ensure fair dealing, even if the government was interested in becoming involved. Bypassing the whole ore amalgamation and simply adding the ground material to cyanide would make it difficult to establish trust, as the miner is no longer in control of the process. It would also be far easier to do this by mixing the ore of different miners into a single batch. However, this would render profit distribution problematic. An additional factor here is the time required. Juan told me that many miners spend much of their time at the mining sites, only coming into town for a few days to visit their families (or party, as the case may be), and do their extractions. As the cyanide extraction takes five days, this option is less attractive than the whole ore amalgamation which takes only four hours. Finally, Juan strongly emphasised how much pride he took in taking the ore from the mountain and processing it to pure gold, and he even joked that there was a religious aspect to this, akin to transubstantiation and a worshipping of gold¹⁵. A cyanide extraction would deprive Juan of the pride and pleasure he has embedded in this practice.

While the portion of gold that the processing shop owner receives does seem high, this division of profits has a material basis, interlinked with the material basis of the system of trust. The processing workshop owner could receive 60% of the gold, however, this is the gold that the miner would never be able to access, and so this is not considered a loss¹⁶. The rates of gold recovery from using mercury in ASGM are relatively low compared to industrial methods, but high considering that no investments are needed. In this situation, the miner is able to extract as much gold as they possibly could using a whole ore mercury amalgamation method, without making any investment in plant or paying for the extraction. Jairo told me that the

¹⁵ A number of times I heard vague references to superstitions relating to hard rock mining, but never for placer mining. This could prove an interesting line of future research.

¹⁶ This also raises the question of the difference between an unfair contract followed scrupulously and a fair one followed unscrupulously, or how injustice is perceived.

very remote mines carried out their own extraction, as they were too far from the processing shops to transport their material. This required investing in and maintaining ball mills while receiving the same or lower extraction rates as a miner using a processing shop. Mercury's entanglement here provides miners the ability to perform a moderately efficient extraction with no capital investment. This also avoids the legal risk of extraction equipment being confiscated. As Santiago's workshop is not a mining operation, it is not regulated by the Secretary of Mines. While his facility is in violation of the relevant environmental codes, this has been enforced only recently.

Some level of investment is needed in hard rock mining for the period of establishing the tunnels, and this credit pathway is also entangled with mercury. Juan said it could take several years excavating a tunnel, without earning, before finding gold. Juan told me he lived off very little money during this time, but the money he did have was mostly obtained from the gold processing shops. Santiago and Juan told me that this could be in the form of an interest charging loan, or the shop owner taking a share of the mine. Both of these arrangements also secured future customers for the workshop, which is completely based around mercury. Once again, mercury has enabled a low investment mode of mining, while the small amount of investment needed is entangled with mercury.



Figure 10: Cyanide storage tanks.



Figure 11: Cyanide extraction in concrete pools. The planks to the rear are used as a walkway.



Figure 12: Cyanide pools in the tailings outside. The visible buildings are residential.

Gold Buying Shops

The gold buying shops are where miners sell their mercury-gold amalgam for it to be processed leaving concentrated gold. David owns such a shop on the main street of Caucasia, within a block of the food market and a large number of bars and restaurants. While talking with David in his shop, various miners would drop by with small balls of mercury-gold amalgam. David would examine these with a small lens, trying to roughly establish the ratio of gold to mercury. He would then weigh it on a set of balance scales, and calculate the expected weight of gold. David would then refer to the day's gold price, which he obtained daily from a telephone call to the Bank of the Republic (*Banco de la República*), and carefully noted on the back of an old torn envelope. From this, he would give the miner a quote for their amalgam. Some miners decided to try for more elsewhere, while others accepted the quote. Once accepted, David would don his gloves, apron and respirator mask, and place the amalgam on a plate inside a fume hood (Figure 13, Figure 14). He would pass a gas torch over the amalgam through an opening in the front, evaporating the

mercury and leaving concentrated gold. This would then be weighed, and the miner paid in cash. While David had recently installed a filter for the chimney leading from the fume hood, he assured me that the height of the chimney (15 foot) had ensured that no pollution reached the town prior to this instillation. This claim is strongly contradicted by atmospheric studies conducted on the same street (Cordy et al., 2011). David also sold mercury to the miners, both recycled from his filter and sourced from other suppliers. At the time (July 2015), this was priced at \$5.30 USD an ounce. The mercury was measured out in a syringe into a glass bottle (Figure 15), which the miners wrapped tightly in a plastic supermarket shopping bag.



Figure 13: The fume hood where the amalgam is burned.



Figure 14: Inside the fume hood.



Figure 15: Mercury for sale in Caucasia, and the measuring syringe.

Tradition, Custom, and the Nature of Change

A dominant trope in explaining mercury use in ASGM is tradition, which seems to be a simplistic way of describing a complex phenomenon. However, its pervasiveness means it warrants some consideration. This explanation is popular both in the literature (see Cordy et al., 2013; Veiga, Angeloci-Santos, & Meech, 2014) and among the miners themselves. Carlos told me, “It’s a challenge to not use mercury. It’s not easy, because it’s a custom that has existed for a long time.” Juan said that the mining in Segovia was ancient, ancestral, and that miners do things the way their grandparents did. Felipe and Esteban told me that miners use mercury in the sluice boxes because mercury has always been a tradition in Colombia. While many of the miners I spoke to used tradition as an explanation for mercury use, many of them were describing other miners and not themselves. The ‘tradition’ explanation was normally mentioned after switching on my dictaphone, which shifted the conversation to a more formal tone, indicating to me that tradition had become a part of a hegemonic discourse on the subject. Mercury certainly appears to have been used in Antioquia for a long time. No one was able to tell me when it was introduced or how, so the origin of the practice appears to extend beyond living memory. However, immediately classifying the practice as a tradition because of longevity seems problematic.

To consider this, I want to look at the discursive construction of tradition, the politics of tradition, and to introduce the discussion of practices and logics of practice. In their seminal text, *The Invention of Tradition*, Hobsbawm and Ranger (1992) refer to ‘traditions’ as static, formalised practices, which are often recent inventions claiming continuity with the past. ‘Customs’ are repeated practices which are not formalised, and are therefore open to change as the world around changes. Under this schema, mercury use would be best described as a custom¹⁷, not a tradition. Unlike tradition, customs allow a degree of flexibility for the practice to adapt to a changing world, and the basis for customs is more technical

¹⁷ By making this distinction I am translating the term from vernacular to academic language, not contradicting my participants. Here I consider the vernacular to academic translation as the primary consideration, and the Spanish to English translation as the secondary.

or practical than ideological. I would argue here that traditions are largely functions of society or culture, but practices engage, to a greater extent, with a material world which is never constant, and so practices need to change also. However, Hobsbawm (1992) does not reduce customs to purely 'practical' activities, noting that they are still linked to forms of culturally specific sense or logic. I find it more useful to approach the question of the causes of mercury use in terms of the types of sense or logic that are implicit with the custom/practice of mercury use, as opposed to reifying it to a tradition which mystifies the practice more than it illuminates it. Nevertheless, the ubiquity of the explanation warrants a little more consideration.

Hobsbawm and Ranger's (1992) key point is that many traditions are invented, or rather discursively created. Despite being recent inventions, these 'traditions' manage to claim the appearance of antiquity. In this case I am not suggesting that mercury is only a recent introduction, as I have no reason to suspect it has not been used for a long time. Rather, I suspect that while the use of mercury is a custom, its elevation to tradition¹⁸ as an explanation for its use is a recent discursive invention. There may be an element of cross-transference of the term between the discourses of those working to eliminate mercury use and the discourses of the miners themselves. Tradition also appears to be a political tool used to establish mining rights. Rivera-Sotelo and Pardo Becerra (2014) write that indigeneity in Colombia is associated with traditional rights, whereas the majority of the population are labelled 'non-ethnic', effectively denying them historical rights and a connection to the land. Tradition is, therefore, a means of making a meaningful claim to mining rights. Hobsbawm (1992) observed that the use of tradition to claim rights often refers not so much to historical facts but a balance of forces in the constant struggle for those rights. In this case, tradition has an additional political element with regards to mercury. Mercury has become a tool in the dispossession of miners, as its use frames them as environmentally destructive. Tradition, when applied to mercury use, would appear to be a political tool used not so much to justify the use of mercury but for miners to frame themselves as people who require state

¹⁸ Custom and tradition are used here as defined by Hobsbawm (1992).

assistance to eliminate mercury as opposed to discipline for using it (to be discussed in Chapter Seven). While these political aspects are significant, the term 'tradition' contributes little to understanding the material aspects of mercury use in ASGM.

Awareness of Mercury Poisoning

An important consideration in the entanglement between miners and mercury is the level of miners' awareness of mercury's health effects. A 2010 study reported poor levels of awareness amongst miners in Antioquia of the health impacts of mercury (Cordy et al., 2011). My participants told me that this used to be the case, although the situation has since changed, thanks to ongoing awareness campaigns. Carlos, who is passionate about eliminating mercury, was particularly concerned that he had used a lot of mercury previously, but told me he simply did not know it was harmful. Juan told me that he used to get fevers and headaches after working with mercury, which he has done for some thirty years. However, on being questioned by a friend of his who was present during an interview, Juan said that now he was fine and healthy, implying he did not associate long term health effects with mercury. Santiago continues to assert that mercury is not harmful, despite having heard arguments to the contrary. He told me how when he was young, his father used to burn mercury-gold amalgam on their cooking fire next to their *arepas*, the corn cakes that are a staple food in Antioquia. Santiago himself had used mercury at work for the last twenty four years, and still considered himself healthy¹⁹. As mercury accumulates in the body, and only displays serious effects once a threshold dosage is reached (Gibb & O'Leary, 2014), it is easy to see how the connection between cause and effect might be missed. There is also significant 'background noise', in that some miners are not living an otherwise healthy lifestyle; for example, Juan is a chain smoker and heavy drinker who works in tunnels filled of dangerous dust, and lives in a town with a rundown health clinic.

¹⁹ Santiago was also aware of the politics surrounding mercury, which contributed to his belief that it was harmless. This will be discussed in Chapter Seven.

Mercury's true materiality or impact on the human body has been obscured, and intra-acts through the body beyond everyday human perception.

ASGM: A Performed Entanglement of Miners and Mercury

Building on the idea that human thought can be entangled with practices or materials, I argue that the entanglements of miners with mercury operate to a large degree at the level of miners' worldviews and modes of approaching mining. Not only has a certain mode of mining arisen around mercury, which is effective within and co-constitutive of a context of informal ASGM, but so has a certain mode of approaching mining, or a particular worldview in relation to mining. To clarify here, I am not trying to create a duality of the practice and the cognitive, as to me these aspects seem so entangled that meaningful distinctions cannot be made. However, the cognitive aspect has been so far neglected by the 'tradition' centred discourse, and so I am trying to incorporate a cognitive aspect to mercury use, but in such a way that it is seen as entangled with practice and not as a dichotomy to practice.

While practices in mining change, these changes are only sometimes perceived, and so it is tempting to differentiate between practices and the logic of practice. It became clear that customs had been reified to the status of unchanging traditions, and I was told quite explicitly by a number of miners that the methods used in mining were relatively static. For example, Esteban told me that the mining system has been the same since the Spanish conquest 500 years earlier. Realising the problem with this statement, he followed this up by admitting that now he used motors and pressure, but that the principles of 'earth and water' were still the same. This presents a paradox, as Esteban is describing change but calling it continuity. As customs are not fixed, and have to adapt to a changing environment, it is tempting to assign a Bourdieuan (1990) 'logic of practice' that underlies and informs these practices or customs.

A 'logic of practice' approach would imply that the practices change but the logic behind the practices is more durable, so no real change is perceived. On one level, Bourdieu's logic of practice provides a useful concept, as a durable logic of practice could provide continuity to changing practices: while the practices have changed, by the introduction of motors and pressure, the logic underlying has not, and so nothing has truly changed. While Bourdieu's logic of practice begins to link practices and cognition, it does so on the basis of a duality between the practice and the mental. While practice/cognition link could be interpreted as embodiment, this can also be problematic. Ingold (2012, p. 437), for example, draws on the work of dance philosopher Maxine Sheets-Johnstone (1999) to argue that the term 'embodiment' is nothing more than a "lexical band-aid" that covertly maintains the distinction between knowing and being, arguing this can only be resolved by attention to 'movement'. In my interpretation, I refer to practices rather than movements, as the term 'practices' is more relevant in this context while still encapsulating the significance of movement, as both terms refer to a 'becoming' and not a 'being'. The duality between practice and cognition is problematic here because the miners never talked about practices of mercury use as cognitive. However, to abandon the cognitive 'logic of practice' would leave the continuity assigned to the practices unexplained. 'Embodiment' seems to be a poor resolution of this problem, while performative approaches offer potentially a more informative understanding.

I have found a performative interpretation of mercury use more illuminating than a Bourdieuan one, although aspects of the latter can still be productively employed. The concept of performativity can be investigated through education. When I asked miners about how they learned to use mercury, I always got shoulder shrugs or vague responses. The most articulate response I received was that they just '*learned from doing it*' (which contrasts completely with explanations of how miners recently learned to work without mercury). It was clear that education did not exist as an institution with regards to mining or mercury. The practices were learned through practicing or practising-with, rather than through representations of practice. I say 'practising-with' because this is not a solitary process, with miners saying they learned these practices alongside other workers and materials. This

implies there was an element of instruction, although in a fundamentally different manner to that of a classroom, and this was provided by materials as well as people. This problematizes the practice/cognitive duality which sees cognition governing practice, when in reality the cognitive is arrived at through the practice. This seems more akin to Ingold's (2010b) knowledge of walking²⁰, or more broadly a knowledge gained from moving through the world, interacting with it, and completely sensorially experiencing it as opposed to viewing it from afar. This is also exemplified by Juan's description of the mining process, from the construction of tunnels to the final burning of the mercury-gold amalgam, even extending into the partying that might occur afterwards. This is a performed activity, sensorially experienced and practiced, and it is this that Juan tells me what mining is all about. It is far more a mode of doing and becoming than a mode of being or thinking.

Ingold (2012) goes further and identifies two different types of science; the chemical and the alchemic. There is chemical science in which knowledge is gained from representations, and as a result the scientist learns what materials are, and alchemic knowledge in which the practitioner learns through practice about what materials do. Ingold gives the example of renaissance painters as alchemic scientists in that they knew nothing of the chemical structure of the ingredients of their paints, but knew exactly what they did and were able to produce amazing works of art with them. There are parallels to gold extraction here:

We take a measure of mercury, half an ounce, and we throw this in each *coco*. There are times when the mineral is attracted to [*In Spanish, Santiago uses 'amar', more commonly used to mean 'to love'*] the mercury, but other times it isn't, so we throw in lime [juice]. [if the material is not attracted to mercury] then it means we use more mercury, it is uneconomical. But when we add lemon it is attracted. (Santiago)

However, Jairo, sitting in his office in Medellín, told me how lime juice and soap are often added to the mills, yet have no effect whatsoever. The two types of

²⁰ Also referred to as a 'dwelling perspective' (Ingold, 2000).

knowledge are clearly visible here: one gained from interacting with materials and knowing what they do; the other from abstracting and formally studying them to find out about what they are. Santiago's understanding is largely based on 'practice' and intuition, and not purely on cognition.

Considering performative understandings of knowledge seems far more appropriate in this situation than focusing only on cognitive aspects. What a Bourdieuan perspective might contribute is a greater understanding of how this performative understanding is structured and then reproduced. The reasons I have included a Bourdieuan perspective in this chapter will become more salient in the following chapter. Ingold's 'alchemic' and 'chemical' sciences are not absolute categories, but rather opposite ends of a spectrum, across which real world situations can be distributed. While so far, the knowledge of working with mercury is located closer to the performative/practiced end of the spectrum, the knowledge of working without mercury approaches the cognitive/representative end. This offers a different interpretation of the paradox of changing practices being perceived as continuous. There is continuity in 'thought' or 'cognition', but only in the sense that thought/cognition and practices are entangled, and not dichotomies, with miners thinking through practices. This relatively practise based knowledge offers a way of understanding how practices of mercury use have become entangled with modes of how miners approach mining.

Conclusion

In this chapter, I have described the practices of mercury use and the significance of these practices. I have argued that the defining traits of ASGM in Antioquia are relatable back to mercury, as it allows a moderately efficient extraction at a small-scale system with limited investments. The entanglement can be seen at a deeper level again, in the knowledge of mercury that is gained by prioritising practice over representation, and how this represents a distinct mode of approaching mining. This entanglement was able to arise as miners had extremely limited knowledge of the toxic effects of mercury, a failing of practice-based knowledge due to the

invisibility of the symptoms of mercury poisoning. Miners and mercury have been entangled for generations, and the practices of mercury use have often been referred to as 'traditions', a term that is also a political tool for miners to establish a right to mine. However, this approach for understanding mercury mystifies rather than illuminates the practice, as it ignores the materiality and practice-based knowledge of mercury's entanglements with miners. Mercury-based extraction is not just a strategy that works well in an informal industry, but it is co-constitutive of an informal industry. This will become more apparent in the following chapter where the challenges of mercury elimination are discussed. ASGM then seems to be an entanglement of miners, mercury and gold, and these 'entities' exist relationally, through their intra-actions with each other.

Chapter 6: Disentangling Mercury

“When they told us that we couldn’t use mercury, I thought the mining was finished, because if we can’t use mercury, how could we extract gold? But it turns out there is very advanced technology, technology that we didn’t know about.”

Carlos, a placer miner from Caucasia.

“He [Pierre Bourdieu] aimed to show that capitalism did not merely introduce new practices that the peasants were not capable of mastering; rather these practices forced on peasants a new reality: they actually robbed the peasants of the very reality in which they could operate.”

Ghassan Hage (2014, p. 152).

This chapter is about the disentanglement of mercury from miners, a disentanglement which represents a de-constitution of ASGM in Antioquia. While the last chapter emphasised continuity, this chapter is about change. I will examine this change first of all through Carlos’ experiences, which highlight the challenges of eliminating mercury in a small-scale and informal reality. This is challenging as mercury is co-constitutive of informal ASGM, as has been explained in Chapter Five. However, the informal reality co-constituted by mercury is becoming dominated by a formal, mercury-free reality, and this shift incentivises mercury elimination. It is through Carlos’ story that I will introduce and develop a theoretical framework, which I will then use to discuss the experiences of those miners who have better linked mercury elimination with formalisation. This includes the changes that occur at the level of physical flows of materials and their intra-actions with technology in terms of alluvial open-pit mining, hard rock mining, gold processing workshops and gold buying shops. I will look at the new and radically different skills and education needed to use these technologies and manage the flows, and how in many cases this represents a more representational than performative knowledge of materials and therefore a change in worldview for miners. I will also look at these changes in relation to the (non)ecological habitus of miners, which shows a complex interplay

of social and material factors. It is through new and unexpected entanglements and intra-actions that a new and dominant reality of formal and mercury-free mining is being constituted, a '*minería bien hecha*'²¹, or a responsible mining that relates to far more than just mercury. However, there are significant barriers to miners including themselves in this new dominant reality.

Dredge-Based Placer Mining

Dredge-based placer mining is highly informal, and while mercury elimination is possible in this context, it is a major change in operation which creates an untenable conflict with the informal nature of this activity. Of all the miners I spoke to, Carlos has made the most impressive effort to eliminate his use of mercury, which he has successfully achieved. Despite this level of commitment, Carlos was only able to do so with outside assistance in the form of technology and education. The changes were not simple to enact, and amounted to what Carlos described as a "complete change in mentality". Carlos recalled how he first heard about the harmful effects of mercury from a talk given in his village by the Colombia Mercury Project. Disturbed by the news that his livelihood was responsible for environmental degradation and health problems, Carlos and a friend decided that they would do something about it. Immediately, this makes Carlos somewhat exceptional, in that of all the people who heard this talk it was him and his friend who decided to act.

The town in which Carlos is based has a loose miners' association, of which Carlos is a key member. Representing the association, Carlos met with the director of an NGO working in the mercury reduction field. The NGO agreed to provide the necessary equipment for the miners to work without mercury, signing an agreement with the association to establish the terms of use. The equipment included a sluice box (Figure 16), a trommel (Figure 17), a centrifugal concentrator (Figure 18), a spiral pan (Figure 19), and a gemini table (Figure 20). These are all

²¹ This is literally translated as 'mining done well'. However, I prefer to translate it as responsible mining as this better represents what the term means in the context in which it is used.

gravitational technologies that operate on the principle that gold is heavier than sand, and do not require the use of chemicals. Any of the local miners may use the facilities, with 40 currently doing so. Carlos hopes to increase this to 70, and he has been working hard to convince more miners to participate. Carlos learned to use this equipment with the help of the NGO by hands on demonstrations, a performative process, and he has passed on this knowledge to other miners. His approach to convincing another miner of the efficiency of the equipment was not to use representations, or claims of efficiency, but to suggest a practical engagement. Bottom up initiatives have been strongly argued as necessary for mercury elimination (Hilson et al., 2007), and the importance of performativity has been noted, if not in those exact terms (Jønsson et al., 2009; Tschakert & Singha, 2007). The combination of these approaches seems to have contributed to the observed success here.



Figure 16: Sluice box.



Figure 17: Trommel.



Figure 18: Centrifugal concentrator.



Figure 19: Spiral pan.



Figure 20: Gemini table.

Carlos said that at the end of each day working on the river, he would take around 70 kg of sand to the workshop. This can be washed firstly in the sluice box, or sent straight to the trommel or the centrifugal concentrator to be reduced down to 20 kg. From there, the material would be further processed using either the spiral pan or the gemini table, which wash the material and return the heavier gold. The process is relatively quick, with the spiral pan, for example, being able to process an individual miner's batch in around 10 minutes. This quick processing time reduces congestion amongst miners using the workshop at the same time. Which process is used depends on the preference of the miner and on what equipment is free at the time. Carlos has been incredibly happy with the machinery, as in addition to being mercury-free, he believed it to be up to 90% efficient²². When another miner was sceptical about the efficiency, Carlos suggested he process half his material with the gravitational technology and the other half using mercury. This test demonstrated the gravitational equipment's efficiency, showing it could earn the miner \$40 USD more per week in gold sales, plus the savings on mercury. This test was performative, as opposed to sending material to a laboratory, which would be a 'representational' test, as from a miner's perspective the results would be abstracted from the material and the practice. This performative testing seems to be crucial to the success being experienced by Carlos. While Carlos was happy with the technology, he did make the point very strongly that working with it involved "a complete change in mentality."

Despite Carlos' exceptional commitment, his ability to work without mercury is completely dependent on equipment which was only obtainable with the assistance of the NGO. Carlos estimated that the equipment was worth about \$6,000 USD, which was not too expensive, he said, but he probably would not have made this purchase independently. A rough, conservative calculation shows this equipment gives a good return on investment. A \$40 USD a week or \$2080 USD *per annum* increase in income is roughly a 35% annual return on investment, before considering savings on mercury. This return increases as more miners use the

²² While I have heard doubt expressed about this figure by those working in mining engineering, other sources indicate that this could be possible (See Mitchell, Evans, & Styles, 1997).

facilities, with only three being needed for a complete return of investment within a year. Despite this profitability, Carlos discussed several challenges to achieving this independently. The standard mode of obtaining credit was from the gold buyers/mercury sellers, who would not provide this amount of money, nor fund an operation that would compete with their own business. All my participants said banks would never loan to a miner without a license, and other non-bank lenders had a shady reputation. However, the problem is not just the *ability* to access money but the *decision* to make the investment. Carlos told me that dredge mining is a subsistence activity, and that he works one week to put food on the table for the next. Making capital expenditures for long term returns is not a part of his *modus operandi*.

While capital investment is one barrier to eliminating mercury in ASGM, education is another significant factor. Carlos did not know of mercury's harmful effects until he witnessed the Colombian Mercury Project's education and awareness campaign. Nor did he know that it was possible for him to work without mercury. The knowledge of how to operate the gravitational equipment came from the NGO. This gravitational process works primarily on a different physical basis (gravitational) than a mercury extraction process (largely chemical). Mercury extraction does have a gravitational element, in that the gold sinks to the bottom of the sluice where it encounters mercury. However, I would argue that mercury is the principle extracting agent as its use means that only a basic knowledge and technical capacity is needed to exploit gravitational properties²³. This new physical principle, which was introduced by an actor from outside of the ASGM sector, represents a major change in Carlos' mode of operation, even though it was introduced largely through practice based learning, which was a major factor in the relative success of the venture. While still a major change in operation, I suspect Carlos would have experienced an even larger change had a representational mode of education been used. The other education initiatives discussed in this chapter have far larger representational components, although this situation illustrates that this does not

²³Mercury can be seen as intra-acting through gravity. Forces should be considered to have the same capacity for entanglements and intra-actions as materials.

necessarily need to be the case. The crucial role of the NGO in terms of education means that this change could not easily have occurred independently, despite Carlos' commitment.

The final disincentive to working with gravitational technology relates directly to informality. When I first visited Carlos' workshop, the whole place was shut down. Carlos told me this was because only four days earlier, 15 miners working nearby had been arrested for mining without titles. The miners were released on the threat of prison sentences should they be caught mining illegally again. Following this, Carlos had deemed it prudent to take some time off to wait for the situation to quieten down. This constant risk of arrest makes his work environment less tolerable, and further reduces the incentive for investing in technology. If he were to be arrested, the equipment would likely be confiscated or destroyed, a financial disaster if he had paid for it himself. If the equipment provided by the NGO was to be confiscated, Carlos would lose his ability to work without mercury, although it would not be financially disastrous for him personally. The destruction of mining equipment by the police was one of the chief complaints made by Ramiro Restrepo from the Miners' Association of the Bajo Cauca. While the challenge of mercury reduction has been temporarily overcome for Carlos with the help of the NGO, this does not seem to be a sustainable solution for reasons of scale and informality. First of all, interventions by NGOs require external resources, with the cost of equipment being borne by those not directly profiting from the mining. Marcello Veiga (2015), a leading expert in the field of mercury reduction, has commented that interventions with miners on a very small scale are too costly and inefficient to be sustained. Additionally, as Carlos is working without a mining title, it is legally problematic for the NGO to help him. This could be construed as assisting with an illegal activity: a criminal act under the Colombian constitution. What Carlos' situation shows is that miner willingness to change is not the sole barrier to mercury elimination, as even when a miner is extremely committed, if they remain small-scale and informal they must rely on outside help, and exist precariously and unsustainably.

I found it initially helpful to approach the change in mentality Carlos described through the perspective of ecological habitus, or the privileging of ecological concerns so that ecologically sound actions become practical within a given field (Haluza-DeLay, 2008). Carlos is somewhat exceptional among the miners whom I spoke to, in that his efforts to eliminate mercury have gone beyond what could be considered an appropriate strategy for his field. Bourdieu differentiates between 'disposition' and 'capacity' (Hage, 2014), and while Carlos' *capacity* to work without mercury was achieved with outside help, his *disposition* to do so was internal. Mercury extraction remains an effective strategy in an informal field when environmental and health considerations are excluded. However, once ecological concerns are included as factors in decision making (a process that is not wholly cognitive), the strategy ceases to make sense. Carlos is a proud family man with several children, and he regularly told me that he did not want to leave a contaminated environment to them and their future children. This showed how he had expanded the field that he operated in to include the environment.

While mercury use seemed to be Carlos' primary concern, the inclusion of ecological concerns is of course not just limited to mercury. Carlos spoke more broadly of a responsible mining, in which environmental concerns were generally considered. In developing the concept of ecological habitus, Haluza-DeLay (2008) distinguished between formal education and learning through participation, and identified the latter as the most crucial in forming an ecological habitus. While Haluza-DeLay was referring to participation in social groups, this could be translated into a performative experiencing of the environment. While Carlos' concern for the environment may be a result of his existing and acting in it, his awareness of mercury's harm is a result of relatively formal education, or learning by representations. It is for this reason that Carlos' experience is primarily the result of a mental reframing of the field, and this mental, rather than performative reframing, is a key barrier to more miners adopting this sort of perspective.

A Bourdieuan idea of realities can also illuminate the transition that Carlos' mining operation has undergone. This Bourdieuan idea of realities is explained by Ghassan

Hage (2014), who writes that it is not only individuals that can be dominating or dominated, but so can the realities in which they operate. I have referred to mercury as an appropriate strategy for informal mining. However, this needs clarification as the increasing number of arrests of informal miners who use mercury questions how effective this strategy currently is. Bourdieu's schema is useful in that it can be used to establish informal mining as a reality, and mercury use an effective strategy in that reality. This reality was previously a dominant one. However, for miners in Antioquia informal mining is now being dominated by the reality of formal mining, or of *minería bien hecha*. It is not that mercury use has ceased to be an effective strategy, but that the reality in which it is effective is now dominated by another. Carlos is exceptional in that he remains in an informal mining reality while eliminating mercury, a result of his mental reframing of the field and new mixed performative/representational education. However, this position is difficult. Carlos does want to formalise, as this would allow him to enter a dominating reality and to fully practice a *minería bien hecha* with which mercury elimination is conflated. However, he has been unable to do so, as mining law places insurmountable barriers to the formalisation of small-scale dredge operations (discussed in Chapter Seven). He said that the only possibility is for him to sign a subcontract with a larger company, a potentially exploitative arrangement. These barriers to formalisation have a strong political aspect, and are discussed in the following chapter.

Bourdieu's theories are useful, but do not fully realise the co-constitutive role of materials in constructed realities. As discussed in the previous chapter, mercury use is not a function of the social, but co-constitutive of the social. Mercury is not just an effective strategy in an informal mining reality; it co-constitutes an informal mining reality. Realities are not pure social constructs. This explains some of the difficulties in mercury elimination for Carlos, despite his ecological habitus. For Carlos to change realities, there are material as well as social barriers that go beyond what a Bourdieuan framework can account for. The challenges that Carlos has experienced, or the challenges he would experience if he tried to eliminate mercury without outside help (the normal mode for informal ASGM), prove this

point in the negative. The disentanglement of mercury results in a de-constitution, while the entanglement of new gravitational technologies, with their associated forms of new knowledge and new actors, represent a constitution of a new formal mining, a *minería bien hecha*. Carlos frequently said that this new method of extraction and mining was a complete change in mentality and a totally new way of doing things. This experience of mercury elimination is the result of an entanglement of material, cognitive, economic, and political factors which have become so entangled that they can hardly be considered as distinct.

Alluvial Open-Pit Mining

As open-pit mines often operate on a larger scale than dredges, they have more naturally tended towards mercury elimination and formalisation, although this is not without major challenges. Esteban, Miguel and Felipe have been reducing their mercury use, although they have not yet achieved full elimination. Their reasons for doing so and experiences are somewhat different from Carlos', however. These open-pit miners are all in the process of achieving an overall transition to the formal *minería bien hecha* that their larger scale and desire to expand necessitates. Miguel, Esteban and Felipe each separately and explicitly referred to responsible mining and *minería bien hecha*, explaining in their own way how it was a different way of thinking and going about mining. They have also been reliant on externally provided education and technology to achieve their reductions in mercury use. They have begun working with the National University of Colombia, which has established plans for them to work without mercury, help which is only possible because they are in the process of formalisation/are formalised (CIMEX, 2014). In both mines, the sluice boxes were changed by widening them to allow a slower flow of water and material. Instead of using mercury in cloths, a plastic weave mat was used under a metal grill as a chemical free way to catch the gold bearing material. The plastic mats are removed periodically and washed to remove the gold bearing sand. These changes involved relatively insignificant investments of capital, but an increase in knowledge and a change in the management of the extraction process. Felipe said that previously mercury would be added indiscriminately to

successfully extract gold. Now, he had to think of the type of material being washed, the slope of the sluice boxes, the water pressure, and a number of other factors, new skills for a far more involved and precise process.

The material extracted from the plastic mats was further processed in a trommel in both Felipe and Esteban's mines. These trommels are a more significant investment, and were acquired through a program administered by the National University of Colombia and funded by Corantioquia, the department's environmental agency. The trommels sort material based on size, allowing the fine gold-bearing sand to be collected and stones to be discarded. In Felipe's mine, the trommel was used after each wash, which occurred after 100 hours of mining. Felipe had made a number of modifications to the trommel to better suit his purposes. At Miguel's mine, the trommel is used every three to four days. Esteban's trommel is of a larger scale than Felipe's, and without modifications. From this stage, a mercury-based smelting occurs. Mercury is added to the concentrated sand, a mercury-gold amalgam is formed, and the mercury is burned off leaving gold. In Felipe's case, this occurred off site and so he was unable to provide me with any details. In Esteban's mine, this occurred on site every three to four days. The process was very carefully controlled to protect his workers' health and to prevent mercury entering the environment. Retorts and a 'snorkel' fume hood were used to capture the mercury vapour. While these are not perfect, the fact that Esteban burns the amalgam at his mine instead of taking it to a gold buying shop in the urban centre of Cauca greatly improves public health by reducing mercury pollution in the urban area. The single worker who carries out this process has the correct personal protective equipment, such as gloves, a visor and a respirator mask. He is also sent for urine tests every two months to evaluate his mercury levels. These precautions have been introduced over the previous few years.

Neither Esteban nor Miguel is happy that they are still using mercury, but explained that there are significant barriers stopping them from eliminating it. Their awareness of mercury's harm came from outside sources, but in their endeavours to practice a more modern mining, they have initially been more receptive to

outside ideas. The barriers to mercury elimination primarily relate to informality. Esteban's mine is approaching medium scale, and is in the process of formalisation. He has more access to capital than small-scale miners, which is partly a result of his relative formality: his mine is a limited liability company, and his son (who works in the USA) is a partner. While barriers to credit still cause problems, he does have the financial resources to invest in mercury-reducing technology. He had recently been to a mining conference in Brazil (in itself a sign of a more progressive and international outlook), where he saw new types of extraction equipment that would allow him to work without mercury. However, he chose not to acquire this extraction equipment because he is unsure whether or not he will receive the mining title he has applied for over five years ago. This uncertainty threatens the ongoing viability of his mine, discouraging investment. Secondly, it was a legal requirement to show a mining title to be able to import the equipment into Colombia. While there was some equipment sold within Colombia, it was a far reduced selection at a heavy mark up. Even for Esteban, informality is a barrier to mercury elimination.

For Esteban, Miguel and Felipe, reducing mercury use seems an appropriate strategy for the type of mining operation they wish to have. As they move to increase their mining size and capability, they also need to conform to new rules and to carry out responsible mining. From this perspective, mercury use would be a rational choice, or more appropriately a structurally determined rational choice. From the opposing perspective, choosing to work without mercury is an individual decision, an environmental commitment these miners have chosen to make regardless of social structures, and they certainly seemed to be genuinely passionate about environmental concerns. This dilemma could then be framed as a structure/agency debate. However, Bourdieu's habitus is widely considered as the hinge between structure and agency, with Bourdieu arguing that individuals act primarily to augment their social being (Hage, 2014). Their concern for the environment is not purely motivated by rational choice, but it does augment their social being as responsible miners. They are moving into a field which requires responsibility, among other things, but they are moving from a field which does not

require it. Their responsibility towards mining is also constitutive of a responsible mining field or a dominant mining reality, indicating a co-constitutive relationship between these miners and their new field, a co-constitution that is centred on an ecological habitus.

Minería bien hecha is centred largely on the absence of mercury, but it also includes reforestation, formality, health and safety, gender equality and business acumen. All of this is associated with a discourse of modernity and progressiveness, illustrated by Esteban's lamentation of the closed-mindedness of miners, and the way Felipe went to some length to distance himself from miners who operated their mines based on 'traditions'. Miguel introduced me to the young female student from the training centre in El Bagre who had been hired as a health and safety intern. She ensured workers were properly trained, and that the workers' mercury exposure was limited, and was therefore indirectly assisting with the formalisation process, all of which are progressive steps. Miguel told me how creating a workplace health and safety position was in itself a big change. Furthermore, while most mines would not hire a woman, Miguel explained that they were more progressive and therefore appreciated 'a woman's touch'. I thought to myself that she was simultaneously embodying so many of the forms of progressiveness that comprised a *minería bien hecha*, which was probably not an easy task.

Minería bien hecha is becoming a dominant reality, primarily through an increased level of enforcement of mining law, but also discursively, as it permeates the language of the government, NGOs and miners. As Felipe and Esteban's medium-sized open-pit mines are fixed and highly visible operations, and are beginning to make more capital investments, informality is no longer a practical option for them. Formality offers new opportunities financially, as it allows them to increase their scale and move from the moderate efficiency of mercury extraction to the high efficiency of more industrial modes of extraction. It also allows an augmentation of their individual desires to be responsible miners. Mercury is entangled with informal mining, and its elimination is entangled with the shift to a more formal

mining. The elimination of mercury is neither categorisable as a simple cause or a result of this shift. Changing to this new formal type of mining is not easy, however, and the difficulties involved in this will be discussed in-depth in the following chapter.

Hard Rock Mining

The situation of hard rock miners is quite different to that of placer miners in that they do not own their own extraction facilities. Therefore, they are completely dependent on the gold processing workshops, which are perhaps the strongest focal point of the entanglement between miners and mercury. As the processing workshops continue to use mercury, mercury reduction is being achieved by the use of alternative processing facilities, effectively eliminating the gold processing workshops²⁴. Since 2012, miners in Segovia have been taking gold-bearing material to the cyanidation plant of the Canadian owned Gran Colombia Gold (GCG) mining company for extraction (García et al., 2015). This arrangement has led to an estimated reduction of 19.3 tonnes of mercury per annum as of 2014. The contractual arrangement will be discussed further in the following chapter, but it does involve the miner signing a binding contract with the company, which formalises the miners through that company's mining title. However, this can be an exploitative relationship. The process works by the miners bringing their material to the company, which takes samples to determine the gold concentration. Based on the results of the samples, the company pays the miner the portion of the gold which is stipulated in the contract. The company then proceeds to mix together the material brought by different miners, grind it, then perform a cyanide extraction. This contrasts completely with the process used at the gold processing workshops.

Juan, who currently processes material in this way, strongly dislikes the process and distrusts the company. In the previous chapter, I related how Juan talked passionately about the entire gold extraction process practised in the workshops, a

²⁴ To clarify the terminology here, the facilities I have described and labelled as 'gold processing workshops' are what are colloquially called *entables* in Antioquia. This is a specific type of facility, as opposed to industrial scale facilities that process gold.

performed and sensorially experienced process which he took immense pride and satisfaction in. This satisfaction is denied by using a company's cyanidation plant. Furthermore, the gold processing workshop system allowed for complete trust, with the miner responsible for performing every stage of their own extraction. This is not the case with the company, which Juan distrusts immensely. The gold concentration tests carried out by the company can be considered 'representations', as seen from a miners' perspective, as the results are abstracted from the procedure and not a result of a performance by the miner. In Ghana, Tschakert and Singha (2007) noticed something similar. They found miners were trusting of mercury indicator strips for determining mercury concentrations, a less accurate but hands-on and immediate test, but disbelieved results sent back from a distant laboratory. This helps explain the distrust experienced in Antioquia, as miners typically operate by practice. However, to read too much into this as the source of distrust would be to deny the highly political aspects of the arrangement, so I have postponed further discussion until the following chapter. Once again, this shows by contrast how mercury was entangled with miners and is co-constitutive of an informal ASGM. Mercury's elimination has led to new physical flows, a shift to a representationalist mode of extraction, formalisation and the creation of new and potentially exploitative political economic relationships.

Gold Processing Workshops

Disentangling mercury from gold processing workshops is problematic, as these workshops represent the strongest entanglement of people and mercury. Santiago, a gold processing workshop owner, has made few moves to reduce his mercury use to date, although he assures me that he will do so for purely business reasons. As mercury is so tightly entangled with his business, eliminating it entails a complete change in his processes. He is planning on changing to one larger mill into which all the miners' material would be added and ground without mercury, before undergoing a cyanide extraction. While Santiago was quite adamant that mercury was not harmful, he recognised that the reality in which he operated was becoming dominated due to government regulation, and for his business to continue he

needed to stop using mercury. Regulatory attention is a relatively recent occurrence for Santiago. As gold processing workshops are not mines, they are not governed by mining law, and it is only in the last few years that the relevant environmental legislation has been enforced. The workshops' legal status is perhaps best described as quasi-formal, and it is in this status that the entanglement with mercury has come about. This entanglement is becoming problematic in an environment of increased government regulation.

Santiago's situation contrasts clearly with the change experienced by Carlos in particular, as Carlos changed what he considered important, a reframing of his field to include the environment, which led to the changing mode of how he approached mining. In the case of Santiago, his values and habitus have remained the same, but the reality in which they operate has come to be dominated by another. This necessitates change, but the aims that these changes aim to achieve have remained constant, namely, Santiago still prioritises his business²⁵. Thus, Santiago desires to shift realities without embodying the ethic of a *minería bien hecha*, but he has made little progress in achieving this goal. While Santiago has espoused the *disposition* to change, he may not have the *capacity* to do so (in a Bourdieuan sense). Despite it being halfway through mercury's legal phase-out period when I spoke to him, Santiago had failed to make significant progress towards elimination. An NGO worker who knew Santiago told me that he had been saying he would change for the last five years, and that he had been flown to Portovelo in Ecuador twice to view the new demonstration plant there²⁶. He had even been given financial assistance for purchasing new mercury reducing equipment, all with no result. When I talked with Jairo about the processing workshops, he said that while there were around 50 in Segovia, the town could only support 1-2 full cyanide extraction plants as they worked efficiently on a larger scale. Santiago currently operates in a far more business-like manner than most of the miners I talked to, and had significantly more capital available. However, this new plant would still be

²⁵ Social fields and values are mutually co-constitutive, and so while I am not foreclosing the possibility of Santiago having a change of values, if he manages to change fields, it is not because of a change in values (internal), but because of external factors.

²⁶ This plant is discussed by Veiga et al. (2015)

a considerable increase in scale, a fact he was keenly aware of. It would imply an increase in investment as well as a more scientific and representational knowledge of the process. The problems with trust that GCG experienced from processing the ore from many miners in a single batch would also be experienced here. All of these factors have impeded Santiago's ability to change.

Finally, formality would also be an issue. If Santiago was to move to a larger scale operation in a time of increased regulation, a quasi-formal status is not an option. Through the creation of a mineral trading registration scheme system, the government has criminalised the processing of gold from informal mines and provided a means of enforcing this (Echavarria, 2014). As the majority of the land around Segovia is under title to GCG for perpetuity, the miners in the area are only able to formalise by signing a contract with GCG, which means they are required to use the company's processing facilities. This reduces the possibility Santiago establishing a large-scale, fully legal processing operation. Despite Santiago's disposition, his lack of capacity to change (and the lack of other processing workshop owners), it seems that gold extraction in Segovia is more likely to be taken over by LSM. What this represents is an entanglement of mercury and people so tight that a disentangling of the two effectively results in the complete disappearance of the gold processing workshop industry. For this reason, I refer to the processing workshops as perhaps the strongest point of mercury's entanglement with people. This shows by contrast the strength of mercury's entanglement, an entanglement that is material, political, economic, cognitive and performative.

Gold Shops

While David has made a number of changes to reduce the amount of mercury pollution his shop emits, his operation remains very much entangled with mercury. While he is to some degree aware of the harm that mercury can pose, he still considers it a necessity for mining. As his business is in buying gold, selling mercury is both profitable and necessary, as it exists as a counter trade to gold, with miners

exchanging mercury-gold amalgam directly for mercury. As most of the gold brought for sale is in the form of mercury-gold amalgam, to continue his business David has no option but to purchase this. David had heard about the harmful effects of mercury vapour from awareness campaigns and annual presentations at the Caucasia hospital. Through these avenues, he understood the symptoms of mercury poisoning, but also heard and believed the claim that mercury causes impotence. It is not strictly true that mercury does cause impotence, however this has been noted as an effective strategy for discouraging mercury use, although it is ethically problematic²⁷ (Hinton et al., 2003). David described the risk of impotence as a major motivation for him to take precautions, pointing out to me that he was a married man. However, he did not believe that mercury was water-soluble or could be present in fish. David was aware of mercury's impending illegality, and of police efforts to restrict its trade. While David's attitude towards mercury had certainly changed, his values and habitus had not. For David, the change in attitude is being brought about by representations of mercury and external political factors, and not through a performed experience, and this change of attitude is encouraging him to engage in a new mode of processing gold and mercury.

While David is unable to avoid mercury until the miners he buys from stop using it, in the interests of his business, health, and masculinity he has made efforts to limit his exposure. This comes in the forms of using a fume hood leading to a retort (Figure 21) to capture the evaporated mercury, as well as wearing the correct personal protective equipment such as gloves, a respirator mask and face protection (Figure 22, Figure 23). The retort captures mercury by passing the fumes from the burning amalgam through a bucket of water. The mercury liquefies in the water, allowing David to easily collect it. It is possible that it is this filtering process that led to David's belief that mercury is insoluble in water. The fume hood and retort are made locally, and are priced well within David's financial capacity. Introducing these seems to have happened relatively easily, and has increased David's income as he is now able to sell the mercury he captures in his retort.

²⁷ The rumour that mercury exposure leads to impotence seems widespread in Antioquia; Cárdenas Herrera (2014) reported that Viagra sales have dramatically increased in the mining towns.



Figure 21: Fume hood leading to the retort.



Figure 22: Respirator mask.



Figure 23: Face protection.

Mateo told me that retorts and fume hoods were easily introduced into Segovia also, contradicting my initial assumption that David changed more readily as he was a new entrant to the industry. Mateo explained how one particular gold buyer in Segovia, whose father was a foreign mining engineer, had a retort in his shop. Despite his efforts to keep it hidden, someone managed to make a diagram and soon the other gold buyers had made their own. Mateo told me that the gold buyers were primarily motivated by profit, as they realised that they were losing valuable mercury. Studies elsewhere in the world have found significant resistance to the use of retorts, which many miners distrust (Jønsson et al., 2013; Kaplan et al., 2015). This situation seems to speak to the importance of bottom up initiatives, as the retort arriving via a local actor. Perhaps there is also an element of reverse psychology, with the secrecy actually encouraging the retort's use.

While the implementation of retorts is positive, Cordy et al. (2011) argued that no existing apparatus was efficient enough to ensure safe atmospheric levels while amalgam burning occurred in urban areas. These authors argued that the gold buying shops were located in urban areas due to security issues and paramilitary activity in rural areas. David confirmed this, reminding me that he entered the gold buying business because he had to leave his previous rural employment due to threats from the paramilitaries. However, David was confident in the complete efficiency of his retort, and so he did not feel that there was a problem with remaining in the town. Mercury pollution by gold buyers can be reduced to an extent by the introduction of new technologies to manipulate the flows of mercury. Despite this improvement, mercury remains entangled with the gold buyers, and cannot become disentangled without first disentangling mercury in other sectors. While this goes against Hilson's (2006) suggestion that these gold buyers/mercury sellers are a key focal point for mercury elimination, this may merely be due to differing contextual factors.

A New Mode of Education in El Bagre

A change in practices to achieve mercury-free extraction has also been largely associated with a change in how these practices are being learned. The mode of education has shifted from a relatively informal and performed model to a more formal and representationalist one. In the mining training centre in El Bagre, the students learned about gold extraction through classes in which instructors represented the process. In a small, tidy workshop, I was shown all the different machines that could be used for mercury-free extraction, including gravitational, cyanide and flotation based methods. However, the machines were disconnected from each other, and were not a functioning chain. The workshop also seemed strangely clean, especially after seeing other extraction facilities. While these were used for demonstrations, and so there was an element of practice, this was still an overwhelmingly representational mode of education. Perhaps the best example I can give is the training to use excavators, which was being taught by visual simulators. I wondered what Felipe would say, himself a self-proclaimed modern miner, who proudly learned to use an excavator by operating one. This most strongly highlighted the relative difference between representational and practice-based education.

The second important aspect of this new mode of education is that it is formal. The centre in El Bagre is funded by the government, and students are formally enrolled to the institution. This can lead to some unusual contradictions. One friend at the centre told me his parents work in informal mining. For him to go and work for them would mean that he could be arrested by the government for implementing the skills the government had paid for him to learn. Others at the centre were instead considering working for LSM companies, such as the local *Mineros S.A.S.* The centre does more than just teach mercury-free extraction, but also promotes a *minería bien hecha*, or is itself a symbol and outcome of a shift to a *minería bien hecha*. Esteban's workplace health and safety intern, the individual embodiment of progressiveness, was a student at the centre. While the centre is relatively new,

opening early in 2015 (Martínez Arango, 2015b), it represents a shift to a dominant reality of *minería bien hecha* that is likely to have a significant impact on the sector.

Conclusion

This chapter presents the disentanglement of mercury from ASGM in Antioquia. In the preceding chapter, I argued that mercury was co-constitutive of, and effective in, an informal ASGM reality. This was theorised through the work of Karen Barad (2003, 2007), who explained how these entanglements were significant, and also through Ingold's (2010a) learning through practice. Here, I have examined how the elimination of mercury use represents a change in the flows of materials, social relations and practices. These changes in practices and new forms of education show how miners have transformed how and what they know about materials. Mercury's disentanglement from miners has represented a de-constitution of ASGM. The de-constituting role of mercury's elimination is complex and political, leading to unexpected entanglements, practices, social relations and values. Differences in the (non)ecological habitus of miners' explains to an extent the variation in how miners are experiencing these changes. New entanglements of mercury-free technology, formalisation, the engagement with new actors and a new mode of knowing materials come to constitute a new, formal mining reality in which mercury has no place. While mercury remains an effective strategy in informal mining, an increase in governmental regulation has meant that formal mining has become the dominant reality. Changing to formal mining is difficult, and part of this difficulty relates to materiality, showing the importance of materials in constituting these realities. The dominant *minería bien hecha* is a conflation of different environmental, legal, social and economic responsibilities, and an associated discourse of modernity. In the following chapter I will discuss the politics of re-constituting ASGM as *minería bien hecha*.

Chapter 7: The Politics of Disentangling Mercury

“We are miners. We are not illegal, we are not criminals. And the people here know that because the miners have been here for a very long time, and because the miners are responsible.”

Ramiro Restrepo, President of the Miners’ Association of the Bajo Cauca.

“Political sovereignty, or domination, has two heads: ... Varuna and Mitra, the despot and the legislator, the binder and the organiser.”

Gilles Deleuze and Félix Guattari (2014, pp. 409-410).

All of my conversations with miners in Antioquia indicated that their primary concerns were political ones centred on (in)formality. In this chapter, I will pay closer attention to the concept of formality and its performative aspects. I will look at the material-political nature of mercury’s absence and its entanglements with formalisation by subcontracting: a potentially exploitative relationship. A formal reality is constituted by performances with material, governmental, non-governmental and corporate actors, and by performing a more business-like mining. In light of open-pit and dredge-based placer mining, I will discuss how miners are trying to perform citizenship or a *minería bien hecha* through mercury’s absence. This is done for miners to frame themselves as informal miners deserving state assistance and not illegal miners deserving state discipline. However, a number of barriers exist which impede miners from transitioning to the dominating reality of *minería bien hecha* and obtaining mining titles. These barriers include material factors, the small-scale of mining operations, heavy regulatory burdens, and a nomadic occupation of space. I will also consider the government’s partially successful efforts to regulate gold processing and trading. I will conclude by returning to Barad’s novel definition of discourse, arguing that mercury is material-discursive and material-political, and that these political entanglements must be addressed for mercury elimination to be achieved.

Formalisation

Formalisation has often been discussed as a strategy to address mercury use in ASGM, and was a key component of the approaches established under the Minamata Convention (Clifford, 2014; Eriksen & Perrez, 2014; Kohler et al., 2013). The Minamata Convention was identified by Echavarria (2014) as a key driver of the most recent formalisation initiative in Colombia. Despite a general agreement that formalisation is necessary for improvements of the ASGM sector, both related to mercury and otherwise, there is little consensus on what the term actually means. Spiegel et al. (2015) point out that the Minamata Convention fails to define formality and thus problematizes its practical application. Veiga, Angeloci-Santos, and Meech (2014) argue that formality can only become effective when accompanied by additional support services.

So far in this thesis I have shown that there is a relationship between mercury and informality, however, the above critiques suggest that closer attention must be paid to the concept of formalisation. In defining formality in relation to ASGM, Siegel and Veiga (2009) identify three commonly discussed themes: a consistent legislative framework to govern mining; the registering and recording of mining activity (including taxation); and the assigning of property rights. Implicit in all of these is that formality allows effective state regulation, and therefore the possibility to implement anti-mercury laws. Siegel and Veiga (2009) particularly rely on the work of de Soto (2000) to describe formalisation as the integration of informal, customary property rights into a formal system of property rights which allows their sale and transfer. Verbrugge (2015a) defines these perspectives as dualistic and legalistic, arguing that they view informal ASGM as a homogenous, poverty driven activity, and ascribe the failure of formalisation attempts to administrative and political barriers. Verbrugge (2015a) is critical of these perspectives, and demonstrates the flaws of viewing formality and informality as a duality.

Verbrugge (2015a) describes structuralist or post-Marxist accounts of informality, which consider the heterogeneity of informal miners and the collaboration

between the informal and formal sectors. Formalisation campaigns can be used by entrepreneurial informal miners to gain formal mining titles. These ‘formal’ miners then rely on informal labour to exploit their claims, which further entrenches the exclusion of many miners (Fisher, 2007; Verbrugge, 2015a). Verbrugge (2015a, p. 1023) uses both legalistic and structuralist accounts to describe a “transition away from capital-intensive large-scale mining to a flexible regime of accumulation built around the exploitation of informal ASM [artisanal and small-scale mining] labour” in the Southern Philippines. While these accounts are useful, what I have found missing in many is the distinction between illegality and informality.

I have found it useful to consider a tripartite definition of informality, formality, and illegality. These can be viewed as a non-linear spectrum with significant thresholds, meaning it is neither a smooth spectrum nor an absolute duality/triarity. There is still a great deal of heterogeneity within these categories. This heterogeneity relates not only to the status of the mine with regard to the government, as discussed by Verbrugge (2015a), but also to the different types of mining, which as I will argue here influences the relation of the mine to the state. A variety of factors can be seen to contribute to the spectrum of formality, including legislation, property rights, registering, regularisation, enforcement and citizenship. Discussions of how these factors come to constitute formality are often problematized by a lack of distinction between what formality is and what it should be, as well as by asking to whom the definition of formality is for.

The legislative issues around formality in the Colombian context are complex, and will not be fully discussed here. Echavarría (2014) provides an excellent overview, noting that while informality is generally not recognised in Colombia legislation, there are some exceptions. Prominent Colombian mining lawyer Cardona-Valderrama (2015) has said that legality in mining was historically considered to involve having a mining title, but now involves having both a mining title and an environmental license. The implication is that legality can now extend beyond the activity itself (mining) to how the activity is carried out (*i.e.* environmentally responsible mining practices). Rivera-Sotelo and Pardo Becerra (2014) describe the

case of a largely indigenous group in the Chorrochocón region of the Colombian Amazon who had a legally recognised traditional right to mine. However, their operation was made technically illegal due to their inability to comply with the accompanying environmental legislation, in spite of their legal right to mine. Formalisation is far more than just property rights, and perspectives which focus on these are, I argue, top down approaches. Seen from a bottom-up perspective, the performative aspects of formalisation are more salient.

Mercury elimination is a key part of environmental legislation, and therefore a part of formalisation in a legal sense. As mercury use in ASGM will become illegal in 2018, a requirement for an environmental license is the presentation of, and compliance with, a plan for mercury elimination by this date (El Congreso de Colombia, 2013). Essentially, to not make any attempt to eliminate mercury indirectly makes the entire mining operation illegal. Mining titles, environmental licenses and, by extension, mercury elimination, become thresholds of legality. They do not completely define legality, which would be the dualistic perspective; at the same time they are extremely important to miners, and so legality cannot be considered a smooth spectrum which would ignore the importance of these documents. Mercury elimination is definitively correlated with formalisation in a legal sense. However, mercury elimination is a performance, which is how this aspect of formalisation is experienced by miners.

It is from this bottom-up perspective that I have begun to consider formalisation as a performance. Formality is not just something that one *possesses*, as in a mining title, or even something that one *is*, but also something that one *does*. In a Deleuze and Guattarian (2014) sense, this is not a 'being legal' but a 'becoming legal'. In Antioquia, mercury use is almost synonymous with informality and/or illegality, while mercury elimination has come to be closely linked to formalisation under the wider umbrella term of *minería bien hecha*. This is not just a correlation; formality is performed through mercury eliminating technologies or the absence of mercury itself. Likewise, engaging with governmental bureaucracy can be seen as a performance between miners and the government, making bureaucracy not so

much a barrier to formalisation, but formalisation itself. Ramiro Restrepo of the miners' association of the Bajo Cauca told me "For us, it would be marvellous if every miner was given a mining title and an environmental license. But it's very complicated." Reading into Ramiro's description of formality, he considered miners as having a traditional right to mine, a right that he felt should be incorporated into the state's system of property rights. This understanding corresponds with de Soto's (1986, 2000) concept of formalisation, as described by Siegel and Veiga (2009). However, this is not what is happening in Colombia, and the complications Ramiro referred to are the performative aspects of formalisation, namely what miners have to do, rather than what rights they (should) hold. Mercury is related to formalisation through these performative aspects, as miners must eliminate mercury to be formal. While this performative understanding of formalisation is not what Ramiro wants, it more accurately represents what is happening.

Formalisation through Subcontracting to LSM

The success in mercury reduction in Segovia has been largely achieved through miners using the Gran Colombia Gold Company's (GCG) cyanidation plant, achieving an estimated 19.3 tonne reduction in mercury use in 2014 (García et al., 2015). This arrangement has been brought about by miners signing contracts of operation with GCG, which are new and potentially unjust economic and political relationships in which mercury's absence is complicit. I say mercury's absence, because now that mercury has been successfully disentangled, there is no longer any mercury physically present. Despite this absence, mercury's materiality can still be traced.

By formalisation through subcontracting, I refer to a number of legal devices which allow mining title holders to sign contracts with third parties, permitting these parties to operate within the mining title. These third parties have typically been ASGM operations already existing within the title. These devices primarily include contracts of operation and subcontracts of formalisation (El Congreso de Colombia, 2001, 2013). Under both devices, the title holder remains legally responsible for all activity within the title, including environmental laws, health and safety,

employment law, taxation and mercury use. The more recent subcontracts of formalisation allow a greater level of regulatory oversight by the state (Echavarria, 2014). This provision for subcontracts of formalisation was included in the Law 1658 of 2013 (the so called 'mercury law'), which started the phase-out of mercury's legality. The preamble to this law focuses on mercury, and mentions neither mining nor formalisation, showing the way these two issues have become entangled.

These legal provisions offer practical yet controversial means for achieving both miner formalisation and mercury elimination. The lack of untitled areas for mining and the high level of bureaucracy involved have been identified as barriers to formalisation, both by the miners I spoke to and by Echavarria (2014). Formalisation by subcontracting allows formalisation to occur in titled areas through a streamlined process; Carolina Arbelaez at Barbosa Gold told me she could formalise an ASGM operation in three months this way, while miners such as Esteban often wait for over five years with unpredictable results. Despite the capacity of these legal devices to provide the formalisation that so many miners want, they have had a mixed to poor reception. Ramiro felt that miners were often pressured into these contracts, and could have to pay unfair amounts to the company. This was a sentiment echoed by many others. This type of formalisation is particularly prominent in Segovia, the location where I will consider this arrangement more.

GCG arrived in Segovia in 2010 via their subsidiary Sandor Capital, buying the assets and mining title of the bankrupt Frontino Gold Mines (José Hoyos, 2012). Unlike most mining titles, which are given for a fixed period of 32 years (Cardona-Valderrama, 2015), the title around Segovia is for perpetuity²⁸. Segovia has a long history of ASGM, according to the local miners and Marco Antonio from the Segovia's Miners' Association. Juan said historically there had been only limited interaction between the ASGM operators and the larger mine. According to Mateo, a local miner who was hired by an NGO to help with the formalisation process, there were around 120 mines in GCG's title in 2010. Of these, 59 were able to

²⁸ I was regularly told that this was a gift from Simon Bolívar to the English Frontino Gold Mines Company out of gratitude for English help in the war of independence against the Spanish. However, I have not yet seen documented accounts to support this.

legalise, while the others were unable to do so as their operations could interfere with GCG's own mining, civil works, or the miners were too nomadic to be able to work a fixed area. Of these 59 mines, 40 were successfully legalised using contracts of operation, while the remaining mines were required to leave by either the company security or the police. As previous national formalisation drives have had success rates lower than 1% (Güiza & Aristizábal, 2013), the 33% success rate here is an achievement in relative terms, although still not actually high. This forced removal of miners again shows that informal mining is becoming a dominated reality. Problems in this formalisation process led to distrust between miners and GCG. Marco Antonio told me that his association assisted with a census of mining activity for the government. However, this information was delivered to the company, which Marco considered a major breach of trust. GCG has been assisted in this process by the Colombian Mercury Project, whose sole purpose was mercury elimination, and Bioredd, which has a dual purpose of miner formalisation and mercury elimination (Bioredd, n.d.), again emphasising the entanglement of mercury and formalisation.

The use of contracts of operations and the politics of mining titles raises questions of mining rights. ASGM was present in Segovia before GCG, and, according to Marco, before any LSM. Yet GCG has the legal mining title, and therefore controls the property rights.

You have to enter into business with Sandor Capital [GCG's subsidiary]. Sandor Capital says to you that you can work under these conditions. The ore has to go to Sandor's [cyanide] plant to process the mineral. But the mining happens in an area that belongs to us, and we have to pay them. We take the big risks. And you have to pay all the expenses and everything, while they are taking 45-50% of all the gold.

Juan emphasises here the injustice of paying to exercise what he considers his traditional right to mine. Marco agrees with this, blaming the government for allowing a title in perpetuity to the detriment of miners, a conflict between

customary and formal rights. Mateo said that as many miners had no understanding of mining titles before the formalisation process, they considered GCG's acquisition of the mining rights to be theft. This ethically dubious arrangement is partly enforced through the process of gold extraction. Miners' are contractually obliged to process all their ore in GCG's cyanidation plant, which not only achieves mercury elimination, but provides a means for GCG to ensure that they receive their percentage of the gold. Carolina described this explicitly with regards to her company, saying that if miners were to undertake their own processing, they could not ensure either mercury elimination or transparency in terms of how much gold is extracted. As was discussed in the preceding chapter, miners are distrustful of the cyanidation process, and often suspect the company is underpaying them. There may be other technical approaches to overcome this problem. For example, Carolina's firm is experiment with an activated carbon extraction system, which would allow batches of ore to be processed individually while the miners are present. While subcontracting to LSM has allowed miners to shift to a dominating reality, they come to occupy a dominated position within that reality, and mercury is entangled with this structure of domination.

This arrangement has proven profitable for GCG. In 2014, gold from 'contract mining cooperatives' in Segovia accounted for 78% of the gold the company produced in Segovia or 48% of the gold from all their operations (calculated from GCG, 2015, p. 4). This is a major factor in the profitability of the mine, which had gone bankrupt under the previous owner. While GCG does draw attention to the environmental benefits of this arrangement in terms of mercury reduction (GCG, 2016), this should be primarily considered a business operation. There is a parallel here to Verbrugge's (2015a) description of a shift from capital-intensive mining to mining based on the exploitation of informal labour. The situations differ, in that subcontracted miners are technically formal. However, the title holders can cancel these contracts of operation (the device used in Segovia) with ease, and because of this precarity the same principles apply. Subcontracts of formalisation, the device used by Carolina's firm, are subject to more regulatory oversight and may offer a more equitable relationship.

Both Mateo and Juan emphasised how becoming a contracted operator to the company meant operating with a more business-like mentality. As the title holder, GCG is responsible for ensuring the regulatory compliance of contracted miners. Juan said this involved the use of personal protective equipment, workplace health and safety plans, paying social security for miners, and a range of new requirements that, for him, culminated in a more business-like mode of operation. He said by signing a contract with GCG “The miner has to create a company, but it’s not the culture of this region. Here the miner works very artisanally. He works for his daily bread.” This arrangement has also led to crippling expenses:

With this 50% that stays with you [revenue left after paying GCG], you have to pay taxes, energy, healthcare, buy wood, pay workers, everything that you need to do to maintain a company, there is ventilation, machines, explosives, everything! And you’re giving 45% or 50% to Sandor. Free. Because they are the titled miner. (Juan)

Juan also had to pay protection money to the paramilitaries, on top of the regular business expenses. Mateo also talked about the change of mentality for miners, who moved from a subsistence mode of operation, “living day to day”, to having to operate like a business. Mateo attributed this to engaging with bureaucracy and paperwork. Carolina also mentioned how hard it was for miners to meet the bureaucratic requirements of operating legally, especially as many miners are only marginally literate. Formalisation then signifies a new, business-like performativity.

This change to a more business-like mentality and performativity is linked to a changing engagement with the governing assemblage. It is interesting that ‘business-like’ is used to describe operating within a legal framework, and not to signify a change to operating for monetized profit (as miners were already doing prior to formalisation). Here, formalisation refers to a performed engagement with bureaucracy, and therefore a business-like performativity, and not the acquisition of property rights. As the environmental framework implemented by GCG requires mercury’s elimination, formality is being performed through mercury’s absence.

This formality is being performed not only with regards to the state, but to an assemblage of the state, companies, NGOs and materials. In the Colombian model, the state offers the right to mine, but expects the miner to comply with certain requirements and to pay specified taxes, and has the right to legitimately use violence should the miner fail to comply. This is almost identical to how miners relate to GCG: GCG also offers the right to mine under certain conditions and on the payment of 'taxes', and can either use their own security²⁹ or the state's apparatus of violence to ensure compliance. This effectively makes GCG a state-like entity, with NGOs also enrolled in this arrangement. The paramilitaries also take on state-like qualities to an extent, as they use violence and demand 'taxes' from miners. Governance is not limited to the state, and miners in Segovia are engaging with three state-like entities. This does not necessarily signify state weakness, as both Verbrugge (2015b) with his work on 'corrupt' governance of ASGM in the Philippines and Civico (2012) in his work on paramilitary-state alliances in Antioquia argued that the state's ability to co-opt non-state actors is in fact a strength. This view is not necessarily shared by miners. Juan resented paying money to paramilitaries, in this case 'Los Urabeños', and felt that this meant he existed at the margin of the law and had been neglected by a weak state. Formalisation in Segovia has been brought about by and exists through entanglements with mercury's absence, making mercury's absence complicit in new and potentially unjust economic relationships between miners and a governing apparatus that is not limited to the state.

Alluvial Open-Pit Mining

For Esteban and Miguel, mercury's absence was used to perform citizenship as part of the formalisation process. Both Esteban and Miguel are proud miners, and were concerned that they were transitioning from informality to illegality. The creation of a distinction between informality and illegality is partly the result of a state performance of enforcement. What constitutes illegality is, in part, what is actually enforced, a performative rather than a legislative consideration. Prior to this state

²⁹ I did not hear of paramilitaries being employed by GCG in Segovia.

enforcement, their informality was distinguished from illegality by a ‘social license to operate.’ This is a recent concept, generally defined as the acceptance of an activity (usually mining) and permission to conduct it, as granted by the local community (Moffat & Zhang, 2014; Prno & Slocombe, 2012). The implication here is that historically their mine was informal and not illegal because the local community accepted it.

State enforcement of mining laws was seriously initiated in 2010, which was when Esteban began the process of formalisation. Ramiro told me bitterly about arrests of miners, the burning of equipment such as excavators and dredges, and a widespread persecution of miners. Miguel regularly said to me, “We are miners. We want to work. We are not criminals, and we are not drug traffickers. Make sure you go and tell everyone that!” Esteban was likewise offended at being labelled illegal. I could understand these attitudes, as listening to them talk about their efforts to carry out more responsible mining and comply with what the government wanted made the idea that these men were criminals seem ridiculous. Their self-differentiation from drug dealers seems to be partly based on their social license to operate. The existence of this social license was shown by the huge number of people in Cauca who attended the pro-miner demonstrations organised by Ramiro: mining was deemed an acceptable occupation. These demonstrations have achieved a temporary reprieve for miners, something Ramiro attributes to positive coverage from foreign journalists who attended³⁰. Their operation was historically informal, as while it was not permitted legally, they had a social license to operate. It was only upon state enforcement of mining laws that their operation became illegal. This is something that Miguel and Esteban feel strongly about, and so their motives to formalise are not purely financial, but linked to their identity: they do not consider themselves illegal miners.

Deleuze and Guattari (2014) offer the concept of the state as having two heads: Varuna and Mitra. Varuna is the pact-making or welfare-providing head, while

³⁰ Ramiro said that local journalists had a pro-government bias. I think this is likely, as most of the Colombian media coverage of ASGM I have seen is negative. Cárdenas Herrera (2014) is a notable exception.

Mitra is the disciplinary head. This concept has been found useful by other anthropologists, in particular by Singh (2014). Esteban and Miguel are in the process of changing which head they are facing. They are trying to frame themselves as informal miners and good citizens who deserve state assistance instead of criminal miners who deserve state discipline.

They [government assessors] are always coming here with a hostile attitude ... but we don't want to argue with them, or fight with them, we want to work ... OK maybe something isn't being done right, so teach us! We can do it responsibly, seriously, but they need to help us ... not just look for problems.

Miguel describes this framing quite directly here, asking the state for assistance instead of discipline. This reframing is being attempted by performing good citizenship through *minería bien hecha*, which incorporates both the formalisation process and mercury elimination. By entering the process of formalisation, Esteban has been able to access state assistance in the form of help from Corantioquia and the National University to eliminate his mercury use. This elimination of mercury is also helping with his environmental license application. There is a circularity here, as by performing *minería bien hecha*, state welfare can be accessed to assist with a *minería bien hecha*. This option is denied to those unable to enter the formalisation process.

For Esteban and Miguel, formalisation and citizenship are being performed through mercury's absence. In his work on AIDS in Brazil, Biehl (2007, 2013) develops the concept of pharmaceutical citizenship, or how marginalised citizens in Brazil become citizens by engaging with the state's pharmaceutical-centric health care system. My interpretation is that Biehl is arguing that citizenship should be considered a performance or an engagement, as opposed to something one possesses. This is pertinent, as Biehl's concept of citizenship seems closely related to formality. Formality is enacted through engaging the state and by eliminating mercury, and not simply by acquiring mining titles. Returning to Barad's (2007)

concept of intra-action, this citizenship is not performed *on* mercury as if it were a passive mass of matter waiting to be shaped. Rather, citizenship is performed by intra-acting through mercury and its active materiality. While describing the environmental progress being made in his mine, Felipe said that “In this area, we are implementing everything [various environmental practices] to show that we are capable of working in mining. We are competent to do it. Look!” For Felipe, it was his environmental practices and elimination of mercury that made him a good miner and a good citizen. Felipe then spoke of the practical challenges of eliminating mercury, showing how mercury’s materiality and intra-actions had become entangled with formalisation. Mercury has become a political material, entangled with miners who are performing their citizenship.

Esteban applied for a mining title five years ago, but is still waiting for this to be granted, leaving him in a state of limbo. Attempting to legalise has been difficult for Esteban, for a range of reasons. Colombian mining legislation does not differentiate between small and large-scale mining (Echavarría, 2014; Güiza & Aristizábal, 2013; Urán, 2013), meaning that Esteban must comply with the same regulatory requirements as transnational mining companies, a heavy regulatory burden. Mercury elimination is certainly one major component of this challenge with regards to environmental legislation. All the relevant government agencies have their offices in Medellín or even Bogotá, with the exception of Corantioquia. Furthermore, these agencies have a very high staff turnover. This has made it challenging for Esteban to work with them.

The most significant challenge according to Esteban relates to the occupation of space. Esteban’s mine has been working along a dried up river bed for 32 years. In the process, he has crossed two land boundaries, the most recent less than 10 years ago. The government typically formalises those who have been mining the same area for more than 10 years. Therefore, they judged that Esteban cannot demonstrate history in that area, as he has less than 10 years of history *within that land boundary*. Felipe’s mine successfully formalised, but only by limiting the area which can be mined within a land boundary. In Esteban’s case, this would reduce

the viability of the business. However, the owner of Felipe's mine owns the land it is located on. For him, the mining is only supplementary to farming and so the limitation is tolerable. This nomadic occupation of space can be problematic for ASGM operators wishing to formalise.

Dredge-Based Placer Mining

Carlos is exceptional in that he has eliminated his mercury use without being in the process of formalisation. While Carlos wants to legalise his operation, this has so far proven insurmountably difficult. Carlos is only marginally literate, and so undertaking the same regulatory process that Esteban and Felipe both struggled with is not a practical option. Carlos also faces challenges relating to the nomadic nature of his mining. He moves up and down the river on a day to day or week by week basis, following the areas where the shifting black sand is deposited. He told me that even if he were to obtain a mining title, it would be for a small fixed area, effectively making his operation non-viable. Following Deleuze and Guattari's (2014) model, Carlos is operating nomadically in 'smooth space', as he moves along the river without being impeded by boundary lines. The Colombian state, however, is operating in 'striated space', and can only recognise rights within certain boundaries, leading to Carlos' inability to obtain a title³¹. Formalisation would change how he occupies space, which is a relation to materials, namely, to the earth. This is the same challenge that Esteban and Felipe face, although perhaps not quite to the same extent as Carlos. Carlos still wants to formalise, and so he has reluctantly begun to investigate the possibility of formalisation by subcontracting.

Carlos wishfully told me how he would like to invite the Secretary of Mines to his gravitational workshop and show him how they operated. While this statement was not made as a serious proposal, it was not suggested as a joke either. Carlos' operation is unambiguously categorised as illegal by the National Development Plan (República de Colombia, 2011), and the arrests of nearby dredge miners shows this

³¹ Mineros S.A.S. is a large-scale, legal, Colombian dredge mining company. They have achieved legality through scale, acquiring the mining title to extremely large sections of the Cauca River around El Bagre. While dredges can in theory be legal, this is not a possibility for Carlos.

illegality is being performed through state discipline. Should the Secretary of Mines actually visit, this might result in Carlos' arrest. Carlos considered this situation extremely unjust. Carlos was open and proud of his profession, and from what I saw of him interacting with others in his village, he was highly respected, and he seemed to implicitly have a social license to operate. I understood the statement at the start of this paragraph as an expression of his good citizenship, proven by his elimination of mercury and performing a *minería bien hecha*. This refuted his illegality, which explains why he wanted to show it to the Secretary of Mines. Carlos is, in this instance, performing his citizenship through gravitational technology and the absent presence of mercury. Carlos has been fortunate enough to have assistance from an NGO in this regard. As he is not in the process of formalisation, it is legally dubious for NGOs to help him. If his informality had prevented him from having access to gravitational technology, he would not have been able to perform his *minería bien hecha*, making him even more 'illegal'. Carlos' unique status as an informal miner working without mercury has meant that he is straddling two realities, a difficult and precarious liminal space. For Carlos to become fully formal and enter a field co-constituted by mercury's absence, he will have to overcome excessive bureaucratic hurdles or enter a potentially unjust relationship by subcontracting to corporate actors.

Processing and Sales

Neither gold processing workshops nor gold buyers are governed by mining law. Nevertheless, they are experiencing significant regulatory changes in the form of mineral tracking registers and environmental legislation. This further shows that formalisation relates to more than just property rights. The Register of Mineral Traders (*RUCOM-Registro Único de Comercializadores de Minerales*) was introduced through the National Development Plan (*Plan Nacional de Desarrollo*) to ensure that mineral traders could only purchase minerals from mines which held legal titles or were in the process of formalisation (Echavarria, 2014; República de Colombia, 2011). Jairo described the system in more detail, saying that all mined material had to have a certificate of origin linked to it, which stated the mine it

came from. As all mines now need environmental licenses, this also regulates mercury use. RUCOM represents formalisation in the sense that it is a recording of mining activity. This implicitly enables regulation by reference to property rights. This is beginning to create problems for Santiago and David, who primarily deal in gold from informal miners.

This initiative seems to have only had a limited affect, although it is becoming more important. David was only meant to sell mercury to miners who could obtain a RUCOM certificate, and had to register the sale. However, he admitted that he did not do so, and said that he was worried about trouble with the police, but he could see no alternative to mercury. Jairo said that the illegal importation of mercury was a major problem. David was also supposed to fill out certificates of origin for all the gold that he purchased. While he said that he did, I was somewhat sceptical, as he could not explain the form to me. Santiago told me how many of the Barequeros, or gold panners who only had to register themselves with the local mayor, would sell gold on behalf of informal miners. Jairo told me that nationally, these Barequeros officially produced far more gold than could be expected from their mining methods. In 2013, John Hernandez, the CEO of the Medellín based gold refinery Góldex, was arrested for his part of a \$970 million USD money laundering scheme which included mixing gold from illegal or informal mines with that of formal ones (El Tiempo, 2013). While RUCOM is far from achieving a complete register of all mineral trade in Colombia, it is a move towards regularisation that has problematized the future of informal trading.

Despite its lack of complete effectiveness, RUCOM has had an impact on miners. Ramiro said that many informal miners now had to sell their gold on the black market at a 15-20% discount, and pay an excess for mercury. In September 2015, David was selling mercury for \$5.26 USD an ounce, or \$185 USD a kg. This is a significant increase from the \$150 USD a kg reported in 2014 and \$35 USD a kg in 2007 (García et al., 2015). These price changes, Ramiro said, have made life harder for miners without solving the problem. This was confirmed by all other miners I spoke to except Mateo. Mateo said that miners in some parts of Antioquia could

sell gold at a higher rate on the black market than on the legal one. This has also been noted in ASGM areas in Africa, where local gold prices rose above international ones as the demand for gold to be used in money laundering or as a means of money transfer outstripped what ASGM miners could supply (Rolfe, 2015). In Colombia, this seems to be the exception, and so most miners are financially disadvantaged because of RUCOM.

Formalisation of the gold processing and purchasing sector has also occurred through environmental regulation, despite the sector operating outside mining law. David reported that government officials had visited to inspect his fume hood and mercury filter. Mateo described how several years ago, agents from Corantioquia arrived to check the environmental licenses of all the gold processing workshops in Segovia. The workshop owners did not even realise that these were required, instead thinking that their business registrations were sufficient, and were fined as a result. Both Santiago and Mateo placed some blame on the government for suddenly enforcing a law that many did not even know existed. I was told this incident resulted in the formation of the Association of Processing Shops of Segovia (*APLABAS-Asociación de Plantas de Beneficio de Segovia*), a group which had sufficient political power to allow these workshops to continue operating. It remains to be seen if this group will be able to resist the 'Mercury Law' of 2013. Formalisation has begun in this sector in the form of regulation, but has been far from completely successful.

Mercury as a Discursive Material

Through the political struggles around ASGM, various actors have attempted to co-opt mercury as a discursive tool. However, mercury is not reducible to discourse, and its materiality continues to be apparent. Barad (2003, p. 819) writes that "discourse is not a synonym for language", and differentiates discursive practices from linguistic interpretations. She writes "discursive practices are specific material (re)configurations of the world ... [they] are ongoing agential intra-actions of the world" (Barad, 2003, p. 821, italics removed). The only person I met in Colombia

who asserted that mercury was completely safe was Santiago. The reasons were two-fold. Firstly, as has been discussed, linking mercury exposure and poisoning is difficult. The second reason was that Santiago was able to see the attempts towards a discursive co-option of mercury.

If they [the government] are so worried about the health of the people here, why don't they offer us healthcare? ... Go down to the clinic. You'll see there are no beds, no medicine ... And then they say we have to stop using mercury for our health. Bullshit.

Santiago expressed not only doubt about the government's commitment to health, but also appreciated the political nature of mercury's disentanglement. He was losing business to GCG's cyanide extraction plant, which he knew related back to mercury, as GCG's mercury-free status was a key part in allowing this situation to arise and in enforcing it. He also suspected that the government wanted to replace ASGM with LSM, a suspicion shared by Ramiro and many other miners, and one that fits with the government's extractivist agenda (Urán, 2013; Vélez-Torres, 2014). I disagreed with Santiago when he said that mercury was not harmful. However, in discussing this with him, I had to concede to many of his arguments. We both realised the political entanglements of mercury, but disagreed on the nature of its materiality. However, materiality is not reducible to linguistics, and mercury's toxicity was not the least dependent on our conversation. While political agendas are being enacted, they must intra-act through mercury, or its absence, leading to new material configurations. These can include the subcontracting relationship between miners and GCG, or improved public health in mining towns. This is the material-discursive nature of mercury and its absence.

Mercury has become deeply involved with the negotiations miners are making between formality, informality and illegality in an increasingly hostile environment. Mercury use has been near synonymous with informality, and is now becoming synonymous with illegality. In some of my first meetings in Medellín, various people told me bluntly that they knew nothing of mercury, which was only used for illegal

mining. Mercury constructs ASGM as a dirty, polluting industry. It works against miners' attempts to establish traditional rights to mine, as tradition is often linked to environmental guardianship³². This parallels Tschakert and Singha's (2007) observation of how mercury was enrolled in anti-miner rhetoric in Ghana. Miners, however, are keenly aware of this and are actively working to mitigate it. Esteban, Mateo and Miguel in particular talked about the stigmatisation of mercury use. Both Ramiro and Antonio told me that they are working to address the problem of mercury, in part to prove their good citizenship. Ramiro in particular was concerned by the state prioritisation of LSM over ASGM, and so a better environmental record was essential for him in establishing ASGM as the preferred alternative. Ramiro and Marco both prioritised miner welfare and recognised mercury elimination was a tool to achieving this, giving them a different perspective from some other groups whose sole aim was mercury elimination. It has been well argued that the importance of bottom up initiatives and collaborative approaches with miners is necessary to achieve mercury elimination (Hilson et al., 2007; Spiegel et al., 2014). To achieve this, partnerships with miners' associations are necessary, but for this to be achieved miners' welfare must be more holistically considered. This necessarily involves a consideration of the way that mercury has become a participant in anti-miner rhetoric, with major implications for miners.

Conclusion

This chapter has introduced the political entanglements of mercury. Here, I have introduced the idea that mercury and its absence are political and discursive. This has primarily arisen from their entanglement with formalisation, which when seen from a miners' perspective seems more performative than legislative. As proud miners find themselves reframed as illegal instead of informal, many try to practice a *minería bien hecha* through mercury's absence to act as good citizens that deserve state welfare instead of state discipline. Alternatively, this is an effort to shift from a dominated to a dominating reality. This transition is not easy, partly because these realities are co-constituted by materials. Mercury use, nomadic

³² This is also referred to in Rivera-Sotelo and Pardo Becerra (2014).

occupations of space, and an inability to comply with excessive regulatory burdens have blocked many miners from legalising. This has led many miners to seek to formalise by subcontracting. In this situation, mercury's absence has allowed miners to shift to a dominated position in a dominating reality: an exploitative relationship. Taking Barad's view that discourses are the arrangements of materials, in ASGM mercury is both material-political and material-discursive. To achieve genuine collaboration with miners in reducing mercury, these political entanglements of mercury with regards to miners' welfare must be considered.

Chapter 8: Conclusion

In Antioquia, Colombia, artisanal and small-scale gold miners have been entangled with mercury, an entanglement that has been co-constitutive of an informal ASGM industry. As Barad (2007, p. ix) writes, “Existence is not an individual affair.” Mercury and miners exist through entanglements with each other, and they intra-act with each other. This means it is best to view them as co-constitutive and not as individual entities. What mercury’s intra-actions with miners have allowed is an industry which is informal and employs low levels of technology, minor capital inputs and limited amounts of credit, while maintaining moderate productivity. In this informal industry, knowledge of mercury and other materials is largely based on practices. Miners learn about mining more through engaging with materials than through representations of them, in a context where education is non-institutionalised. As practice is entangled with thought, these practices have helped to constitute a particular mode of how miners approach mining. Mercury is also responsible for the creation of a system of trust in a multi-actor extraction process. As these characteristics largely overlap with the essential characteristics used to define ASGM, it is no stretch then to say that mercury co-defines ASGM. These entanglements are complex, and the frequent and simplistic use of the term ‘tradition’ can only provide a very limited understanding of resistance to mercury elimination. The strength of these mutually co-constitutive entanglements provides a deeper and more complex understanding of why mercury elimination in ASGM has been so hard to achieve.

The ASGM industry in Antioquia, which has often been framed as traditional and unchanging, is now in a heightened state of turmoil or flux. This flux is largely relatable to the disentangling of mercury. If mercury holds a co-constitutive role of the ASGM industry, then its disentanglement has a de-constitutive one. Mercury elimination is not a minor change in practice, but a complete reorganisation of the ASGM sector, and thus requires a significant shift to a new worldview and new daily practices. While Bourdieu’s theories are limited by their fixation on the social at the expense of the material, they are useful to an extent in understanding the changes

occurring. Under Bourdieu's schema, mercury use could be considered an effective strategy for an informal ASGM (missing the fact that mercury is co-constitutive of an informal ASGM). However, the reality of an informal ASGM has come to be dominated by the reality of formal ASGM and of *minería bien hecha* in which mercury has no place. Miners' experiences of this situation vary dramatically, and this can be understood through the lens of ecological habitus. Miners have begun attempting to shift into this formal ASGM, which is not an easy transition to make. It has required enrolling new technologies, which in turn require engaging with new actors and taking a new financial mode of operating towards mining. It means entering a new relationship with materials, utilising new physical principles, and often by knowing these new materials and principles more through representations than practices. It means a new relationship with the governing apparatus, as mercury's absence is co-constitutive of a formal reality. Mercury and its absence have political entanglements that are salient when miners attempt to transition between realities.

Both the presence and absence of mercury in ASGM are discursive and political, and so disentangling mercury is a political process. This has largely come about through mercury's entanglement with the formalisation process. Formalisation is a tricky concept to define, and a number of interpretations exist. These interpretations generally focus on mining legislation and property rights, which are essentially top down perspectives. From a bottom up perspective, formality can be seen as performative. This does not mean that miners believe formalisation should be performative, but it more accurately describes how it is currently being experienced. Formalisation involves compliance with a heavy regulatory burden, and an ongoing performed engagement with the governing apparatus. Looked at from the perspective of practices, these engagements are not barriers to formalisation, they are formalisation itself. Most miners consider themselves to be traditional and informal workers who possess social licenses to operate, despite their historic lack of mining titles. By enforcing mining law, a practice of governmentality, the state has effectively reframed informal miners as illegal miners. Mercury's toxic materiality has been complicit in this reframing, portraying

ASGM as an environmentally damaging industry. Many miners now are performing good citizenship broadly through *minería bien hecha*, and specifically through eliminating mercury. Alternatively phrased, they are practicing good citizenship and formality through mercury's absence, resisting their classification as illegal and attempting to face the pact-making head of the state, instead of the disciplining head.

Formalisation in the legal sense is often an insurmountable barrier for various reasons, including high regulatory burdens and different modes of occupying space, blocking miners' ability to transition from dominated to dominating realities. In many cases, miners are coerced into exploitative economic relations with large-scale mining companies. These relationships allow an easier transition to a dominating reality, but miners come to occupy a dominated position within that reality. Mercury is complicit in these relationships by its absence, as it had a major role in the creation of these subcontracts, and the physical process which replaced mercury enforces the economic relationship. Both mercury and its absence can then be seen through Barad's description of being material-political and material-discursive.

Taking this approach contributes to the literature on reducing mercury pollution from ASGM and can inform practical solutions for addressing the problem. The literature on ASGM has frequently cited the need for attention to be paid to the social, cultural and political aspects of mercury use. However, this call has only been sporadically addressed and it has been relatively unclear what a comprehensive answer might look like. Reaching a response to this has been problematized by the tension between materially deterministic and socially deterministic approaches. Materially deterministic approaches configure mercury pollution as a technical problem, and seek to find technical solutions. Socially deterministic views tend to view mercury use as a result of tradition, a widespread explanation, yet one that has not been critically examined or demonstrated as useful. By taking a posthuman approach based on a relational ontology, I have argued that the relationship between the social and the material is co-constitutive,

and that these categories only come into existence through each other. Furthermore, I have discussed the political entanglements between mercury and formalisation. Formalisation has often been discussed as a solution for reducing mercury pollution from ASGM, and despite a general consensus that it is important, there is a lack of clarity on its exact role. This is largely the result of a lack of consideration of the performative aspects of formalisation. What this performative, relational approach has allowed is a reframing of the problem in a more productive sense, as an understanding of the relationship between the social, material and political aspects of the problem can have practical applications for informing mercury reduction initiatives.

This approach also has something to offer anthropology, providing both novel theoretical approaches and also modes in which anthropology can make itself more relevant through addressing environmental and developmental problems. An explicit need for social scientists has been identified with regards to this problem, and as many of the problems with resolving mercury pollution have arisen from the application of Western modes of thinking to non-Western modes of being, an anthropological perspective is desperately needed. In this thesis, I make use of qualitative anthropological methodologies to provide a selection of thick data across from the meshwork of mercury. This approach offers insights unavailable to quantitative analyses which are fundamentally flawed in this context, as when applied to informality they construct not describe reality. Taking this project further would require interdisciplinary work for a deeper understanding of materiality, and participant observation has an important role to play in this.

Theoretically speaking, I feel that the use of the term 'agency' has not helped anthropology. It has tended to assign an object's ability to act within that object and not the meshwork within which it exists. Furthermore, agency tends to mystify what physical science clarifies, making an overreliance on the term a barrier to achieving truly productive interdisciplinary work. A relational ontology is an ideal approach to achieving this, and the work of Karen Barad, despite having a different take on the semiotics of 'agency', could be a powerful tool alongside Tim Ingold's

theories for achieving this. Barad has scarcely featured in anthropology, and this thesis offers insights into how her work could be productively employed. This thesis then emphasises the methodological and theoretical contributions anthropology can make to addressing problems of mercury pollution and development with regards to ASGM, while simultaneously suggesting ways in which these contributions could be enhanced.

Finally, I hope this thesis can help the artisanal and small-scale gold miners and processors of Antioquia who co-produced this thesis and who are the primary ethical stakeholders. These are the miners who have a longstanding connection with mining and traditional rights to mine, yet who find themselves criminalised and vilified because of their livelihood. This classification of miners as criminals is often inaccurate, as this research instead showed proud miners trying to undertake a more responsible mining. As Esteban told me bluntly, “Go back to your country and tell everyone what it’s like here. Tell them what you saw.” I hope I have clearly conveyed this message in this thesis. The concerns of miners must be considered in attempts to eliminate mercury and otherwise improve the environmental and health impacts of ASGM. Without attending to miners’ concerns, a truly collaborative approach will not be achieved. This is a complex undertaking, and I hope this thesis can help inform initiatives which recognise this complexity. Legislation and policy makers desperately need to attend to the realities of ASGM, if formalisation and a *minería bien hecha* are to be achieved. This would include a legal consideration of the differences in the scales at which mining may occur, the types of mining, the capacities of miners, and the nomadic nature of many mining operations. A collaborative approach coupled with appropriate legislation and policies would help miners to be recognised as good citizens who seek support in practicing responsible mining. This would both benefit miners and facilitate ASGM to contribute in a meaningful way to national development. Finally, such an approach would assist in achieving mercury elimination. Collaboration with miners should be considered the primary method for achieving mercury elimination, and genuine collaboration will only be achieved by recognising the concerns of miners, and the wider context in which miners and mercury are entangled.

References

- Akcil, A. (2010). A new global approach of cyanide management: International Cyanide Management Code for the manufacture, transport, and use of cyanide in the production of gold. *Mineral Processing & Extractive Metallurgy Review*, 31(3), 135-149.
- Alcaldía de Caucasia. (2004). *Diagnóstico la población del municipio Caucasia* [Assessment of the population of the municipality of Caucasia]. Alcaldía de Caucasia, Antioquia. Retrieved from http://www.caucasia-antioquia.gov.co/apc-aa-files/65343236303065396165373238666565/PLAN_SALUD.pdf
- Alcaldía de Caucasia. (2012). *Nuestro municipio: Indicadores* [Our municipality: Indicators]. Retrieved from <http://www.caucasia-antioquia.gov.co/index.shtml?apc=v-xx1-&x=3059368>
- ASAANZ. (1992). *Principles of professional responsibility and ethical conduct*. Association of Social Anthropologists of Aotearoa New Zealand. Retrieved from <http://asaanz.science.org.nz/codeofethics.html>
- Ballard, C., & Banks, G. (2003). Resource wars: The anthropology of mining. *Annual Review of Anthropology*, 32, 287-313.
- Banco de la República. (2015). Las lenguas indígenas de Colombia. [The indigenous languages of Colombia]. Retrieved from <http://www.banrepcultural.org/blaavirtual/antropologia/lengua/clas2.htm>
- Barad, K. M. (2003). Posthumanist performativity: Toward an understanding of how matter comes to matter. *Journal of Women in Culture and Society*, 28(3), 801-831.
- Barad, K. M. (2007). *Meeting the universe halfway: Quantum physics and the entanglement of matter and meaning*. Durham, NC: Duke University Press.
- Barry, M. (1996). *Regularising informal mining: A summary of the proceedings of the International Roundtable on Artisanal Mining* (Occasional Paper No. 6). Washington D.C., USA: The World Bank Industry and Energy Department.
- Bateson, G. (2000). *Steps to an ecology of mind*. Chicago, IL: University of Chicago Press.

- Bennett, J. (2010). *Vibrant matter: A political ecology of things*. Durham, NC: Duke University Press.
- Biehl, J. G. (2007). Pharmaceuticalization: AIDS Treatment and global health politics. *Anthropology Quarterly*, 80(4), 1083-1126.
- Biehl, J. G. (2013). The judicialization of biopolitics: Claiming the right to pharmaceuticals in Brazilian courts. *American Ethnologist*, 40(3), 419-436.
- Biehl, J. G. (2014). Ethnography in the way of theory. In V. Das, M. Jackson, A. Kleinman, & B. Singh (Eds.), *The ground between: Anthropologists engage philosophy* (pp. 94-118). Durham, NC: Duke University Press.
- Bioredd. (n.d.). Quienes Somos? [Who are we?]. Retrieved from <http://bioredd.org/?q=quienes-somos>
- Bourdieu, P. (1990). *The logic of practice*. (R. Nice, Trans.). Stanford, CA: Stanford University Press.
- Bourdieu, P. (1996). Understanding. *Theory, Culture & Society*, 13(2), 17-37.
- Bryceson, D. F., Fisher, E., Jønsson, J. B., & Mwaipopo, R. A. (2014). *Mining and social transformation in Africa: Mineralizing and democratizing trends in artisanal production*. London, England: Routledge.
- Bryceson, D. F., Jønsson, J. B., & Verbrugge, H. (2013). Prostitution or partnership?: Wifetypes in Tanzanian artisanal gold-mining settlements. *Journal of Modern African Studies*, 51(1), 33-56.
- Bushnell, D. (2002). *Colombia, una nación a pesar de sí misma: De los tiempos precolombinos a nuestros días* [The making of modern Colombia: A nation in spite of itself]. (C. Montilla, Trans. 9a ed.). Bogotá, Colombia: Planeta.
- Calvert-Minor, C. (2014). Epistemological misgivings of Karen Barad's 'posthumanism'. *Human Studies*, 37(1), 123-137.
- Camara Medellín. (2012). *Industria en Antioquia: Un sector que permanece y crece* [Industry in Antioquia: A sector which continues and grows]. Medellín, Colombia: Camara de comercio de Medellín para Antioquia.
- Cárdenas Herrera, S. (2014, November 24). El mercurio, un monstruo dormido en Antioquia. [Mercury, a sleeping monster in Antioquia]. *El Colombiano*. Retrieved from <http://www.elcolombiano.com/especiales/mercurio-en-antioquia/el-mercurio-un-monstruo-dormido-en-antioquia-YC721881>

- Cardona-Valderrama, J. C. (2015). *Derecho básico minero Colombiano* [Basic mining law in Colombia] (Lecture). Medellín, Colombia: Caval Asesores S.A.S.
- Carlos Andrés, G. M. (2015). Diálogos de paz Gobierno-FARC-EP y las oportunidades para la paz en Colombia. [Peace talks in Colombia: The "end of the armed conflict" and the possibilities for peace]. *Estudios Políticos*, 46, 243-261.
- CIMEX. (2014). *Desarrollar la implementación del proyecto de tecnologías limpias en unidades mineras ubicadas en las zonas auríferas del departamento de Antioquia* [Developing and implementing the clean technology project in mining operations located in the gold mining areas of Antioquia] (final report). Medellín, Colombia: Instituto de Minerales-CIMEX.
- Civico, A. (2012). 'We are illegal, but not illegitimate': Modes of policing in Medellín, Colombia. *Political & Legal Anthropology Review*, 35(1), 77-93.
- Clifford, M. J. (2014). Future strategies for tackling mercury pollution in the artisanal gold mining sector: Making the Minamata Convention work. *Futures*, 62(A), 106-112.
- Cohen, R. (2014). Extractive desires: The moral control of female sexuality at Colombia's gold mining frontier. *The Journal of Latin American & Caribbean Anthropology*, 19(2), 260-279.
- Cordy, P., Veiga, M. M., Crawford, B., Garcia, O., Gonzalez, V., Moraga, D., . . . Wip, D. (2013). Characterization, mapping, and mitigation of mercury vapour emissions from artisanal mining gold shops. *Environmental Research*, 125, 82-91.
- Cordy, P., Veiga, M. M., Salih, I., Al-Saadi, S., Console, S., Garcia, O., . . . Roeser, M. (2011). Mercury contamination from artisanal gold mining in Antioquia, Colombia: The world's highest per capita mercury pollution. *Science of the Total Environment*, 410, 154-160.
- Cortés, R. O. (2008). Economías de guerra e inversión multinacional: Una propuesta de investigación. [Economies of war and multinational investment: A proposal for research]. *Diálogos de Saberes*, 29, 157-172.
- Cudworth, E., & Hobden, S. (2013). Complexity, ecologism, and posthuman politics. *Review of International Studies*, 39(3), 643-664.

- Cuvelier, J. (2014). Work and masculinity in Katanga's artisanal mines. *Africa Spectrum*, 49(2), 3-26.
- DANE. (2015). *Perfil sociodemográfico 2005-2015: Total Medellín* [Socio-demographic profile 2005-2015: Total Medellín]. Medellín, Colombia: Departamento Administrativo Nacional de Estadística.
- Das, V., Jackson, M. D., Kleinman, A., & Singh, B. (2014). *The ground between: Anthropologists engage philosophy*. Durham, NC: Duke University Press.
- Davies, G. R. (2014). A toxic free future: Is there a role for alternatives to mercury in small-scale gold mining? *Futures*, 62(A), 113-119.
- de Laet, M., & Mol, A. (2000). The Zimbabwe bush pump: Mechanics of a fluid technology. *Social Studies of Science*, 30(2), 225-263.
- de Soto, H. (1986). *El otro sendero: La revolución informal* [The other path: The informal revolution]. Lima, Peru: Instituto Libertad y Democracia.
- de Soto, H. (2000). *The mystery of capital: Why capitalism triumphs in the West and fails everywhere else*. New York, NY: Basic Books.
- del Pimar Camargo, M. (2013, March 1). Medellín, la ciudad más innovadora del mundo. [Medellín, the most innovative city of the world]. *Semana*. Retrieved from <http://www.semana.com/nacion/articulo/medellin-ciudad-mas-innovadora-del-mundo/334982-3>
- Deleuze, G., & Guattari, F. (2014). *A thousand plateaus*. (B. Massumi, Trans.). London, England: Bloomsbury Academic.
- Drake, P. (2015). Marxism and the nonhuman turn: Animating nonhumans, exploitation, and politics with ANT and animal studies. *Rethinking Marxism*, 27(1), 107-122.
- Echavarria, C. (2014). *'What is legal?' Formalising artisanal and small-scale mining in Colombia* [¿Qué es legal? Formalización de la minería artesanal y de pequeña escala en Colombia]. London, United Kingdom; Envigado, Colombia: International Institute for Environment and Development; Sustainable Markets Group; The Alliance for Responsible Mining.
- Eftimie, A., Heller, K., Strongman, J., Hinton, J. J., Lahiri-Dutt, K., & Mutemeri, N. (2012). *Gender dimensions of artisanal and small-scale mining: A rapid assessment toolkit*. Washington D.C., USA: The World Bank Group's Oil, Gas,

and Mining Unit, Sustainable Development Network, Sustainable Energy Department.

Ekino, S., Susa, M., Ninomiya, T., Imamura, K., & Kitamura, T. (2007). Minamata disease revisited: An update on the acute and chronic manifestations of methyl mercury poisoning. *Journal of the Neurological Sciences*, 262(1-2), 131-144.

El Congreso de Colombia. (2001). *Ley 685 de 2001, por la cual se expide el código de minas y se dictan otras disposiciones* [Law 685 of 2001, which issues the Mining Code and dictates other regulations]. Bogotá, Colombia: Author.

El Congreso de Colombia. (2013). *Ley No. 1658* [Law number 1658]. Bogotá, Colombia: Author.

El Tiempo. (2013, September 17). Los líos legales de Góldex, uno de los gigantes del oro en Colombia. [The legal troubles of Góldex, one of the giants of gold in Colombia]. *Author*. Retrieved from <http://www.eltiempo.com/archivo/documento/CMS-13066362>

El Tiempo. (2015a, September 16). El asiático señalado de ser el 'duro' de la minería ilegal en Chocó. [The Asian signalled to be the 'hard man' of illegal mining in the Chocó]. *Author*. Retrieved from <http://www.eltiempo.com/politica/justicia/mineria-ilegal-capturan-a-asiatico-senalado-de-ser-el-duro-en-choco/16375492>

El Tiempo. (2015b, February 11). Incautación de oro ilegal creció más de 6.600%: Grupos ilegales perdieron 26 millones de dólares en 2014 por decomisos. [Seizure of ilegal gold increased more than 6,600%: Illegal groups lost more than 26 million dollars in 2014 due to confiscations]. *Author*. Retrieved from <http://www.eltiempo.com/politica/justicia/incautacion-de-oro-ilegal-crecio-mas-de-6600-/15085495>

El Tiempo. (2015c, July 30). Santos anuncia guerra a minería criminal, que mueve \$7 billones al año. [Santos announces war against criminal mining, which moves \$7 billions a year]. *Author*. Retrieved from <http://m.eltiempo.com/politica/justicia/santos-anuncia-guerra-a-mineria-criminal-que-mueve-7-billones-al-ano/16172335/1>

- Ellis, C. (2007). Telling secrets, revealing lives: Relational ethics in research with intimate others. *Qualitative Inquiry*, 13(1), 3-29.
- Eriksen, H. H., & Perrez, F. X. (2014). The Minamata Convention: A comprehensive response to a global problem. *Review of European Comparative & International Environmental Law*, 23(2), 195-210.
- Esteban Vásquez, J. (2015, November 3). Nuevo ataque contra un minero en segovia. [New attack against a miner in Segovia]. *El Colombiano*. Retrieved from <http://www.elcolombiano.com/antioquia/seguridad/nuevo-ataque-contra-un-minero-en-segovia-FD3027700>
- Farrelly, T., Stewart-Withers, R., & Dombroski, K. (2014). 'Being there': Mothering and absence/presence in the field. *Sites*, 11(2), 25-56.
- Fisher, E. (2007). Occupying the margins: Labour integration and social exclusion in artisanal mining in Tanzania. *Development & Change*, 38(4), 735-760.
- Fisher, E., Mwaipopo, R., Mutagwaba, W., Nyange, D., & Yaron, G. (2009). "The ladder that sends us to wealth": Artisanal mining and poverty reduction in Tanzania. *Resources Policy*, 34(1-2), 32-38.
- Frers, L. (2013). The matter of absence. *Cultural Geographies*, 20(4), 431-445.
- García, O., Veiga, M. M., Cordy, P., Suescún, O. E., Molina, J. M., & Roeser, M. (2015). Artisanal gold mining in Antioquia, Colombia: A successful case of mercury reduction. *Journal of Cleaner Production*, 90, 244-252.
- GCG. (2015). *Management's discussion and analysis for the year ended December 31, 2014*. Gran Colombia Gold Corporation. Retrieved from [http://s1.q4cdn.com/320963646/files/doc_financials/Q4%202014/GCM-MD-A-Dec-31-2014-\(Final\)_v001_o50213.pdf](http://s1.q4cdn.com/320963646/files/doc_financials/Q4%202014/GCM-MD-A-Dec-31-2014-(Final)_v001_o50213.pdf)
- GCG. (2016). Segovia operations overview. Retrieved from <http://grancolombiagold.com/operations-and-projects/segovia/overview/default.aspx>
- Geertz, C. (1998, October 22). Deep hanging out. *The New York Review of Books*, pp. 69-72.
- Gibb, H., & O'Leary, K. G. (2014). Mercury exposure and health impacts among individuals in the artisanal and small-scale gold mining community: A comprehensive review. *Environmental Health Perspectives*, 122(7), 667-672.

- Giraldo-Ramírez, J., & Muñoz-Mora, J. C. (2012). *Informalidad e ilegalidad en la explotación del oro y la madera en Antioquia* [Informality and illegality in the exploitation of gold and wood in Antioquia, Colombia]. Medellín, Colombia: Universidad Eafit, Proantioquia.
- Godoy, R. (1985). Mining: Anthropological perspectives. *Annual Review of Anthropology*, 14, 199-217.
- Google. (n.d.-a). [Google map of Antioquia, Colombia]. Retrieved from <https://www.google.co.nz/maps/place/Antioquia,+Colombia/@2.9611448,-72.098788,6z/data=!4m2!3m1!1s0x8e4429b2d9a8a783:0x540a36ca7581959a>
- Google. (n.d.-b). [Google map of Colombia]. Retrieved from <https://www.google.co.nz/maps/place/Colombia/@-27.4066737,-72.3862453,3.75z/data=!4m2!3m1!1s0x8e15a43aae1594a3:0x9a0d9a04eff2a340>
- Grätz, T. (2004). Friendship ties among young artisanal gold miners in Northern Benin (West Africa). *Africa Spectrum*, 39(1), 95-117.
- Grätz, T. (2009). Moralities, risk and rules in West African artisanal gold mining communities: A case study of Northern Benin. *Resources Policy*, 34(1-2), 12-17.
- Güiza, L. (2013). La pequeña minería en Colombia: Una actividad no tan pequeña. [Small scale mining in Colombia: Not such a small activity]. *Dyna*, 80(181), 109-117.
- Güiza, L., & Aristizábal, J. D. (2013). Mercury and gold mining in Colombia: A failed state. *Universitas Scientiarum*, 18(1), 33-49.
- Hage, G. (2014). Eavesdropping on Bourdieu's philosophers. In V. Das, M. Jackson, A. Kleinman, & B. Singh (Eds.), *The ground between: Anthropologists engage philosophy* (pp. 138-158). Durham, NC: Duke University Press.
- Haluza-DeLay, R. (2008). A theory of practice for social movements: Environmentalism and ecological habitus. *Mobilization*, 13(2), 205-218.
- Hawkins, G. (2009). The politics of bottled water. *Journal of Cultural Economy*, 2(1-2), 183-195.

- Heemskerk, M. (2002). Livelihood decision making and environmental degradation: Small-scale gold mining in the Suriname Amazon. *Society & Natural Resources*, 15(4), 327-344.
- Heemskerk, M. (2003). Self-employment and poverty alleviation: Women's work in artisanal gold mines. *Human Organization*, 62(1), 62-73.
- Hetherington, K. (2004). Secondhandedness: Consumption, disposal, and absent presence. *Environment and Planning D*, 22(1), 157-173.
- Hilson, G. (2005). Strengthening artisanal mining research and policy through baseline census activities. *Natural Resources Forum*, 29(2), 144-153.
- Hilson, G. (2006). Abatement of mercury pollution in the small-scale gold mining industry: Restructuring the policy and research agendas. *Science of the Total Environment*, 362(1-3), 1-14.
- Hilson, G., & Banchirigah, S. M. (2009). Are alternative livelihood projects alleviating poverty in mining communities?: Experiences from Ghana. *Journal of Development Studies*, 45(2), 172-196.
- Hilson, G., Hilson, C. J., & Pardie, S. (2007). Improving awareness of mercury pollution in small-scale gold mining communities: Challenges and ways forward in rural Ghana. *Environmental Research*, 103(2), 275-287.
- Hilson, G., & Maponga, O. (2004). How has a shortage of census and geological information impeded the regularization of artisanal and small-scale mining? *Natural Resources Forum*, 28(1), 22-33.
- Hilson, G., & Monhemius, A. J. (2006). Alternatives to cyanide in the gold mining industry: What prospects for the future? *Journal of Cleaner Production*, 14(12-13), 1158-1167.
- Hilson, G., & Pardie, S. (2006). Mercury: An agent of poverty in Ghana's small-scale gold-mining sector? *Resources Policy*, 31(2), 106-116.
- Hinton, J. J., Veiga, M. M., & Veiga, A. T. C. (2003). Clean artisanal gold mining: A utopian approach? *Journal of Cleaner Production*, 11(2), 99-115.
- Hobsbawm, E. J. (1992). Introduction: Inventing traditions. In E. J. Hobsbawm & T. O. Ranger (Eds.), *The invention of tradition* (pp. 1-14). Cambridge, England: Cambridge University Press.

- Hobsbawm, E. J., & Ranger, T. O. (1992). *The invention of tradition*. Cambridge, England: Cambridge University Press.
- Holland, E. W. (2013). *Deleuze and Guattari's a thousand plateaus: A reader's guide*. New York, NY: Bloomsbury Academic.
- Hudson, R. A. (2010). *Colombia: A country study*. (5 ed.). Washington D.C., U.S.A.: Federal Research Division, Library of Congress.
- Idrobo, N., Mejía, D., & Tribin, A. M. (2014). Illegal gold mining and violence in Colombia. *Peace Economics, Peace Science, & Public Policy*, 20(1), 83-111.
- ILO. (1999). *Social and labour issues in small scale mines: Report for discussion at the Tripartite Meeting on Social and Labour Issues in Small-scale mines (TMSSM/1999)*. Geneva, Switzerland: International Labour Organisation.
- Ingold, T. (2000). *The perception of the environment: Essays on livelihood, dwelling & skill*. New York, NY: Routledge.
- Ingold, T. (2010a). *Bringing things to life: Creative entanglements in a world of materials (Working Paper #15)*. Manchester, England: Realities, Sociology, University of Manchester.
- Ingold, T. (2010b). Footprints through the weather-world: Walking, breathing, knowing. *Journal of the Royal Anthropological Institute*, 16(S1), S121-S139.
- Ingold, T. (2010c). Ways of mind-walking: Reading, writing, painting. *Visual Studies*, 25(1), 15-23.
- Ingold, T. (2012). Toward an ecology of materials. *Annual Review of Anthropology*, 41, 427-442.
- Isaza Giraldo, F. (2015a, October 1). Asesinan en Segovia a líder de mina propiedad de Gran Colombia Gold. [A leader of a mine owned by Gran Colombia Gold was murdered in Segovia]. *El Colombiano*. Retrieved from <http://www.elcolombiano.com/antioquia/seguridad/asesinan-en-segovia-a-lider-de-mina-propiedad-de-gran-colombia-gold-XY2809415>
- Isaza Giraldo, F. (2015b, October 3). Urabeños decretan plan "pistola" en Segovia. [The Urabeños declare the 'pistol' plan in Segovia]. *El Colombiano*. Retrieved from <http://www.elcolombiano.com/antioquia/seguridad/urabenos-decretan-plan-pistola-en-segovia-XJ2821404>

- Jensen, C. B., & Rödje, K. (2010). Introduction. In C. B. Jensen & K. Rödje (Eds.), *Deleuzian intersections: Science, technology, anthropology*. New York, NY: Berghahn Books.
- Johnson, C. A. (2015). The fate of cyanide in leach wastes at gold mines: An environmental perspective. *Applied Geochemistry*, 57, 194-205.
- Jønsson, J. B., Appel, P. W. U., & Chibunda, R. T. (2009). A matter of approach: The retort's potential to reduce mercury consumption within small-scale gold mining settlements in Tanzania. *Journal of Cleaner Production*, 17(1), 77-86.
- Jønsson, J. B., Charles, E., & Kalvig, P. (2013). Toxic mercury versus appropriate technology: Artisanal gold miners' retort aversion. *Resources Policy*, 38(1), 60-67.
- José Hoyos, J. (2012, November 11). Dios y el diablo en la tierra de oro. [God and the devil in the land of gold]. *Semana*. Retrieved from <http://www.semana.com/edicion-30-anos/articulo/dios-diablo-tierra-del-oro/263448-3>
- Kaplan, R., Veiga, M. M., Gonzalez Mueller, C., Velasquez Lopez, C., Granda, L., & Leonor Rivera, L. (2015). *Mercury and heavy metal origin and contamination of the Puyango-tumbes river system, Ecuador*. Paper presented at the SIPS: Meech International Symposium, Antalya, Turkey.
- Kasper, D. V. S. (2009). Ecological habitus: Towards a better understanding of socioecological relations. *Organization & Environment*, 22(3), 311-326.
- Kessler, R. (2014). Convenio de Minamata sobre el mercurio. [The Minamata convention on mercury]. *Salud Pública de México*, 56(1), 85-92.
- Killick, A. P. (1995). The penetrating intellect: On being white, straight, and male in Korea. In D. Kulick & M. Willson (Eds.), *Taboo: Sex, identity and erotic subjectivity in anthropological fieldwork* (pp. 76-106). London, England: Routledge.
- Kirby, S. L., Greaves, L., & Reid, C. (2010). *Experiencing research social change: Methods beyond the mainstream*. (2 Ed.). Toronto, Canada: University of Toronto Press.
- Kohler, P. M., Morgera, E., Ripley, K., Schabus, N., & Tsioumani, E. (2013). Summary of the fifth session of the Intergovernmental Negotiating Committee to

- prepare a legally binding instrument on mercury. (International Institute for Sustainable Development) *Earth Negotiations Bulletin*, 28, 1-26.
- Labbé, A. J. (1998). *Shamans, gods, and mythic beasts: Colombian gold and ceramics in antiquity*. New York, NY: University of Washington Press.
- Lamborg, C. H., Hammerschmidt, C. R., Bowman, K. L., Swarr, G. J., Munson, K. M., Ohnemus, D. C., . . . Saito, M. A. (2014). A global ocean inventory of anthropogenic mercury based on water column measurements. *Nature*, 512(7512), 65-69.
- Lasdon, E. S. (1974). The Tragedy of Minamata. *Business & Society Review*, 15, 47-53.
- Le Billon, P. (2001). The political ecology of war: Natural resources and armed conflicts. *Political Geography*, 20(5), 561-584.
- Levi, P. (1984). *The periodic table*. (R. Rosenthal, Trans.). New York, NY: Schocken Books.
- Lopes, A. (2015). Talking and acting for our rights: The interview in an action-research setting. In K. Smith, J. Staples, & N. Rapport (Eds.), *Extraordinary encounters: Authenticity and the interview* (pp. 157-174). New York, NY: Berghahn Books.
- Luis Fernando, V. A., Santiago, S. N., & Héctor José, G. D. (2015). The evolution of security in South America: A comparative analysis between Colombia and Brazil. *Revista de Relaciones Internacionales, Estrategia y Seguridad*, 10(1), 41-63.
- Maconachie, R., & Hilson, G. (2011). Safeguarding livelihoods or exacerbating poverty? Artisanal mining and formalization in West Africa. *Natural Resources Forum*, 35(4), 293-303.
- Malinowski, B. (2014). *Argonauts of the Western Pacific: An account of native enterprise and adventure in the archipelagos of Melanesian New Guinea*. Abingdon, England: Routledge.
- María Teresa, A. E. (2006). *El elogio de la dificultad* como narrativa de la identidad regional en Antioquia. [The *eulogy to difficulty* as the narrative of regional identity in Antioquia]. *Historia Crítica*, 32, 39-66.

- Martínez Arango, R. (2015a, October 19). Cayó en Segovia sindicado de lanzar una granada. [Suspected grenade thrower is apprehended in Segovia]. *El Colombiano*. Retrieved from <http://www.elcolombiano.com/antioquia/seguridad/cayo-en-segovia-sindicado-de-lanzar-una-granada-BN2906542>
- Martínez Arango, R. (2015b, February 10). El centro minero abrió puertas con 456 alumnos. [The mining centre opens its doors with 456 students]. *El Colombiano*. Retrieved from <http://www.elcolombiano.com/el-centro-minero-abrio-puertas-con-456-alumnos-1-IE1251381>
- Massey University. (2015). *Code of ethical conduct for research, teaching and evaluations involving human participants*. Author. Retrieved from <http://www.massey.ac.nz/massey/fms/Human%20Ethics/Documents/MUH%20Code%202015.pdf?497309B983F78ECC2490A4A377F5CBAD>
- McTavish, C. (2015). *Making milking bodies in the Manawatu: Assembling "good cow"- "good farmer" relationships in productionist dairy farming*. (Master's thesis, Massey University, Palmerston North, New Zealand). Retrieved from <http://mro.massey.ac.nz/handle/10179/7262>
- Metcalf, S. M., & Veiga, M. M. (2012). Using street theatre to increase awareness of and reduce mercury pollution in the artisanal gold mining sector: A case from Zimbabwe. *Journal of Cleaner Production*, 37, 179-184.
- Meyer, M. (2012). Placing and tracing absence: A material culture of the immaterial. *Journal of Material Culture*, 17(1), 103-110.
- Miller, C. L. (1993). The post-identitarian predicament in the footnotes of A *Thousand Plateaus*: Nomadology, anthropology and authority. *Diacretics*, 23(3), 6-35.
- Mitchell, C. J., Evans, E. J., & Styles, M. T. (1997). *A review of gold particle-size and recovery methods* (Technical Report WC/97/14). Nottingham, England: British Geological Survey.
- Moffat, K., & Zhang, A. (2014). The paths to social licence to operate: An integrative model explaining community acceptance of mining. *Resources Policy*, 39, 61-70.

- Mosquera, C. (2006). *El desafío de la formalización en la minería artesanal y de pequeña escala: Análisis de las experiencias en Bolivia, Colombia, Ecuador y Peru* (Archive 123847). Lima, Peru: Centro Internacional de Investigaciones para el Desarrollo.
- Nash, J. C. (1993). *We eat the mines and the mines eat us: Dependency and exploitation in Bolivian tin mines*. New York, NY: Columbia University Press.
- National Geographic. (n.d.). [Map of fieldwork locations in Antioquia, Colombia: Created with National Geographic MapMaker Interactive]. Retrieved from <http://mapmaker.nationalgeographic.org/>
- Newcombe, V. C. (2008). *Mercury use in the gold mining industry: A retrospective examination of elemental mercury use in the gold mining industry of the West Coast of New Zealand in the period 1984-1988*. (Master's thesis, Massey University, Wellington, New Zealand). Retrieved from <http://mro.massey.ac.nz/handle/10179/832>
- Nordstrom, C. (2000). Shadows and sovereigns. *Theory, Culture & Society*, 17(4), 35-54.
- Novais, G., & Câmara, V. d. M. (2009). Perception of mercury contamination by Brazilian adolescents in a gold mining community: An ethnographic approach. *Ciência & Saúde Coletiva*, 14(6), 2015-2026.
- Nriagu, J. O. (1994). Mercury pollution from the past mining of gold and silver in the Americas. *Science of the Total Environment*, 149(3), 167-181.
- Okely, J. (2015). Dialogues with anthropologists: Where interviews become relevant. In K. Smith, J. Staples, & N. Rapport (Eds.), *Extraordinary encounters: Authenticity and the interview* (pp. 128-156). New York, NY: Berghahn Books.
- Olivero, J., Mendonza, C., & Mestre, J. (1995). Mercurio en cabello de diferentes grupos ocupacionales en una zona de minería aurífera en el Norte de Colombia. [Mercury in the hair of different occupational groups in a gold mining zone in the North of Colombia]. *Revista de Saúde Pública*, 29(5), 376-379.
- Omohundro, J. T. (2008). *Thinking like an anthropologist: A practical introduction to cultural anthropology*. Boston, MA: McGraw Hill.

- Poveda Ramos, G. (1979). *Dos siglos de historia económica de Antioquia* [Two centuries of economic history of Antioquia]. Medellín, Antioquia: Biblioteca Pro Antioquia.
- Prno, J., & Slocombe, D. S. (2012). Exploring the origins of 'social license to operate' in the mining sector: Perspectives from governance and sustainability theories. *Resources Policy*, 37(3), 346-357.
- ProAntioquia. (n.d.). Aspectos generales de Antioquia. [General aspects of Antioquia]. Retrieved from <http://proantioquia.org.co/web/index.php/quienes-somos/departamento-de-antioquia>
- Radio Santa Fe. (2013, May 15). Condenan al excongresista César Pérez por la masacre de Segovia. [Ex-Congressman César Pérez sentenced for the massacre of Segovia]. *Author*. Retrieved from <http://www.radiosantafe.com/2013/05/15/condenan-al-excongresista-cesar-perez-por-la-masacre-de-segovia/>
- República de Colombia. (2011). *Plan nacional de desarrollo* [National development plan]. Bogota, Colombia: Ministerio de Hacienda y Crédito Público.
- Rivera-Sotelo, A. S. (2012). *Interrogating sustainable development: A case study of large-scale mining in Colombia*. (Master's thesis, Queen's University, Kingston, Canada). Retrieved from https://qspace.library.queensu.ca/bitstream/1974/7494/1/riverasotelo_aidasofia_201211_ma.docx.pdf
- Rivera-Sotelo, A. S., & Pardo Becerra, L. Á. (2014). ¿Qué minería aurífera, por quiénes y con fines de qué desarrollo?: Una mirada a la minería aurífera en la Zona Minera Indígena Remanso Chorrobocón. [What gold mining, for whom, and to what development ends?: A view of gold mining in the Indigenous Mining Zone of the Chorrobocón Reserve]. *OPERA*, 14, 95-117.
- Rolfe, A. (2015). *Estelle Levin Limited-ASM: Our work, approach and vision*. Paper presented at the SIPS: Meech International Symposium, Antalya, Turkey.
- Saldarriaga, M. (2014, November 24). Así trabajan los mineros con el mercurio en Antioquia. [So work miners with mercury in Antioquia]. *El Colombiano*.

- Retrieved from <http://www.elcolombiano.com/especiales/mercurio-en-antioquia/asi-trabajan-los-mineros-con-el-mercurio-en-antioquia-JF689812>
- Schumacher, E. F. (1993). *Small is beautiful: A study of economics as if people mattered*. London, England: Vintage Books.
- Seccatore, J., Veiga, M., Origliasso, C., Marin, T., & De Tomi, G. (2014). An estimation of the artisanal small-scale production of gold in the world. *The Science Of The Total Environment*, 496, 662-667.
- Selin, N. E. (2014). Global change and mercury cycling: Challenges for implementing a global mercury treaty. *Environmental toxicology and chemistry*, 33(6), 1202-1210.
- Sheets-Johnstone, M. (1999). *The primacy of movement*. Amsterdam, The Netherlands: John Benjamins Publishing.
- Siegel, S., & Veiga, M. M. (2009). Artisanal and small-scale mining as an extralegal economy: De Soto and the redefinition of "formalization". *Resources Policy*, 34(1-2), 51-56.
- Singh, B. (2014). How concepts make the world look different: Affirmative and negative genealogies of thought. In V. Das, M. Jackson, A. Kleinman, & B. Singh (Eds.), *The ground between: Anthropologists engage philosophy* (pp. 159-187). Durham, NC: Duke University Press.
- Sintraminercol. (2004). *La gran minería en Colombia: Las ganancias del exterminio* [Large-scale mining in Colombia: The profits of extermination]. Bogotá, Colombia: Author.
- Smith, M. (2001). *An ethics of place: Radical ecology, postmodernity, and social theory*. Albany, NY: State University of New York Press.
- Soemarwoto, R., & Ellen, R. (2010). Gold mining and changing perceptions of risk in West Java. *Human Organization*, 69(3), 233-241.
- Spiegel, S., Keane, S., Metcalf, S. M., & Veiga, M. M. (2015). Implications of the Minamata Convention on mercury for informal gold mining in Sub-Saharan Africa: From global policy debates to grassroots implementation? *Environment, Development and Sustainability*, 17(4), 765-785.

- Spiegel, S., Keane, S., Metcalf, S. M., Veiga, M. M., & Yassi, A. (2014). The Minamata Convention on mercury: Time to seek solutions with artisanal mining communities. *Environmental Health Perspectives*, 122(8), A203-A204.
- Stewart-Withers, R., Banks, G., McGregor, A., & Meo-Sewabu, L. (2014). Qualitative research. In R. Scheyvens (Ed.), *Development fieldwork: A practical guide* (2nd ed., pp. 59-80). London, England: Sage Publications.
- Swain, E. B., Jakus, P. M., Rice, G., Lupi, F., Maxson, P. A., Pacyna, J. M., . . . Veiga, M. M. (2007). Socioeconomic consequences of mercury use and pollution. *Ambio*, 36(1), 45-61.
- Taussig, M. T. (1980). *The devil and commodity fetishism in South America*. Chapel Hill, NC: The University of North Carolina Press.
- Taussig, M. T. (2004). *My cocaine museum*. Chicago, IL: University of Chicago Press.
- Telmer, K., & Veiga, M. M. (2009). World emissions of mercury from artisanal and small scale gold mining. In N. Pirrone & R. Mason (Eds.), *Mercury fate and transport in the global atmosphere: Emissions, measurements and models* (pp. 131-172). New York, NY: Springer.
- Tschakert, P., & Singha, K. (2007). Contaminated identities: Mercury and marginalization in Ghana's artisanal mining sector. *Geoforum*, 38(6), 1304-1321.
- Tsing, A. L. (2005). *Friction: An ethnography of global connection*. Princeton, NJ: Princeton University Press.
- Tubb, D. (2015). Muddy decisions: Gold in the Chocó, Colombia. *The Extractive Industries and Society*, 2(4), 722-733.
- UNDP. (2015). *Human development report 2015: Work for human development*. New York, NY: United Nations Development Programme. Retrieved from http://hdr.undp.org/sites/default/files/2015_human_development_report.pdf
- UNEP. (2006). *Summary of supply, trade and demand information on mercury*. Geneva, Switzerland: United Nations Environmental Programme.
- UNEP. (2012). *Reducing mercury use in artisanal and small-scale gold mining: A practical guide*. United Nations Environmental Programme. Retrieved from <http://www.unep.org/chemicalsandwaste/Portals/9/Mercury/Documents/A>

SGM/Techdoc/LAST%20VERSION%20UNEP_Technical_Document__DEC_31_
E%5B1%5D.pdf

- UNEP. (2013a). *Global mercury assessment 2013: Sources, emissions, releases and environmental transport*. Geneva, Switzerland: United Nations Environmental Programme. Retrieved from <http://www.unep.org/PDF/PressReleases/GlobalMercuryAssessment2013.pdf>
- UNEP. (2013b). *Minamata convention on mercury: Text and annexes*. United Nations Environmental Programme. Retrieved from http://www.mercuryconvention.org/Portals/11/documents/Booklets/Minamata%20Convention%20on%20Mercury_booklet_English.pdf
- Urán, A. (2013). La legalización de la minería a pequeña escala en Colombia. [The legalization of small scale mining in Colombia]. *Letras Verdes*, 14, 255-283.
- Uribe de Hincapié, M. T. (1998). *Las raíces del poder regional: El caso Antioqueño* [The roots of regional power: The Antioquian case]. Medellín, Colombia: Editorial Universidad Antioquia.
- USGS. (2012). *Mineral commodity summaries 2012*. Washinton D.C., USA: U.S. Department of the Interior, U.S. Geological Survey.
- USGS. (2013). *Mineral commodity summaries 2013*. Washington D.C., USA: U.S. Department of the Interior, U.S. Geological Survey.
- USGS. (2014). *Mineral Commodity Summaries 2014*. Washington D.C., USA: U.S. Department of the Interior, U.S. Geological Survey.
- Veiga, M. M. (2015). *Roundtable discussion*. Symposium conducted at the SIPS: Meech International Symposium, Antalya, Turkey.
- Veiga, M. M., Angeloci-Santos, G., Hitch, M., & Velasquez-Lopez, P. C. (2014). Processing centres in artisanal gold mining. *Journal of Cleaner Production*, 64, 535-544.
- Veiga, M. M., Angeloci-Santos, G., & Meech, J. A. (2014). Review of barriers to reduce mercury use in artisanal gold mining. *The Extractive Industries and Society*, 1(2), 351-361.

- Veiga, M. M., Angeloci, G., Ñiquen, W., & Seccatore, J. (2015). Reducing mercury pollution by training Peruvian artisanal gold miners. *Journal of Cleaner Production*, *94*, 268-277.
- Veiga, M. M., & Barker, R. F. (2004). *Protocols for environmental and health assessment of mercury released by artisanal and small-scale gold miners*. Vienna, Austria: UNIDO Global Mercury Project.
- Veiga, M. M., Maxson, P. A., & Hylander, L. D. (2006). Origin and consumption of mercury in small-scale gold mining. *Journal of Cleaner Production*, *14*(3-4), 436-447.
- Veiga, M. M., Nunes, D., Klein, B., Shandro, J. A., Velasquez, P. C., & Sousa, R. N. (2009). Mill leaching: A viable substitute for mercury amalgamation in the artisanal gold mining sector? *Journal of Cleaner Production*, *17*(15), 1373-1381.
- Vélez-Torres, I. (2014). Governmental extractivism in Colombia: Legislation, securitization and the local settings of mining control. *Political Geography*, *38*, 68-78.
- Verbrugge, B. (2015a). The economic logic of persistent informality: Artisanal and small-scale mining in the southern Philippines. *Development and Change*, *46*(5), 1023-1046.
- Verbrugge, B. (2015b). Undermining the state?: Informal mining and trajectories of state formation in eastern Mindanao, Philippines. *Critical Asian Studies*, *47*(2), 177-199.
- WHO. (2007). *Exposure to mercury: A major public health concern*. Geneva, Switzerland: World Health Organisation.