Inextinguishable fibres: demolition and the vital materialisms of asbestos

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Abstract
This paper forwards a performative reading of asbestos in economies of disposal. It argues that materials need to be thought through transformative states, not just stable states, and that materials' performativity varies according to material states. As a radical intervention in form, demolition is one such transformative state, which disturbs and animates materials. Relatively unconsidered in the academic literature, demolition is argued to be the means to an endless source of surprise in the built environment as well as a singular and multiple practice entailing the dissolution of form, the purposeful reduction and dismantling of large scale objects, salvage and remediation work, and a host of micro practices including cutting, tearing, sorting and separating. The paper illustrates asbestos' interventions in demolition activities, using as its exemplar the case of ship breaking in the EU. More broadly, the paper works with asbestos to show that material properties are not fixed but processual, relational and distributed. The paper also flags some key questions for the emergent debate on vital materialisms, highlighting the difficulties materials like asbestos pose for thinking through enchantment and generosity; the importance of thinking a vital materialism through remediation as well as salvage; and the need to extend an ethics founded on generosity to encompass respect, humility, responsibility and surprise towards those materials that most threaten human life.

1: Introduction

Towards the end of her report *Killing the Future*, *asbestos use in Asia*, Laurie Kazan-Allen remarks:

> '… asbestos is yesterday's material and should be relegated to the dustbin of discredited technologies and discarded materials; an asbestos-free future is possible' (2007, p. 37).

Produced for IBAS (the International Ban Asbestos Secretariat), an NGO based in the UK, this report exposes the global trade in chrysotile (white asbestos), delineates patterns in its production and consumption, highlighting its extensive use in construction projects throughout Asia, and emphasises the consequences for human health of its continued widespread and deregulated use.[1] The consequences are indeed stark. According to WHO estimates, 125 million people are exposed to asbestos annually in an occupational capacity, with around 9000 occupationally-related deaths occurring per annum, primarily from asbestosis and mesothelioma. As significant is environmental exposure. That asbestos is just another construction material in Asia means that catastrophes such as the 2004 tsunami, as well as mining and manufacture, release its fibres to the air. Environmental exposure to asbestos is therefore estimated to be widespread. For NGOs, then, there is an asbestos time bomb ticking in Asia, one which will sooner or later realise its presence in the human costs of this deadly material.

The current Asian asbestos crisis is paralleled by asbestos legacy panics in those parts of the world where asbestos use is now banned. The UK is a case in point. In 2008, the replacement

[1] Asbestos is the generic name for a group of silicate minerals with a long thin fibrous structure. There are various forms of the mineral, with chrysotile (white), amosite (brown) and crocidolite (blue) being the most commonly used in industrial and domestic applications in the twentieth century. Chrysotile accounts for > 90% of asbestos currently being used commercially (Kazan-Allen, 2007; note 8, p 40). It is the most flexible of the asbestos fibres, in that its curly fibres withstand the fiercest heat yet are so soft and flexible that they can be spun and woven as easily as cotton (www.asbestos-forum.org).

of Selfridge's shop window in London provided the trigger for a spate of news stories about occupational exposure to asbestos in the UK (BBC Online, October 2008). According to the Health and Safety Executive, an estimated 4000 asbestos-related deaths occur per annum in the UK. Further, there is widespread concern within both regulatory bodies and the unions about uncalculated levels of exposure amongst those who currently work in the electrical, building and plumbing trades. With an estimated minimum of 500,000 commercial and industrial buildings in the UK thought to contain asbestos, low levels of worker knowledge, ambivalent or dismissive attitudes to safety and risk, small profitability margins and widespread practices of subcontracting, trades persons constitute an identifiable body of 'at risk' workers to add to the already well known high levels of occupational exposure amongst those who were formerly employed in the mining and ship building industries. As the UK legacy panic shows, however, the price for past asbestos applications continues to be paid in a range of economic activities including decommissioning, demolition, repair, maintenance and renovation.

Together, both the Asian asbestos crisis and the UK asbestos legacy panic are one of the best reminders that questions of ethics, governance and materials are not confined to new materials and new technologies (for example: mobile phones, nanotechnologies, stem cells) but encompass all materials. Asbestos is indeed one of the oldest materials. Known by the ancients, its material properties and capacities led to it being referred to as 'the magic mineral' (www.asbestos-forum.org). 'Non flammable, a thermal and electric insulator, stable under extreme circumstances, flexible [and] strong' (EC, 2006, Section 6.2.1 – no page), asbestos was widely used in the construction industries of the developed world during the twentieth-century, as well as in the auto industry, where it was a standard component in clutch and brake linings. Currently it has over 3000 patented uses. From the outset, however,

its deleterious effects on human health were discernible. The Greek geographer Strabo noted its effects on those slaves who wore cloth woven with asbestos fibres. The earliest officially recorded asbestos-related death in the UK, however, was in 1900, when the last (un-named) member of a 10 man team who had worked in the carding room of an asbestos textile factory died. Although the same effects were observed in workers across Europe in the early twentieth century, it was not until 1999 that asbestos was officially banned in EU member states. Nonetheless, and as the Asian crisis shows, banning has resulted in a familiar story. Protection in one part of the world has been accompanied by proliferation elsewhere. Advances in occupational health in certain parts of the world have gone hand-in-hand with testimonies to the alleged safety of working with asbestos in other parts of the world. Depending on where one is in the world, asbestos is categorised as either hazardous or benign. It therefore becomes an issue of global environmental and social justice that such inequities are addressed and rectified, hence the activities of NGOs such as IBAS.

The premise behind the activities of NGOs such as IBAS is that ethically human lives do matter more than materials, particularly materials that are known to constitute a risk to human health. Indeed, in such accounts materials like asbestos are labelled as 'bads', the clear intent being to regulate them out of existence. It is this position which lies behind Kazan-Allen's bald statement that asbestos is a 'yesterday's material'. To argue this, however, is to miss a critical point, that for materials there are no yesterdays. Put simply, and however much campaigners might wish otherwise, materials such as asbestos don't go away once declared to be hazardous. Rather, they have futures. That they have futures is not just a matter of discordances in governance and regulation and the consequent capacity for banned materials to be displaced elsewhere, or even about the difficulties attendant upon the storage of old hazardous and/or banned materials (Bolter, 1996; Gille, 2007). It is about material

possibilities and limits too. For, to disappear would be to contradict a fundamental part of the second law of thermodynamics: that material, matter, cannot be got rid of or destroyed, but rather can only transform, mutate, morph. Material might become something else through various treatment technologies; it might morph to conjoin with other materials; or it might stay in the same material state but what it doesn't do is disappear. Given this, in a material sense, asbestos – as its Greek etymology suggests – is inextinguishable. What it becomes, however, is always a matter of the precise manner of its conjuncture with the human.

In this paper we think about asbestos in ways that both acknowledge its material properties and possibilities, and which break with thinking about it exclusively through frameworks of risk and governance. Rather than think asbestos through the anterior category 'hazardous', we work with asbestos in ways which acknowledge its properties and capacities, the co-present entanglements of human and material, and the ways in which entanglements, properties and capacities come together in practices and events. Taking our inspiration from writers such as Annemarie Mol (2002), Andrew Pickering (1995, 2001,2005, 2008), Karen Barad (2007) and Tim Ingold (2007), as well as practice theory (Schatzki et al, 2001), our position here is that asbestos – indeed, all material – needs to be thought of as ontologically co-present. What this means is that material can no longer be consigned to the category of 'dead' matter, positioned as stuff that is, at best, there to be manipulated, at worst as the irrelevant baggage of an unreconstructed materialism. Neither does this mean thinking in terms of categories such as 'hazardous' that work both to separate off human and physical worlds, and to prop up constructivist readings of material. Rather, we want to think of asbestos as material handled in practice and practices (Gregson, 2009). This means that asbestos can be many things. In many instances, its co-presence in practices is invisible: think of how shopping, and indeed window displaying, had gone on for decades in London's Selfridges without any care, or

even awareness, of asbestos' presence in this fabricated structure. Once the practices of repair and maintenance (Graham and Thrift, 2007) - and, we would add, demolition - intervene in structures, however, asbestos discloses its presence. It comes into being, in ways that can have radical effects on these practices. In this way, asbestos becomes performative. Disturbance threatens animation, specifically an airborne dance of inextinguishable fibres that – at least in certain parts of the world – conjoins with occupational health legislation to choreograph a distinctive set of handling practices that in turn intervene in the enactment of particular practices of repair, maintenance and demolition.

The paper focuses in large part on the performative character of asbestos in economies of disposal in the EU and specifically on the practice of demolition. Drawing on the arguments of Esther Leslie and Jennifer Gabrys, who have looked at synthetic chemicals and digital waste, respectively (Leslie, 2005; Gabrys, 2007), as well as the work of Andrew Pickering (2005), we argue that it is the transformative qualities of materials that makes them performative, and therefore that materials need to be thought through in their transformative states, and not just in their stable states. For reasons to do with its grounding in materials transformation, it has been the chemical industry that has been the focus for what little work there has been thus far on materials transformation in the social sciences (Barry, 2005; Bensaude-Vincent, 1996; Gregson, 2009; Leslie, 2005; Pickering, 2005). This should not, however, be to the neglect of other sites and states of materials transformation. Experimental work, materials design and innovation are clearly other important sites for studies of materials transformation. Another, however, and our focus here, is demolition.

One reason why it matters to pay demolition attention is to recover it from the academic neglect in which it has languished, at least in so far as the social sciences are concerned (c.f. Byles, 2005). Albeit that the conceptual significance of demolition has been recognised – as

creative destruction – by Schumpeter, Harvey and Benjamin, its importance for contemporary theoretical debate is less to do with value and rather more to do with materials and materiality (Ingold, 2007). In this regard, as both Bill Brown and John Frow have acknowledged when thinking about things, the points at which things break, stop working, or don't work as they should, are ones where we are confronted with the 'thingness' of things (Brown, 2001; Frow, 2001). By this they mean that it is at this juncture that we are forced to look beyond the object, to deal with materials, with material effects, and with the sheer materials complexity of many of the things that are co-present in our lives. Demolition, however, goes beyond points of wear and tear, breakdown and repair. It is an intentional human intervention in, disruption of, and termination of, particular associations and arrangements of materials in the world, to bring about new associations, arrangements and conjunctures. As Benjamin remarked:

> "The destructive character sees nothing permanent. But for this very reason he sees ways everywhere. Where others encounter walls or mountains, there, too, he sees a way. But because he sees a way everywhere, he has to clear things from everywhere. Not always by brute force; sometimes by the most refined. Because he sees ways everywhere he always positions himself at the crossroads. No moment can know what the next will bring. What exists he reduces to rubble, not for the sake of the rubble, but for that of the way leading through it (1997, pp 158 – 9)

As such, demolition, or destruction, is a transformative state in which materials stilled in the object form become animated. Yet there is a scalar dimension to these interventions. Frequently, indeed, demolition as an activity is about the 'unbuilding' of the built environment – the ending of particular designs and the emergence of others. Whereas the thingness that confronts both Brown and Frow is that of domestic or small things (the toy, wooden floors and pebbles), the concern with respect to demolition and the built environment is with large, often very large, objects that far exceed the human in their size and shape (Jacobs, 2006). Things like high-rise buildings, power stations, cooling towers and

factories. One such object features in this paper as the vehicle to explore materials transformation in demolition. This is the ship. Large complex objects like ships are heterogeneous materially and, as with other complex objects – notably the iconic objects of the digital economy (mobile phones and computers) – their break up involves the animation of an abundance of materials including, currently, in this instance, asbestos.

Thinking materials through animation is also central to the vital materialist tradition (Bennett, 2004a, 2004b, 2007; Hawkins, 2006, 2009). Gay Hawkins argues:

> "Bennett is not arguing for an essentialised materialism. Rather, she is insisting that things have the capacity to assert themselves, that their anterior physicality, their free or aleatory movements, can capture humans as much as humans like to think they have the world of things under control. Recognising the thingness of things is not to deny the dense web of connections that they are always caught up in. It is simply to be open to the powers of matter and the recognition that there are multiple sites of agency in the world beyond the human." (2009, p. 188)

It is precisely this sense of agency, or, more accurately, material properties, capacities and affordances, that we explore in this paper, specifically in relation to asbestos. Beyond this, however, the kernel to Bennett's work as a political theorist is to rediscover enchantment and to show how enchantment is central to ethical behaviour. An ethics of generosity lies at the heart of her work. She states:

> "If the power to self-move, to laugh, or to dance adheres, albeit differently, in all material things, then humans must reckon with a much larger population of entities worthy of ethical concern, and humanity faces the difficult prospect of moderating its claims to uniqueness. At the same time, animations can delight … if things that we had previously considered to be but the passive context for our activity are themselves mobile, vital matter, then the world becomes more interesting" (2004: 112).

Taking her cues from Bennett, Gay Hawkins works with Bennett's arguments to regard waste as vital and to explore rubbish through enchantment (Hawkins, 2006). In a range of encounters with ordinary everyday objects, including plastic bags, dumped cars, potatoes and empty bottles, Hawkins explores how waste, and human relations to waste, can be re-thought

through generosity and the arts of transience. Her intent is to consider the enchanting possibilities in discarded things and to see in this the scope for living differently with wastes. Material metamorphoses are central to Bennett's concept of enchantment: they encapsulate the magical qualities that are the hallmark of enchantment. As Hawkins argues, the sound of breaking glass in a recycling lorry is the moment when bottles are re-born into the recycling economy (2006, p 93). They mark a crossing point, in Bennett's terminology, that animates the glass from the confines of the empty bottle. Hawkins' account of recycling, therefore, is intensely positive. Recycling here is an activity of salvage, in which the purpose is to extend the useful life of material, to avoid and arrest materials loss (Soderan and Carter, 2008). Given this, it is not hard to see why recycling is promoted as emblematic of the arts of transience and as illustrative of what is meant by an ethics of generosity towards materials. But it is important to note that this is a generosity towards specific sorts of material: paper, glass, tin and plastic. What about other sorts of materials? Materials like asbestos? An issue which this perspective has yet to fully acknowledge is the difficulties certain materials pose for thinking through enchantment and generosity (and see too, Khan, 2009). In short, and a point that it is impossible to overlook: some materials are just not nice for humans to know corporeally, at least when they are in certain states. Asbestos is just one such material. And indeed, wishing it condemned to the dustbin of discredited technologies and materials, as per Kazan-Allen (2007), is indicative of the very different ethical responses, of rejection and disavowal, that hazardous waste material invariably seems to conjure up. The problem that asbestos poses enchantment then is that, unlike glass and tin, it is not benign in its animation. Rather, it is categorised as a hazardous material for the simple reason that, once let loose, the tiny needles that are asbestos fibres are highly aerodynamic and easily inhaled. Although there are differences between the various asbestos fibres in this regard, once released they all have the capacity to capture humans, to lodge themselves in lung tissue and to become

pleural plaques. Once part of the human body, fibres work to constitute scar tissue, tumours, and to constrict the very breath that defines life. They snuff it out. They extinguish it. As such, whilst asbestos can certainly be thought through animation, and whilst such animations occur through material metamorphosis – typically, currently through the repair and demolition of fabricated structures – its animation is not the stuff of delight.

The structure of the paper is as follows. In the following section (Section 2) we outline briefly and in broad terms the demolition activity of ship breaking and the place of asbestos removal within this. The emphasis here is on some fairly well rehearsed descriptions and schematic representations of the empirical activities involved. As well as being a means to outline the transformations involved in demolition, this works as a necessary prelude to Section 3, where attention switches to thinking about asbestos as economically performative. Our key point here is that asbestos removal, as this has been observed in ship breaking yards in the EU, is an altogether messier practice than smooth, simplified, stylised representations make out. Instead, and critically, paying attention to practices shows asbestos to have the capacity to disrupt and interfere in the temporal logic of individual demolition projects. As such, asbestos is shown to exert effects – on the performance of this form of demolition work, specifically on labour and working practices, and ultimately on the profitability of the work. In turn, the potential for ship breaking to become a viable market-based activity in certain parts of the world is questioned. In Section 4 of the paper we turn to consider asbestos in 'disposal'. Whilst asbestos from ship breaking in the EU continues to be buried in landfills, alternative treatment technologies are emerging. These work by destroying asbestos, such that it becomes something else. To destroy asbestos, however, requires that its fibres be extinguished. This is a costly process, regardless of the technology. Consequently, we argue that asbestos continues to exert effects, even in its elimination. Sections 3 and 4 work in

parallel; they examine how the performativity of asbestos changes according to material states. As such, they signal one of three guises in which asbestos figures in this paper, as a marker of the situatedness of material capacities and properties, to run alongside the more avowedly realist guise of asbestos as an active yet ontologically separate health hazard, which features in both Section 2 and in NGO accounts. Section 3 also registers a third guise, in that it works to signal the inexhaustibility of the built environment and its capacity for endless surprise. The paper concludes by emphasising the performative qualities of asbestos fibres; by highlighting the importance of demolition activities, not just to furthering understandings of performative cultural economies (Amin with Thrift, 2007; Mackenzie, 2004, 2009; Mackenzie et.al, 2007; Thrift, 1997, 2000a, 2000b) but to debate about materials and materiality (Ingold, 2007), and by reflecting on how thinking about asbestos in these ways contributes to the emergent debate on vital materialisms (Bennett, 2004a,2004b; Hawkins, 2006, 2009).

2: The rhetoric of demolition: talking salvage and remediation

Often likened by shipyard workers and crew members to a city in its size and scale, the materials complexity of a ship has few parallels, other than perhaps the aircraft. This is precisely because – like the aircraft – it functions as both a secure cargo transport system and as a human life support system whilst it is at sea. Like the aircraft, however, ships eventually come to the end of their economically useful lives. For a commercial vessel this is usually after some 25 – 32 years of use. The same holds for government or naval vessels. At this point they are sent for what the shipping industry continues to term ‘scrapping’, ‘breaking’ or ‘demo’, but an activity that the breaking industry itself is re-branding as ‘recycling’. The rhetorical greening of demolition activities in the EU is a recent development, linked to the parallel growth in new markets in recyclables which, in turn, can be identified as an effect of

the EU Landfill Directive of 1999. Indeed, the break-up of a ship is in part a complex exercise in materials salvage, primarily as tons and tons of steel are torn from the ship, cut and cut again, and then shredded, and prepared for sale as scrap steel. But, what is also released in the process of ship breaking, and what is not contained by the greening rhetoric, is a range of other materials that, at least in the EU, fall within the category of 'hazardous wastes'. Amongst these materials are residues such as oily wastes and asbestos. Whilst the former is found in tanks, engines and previously moving parts, the latter coats seemingly endless runs of cabling and wiring, pipes, panels and funnels (Figure 1).

Figure 1 about here Asbestos clad piping (© Helen Watkins, The Waste of the World)

As with land buildings of the same vintage, asbestos is everywhere aboard the ships that are currently being declared 'end of life'. Contained and stable, asbestos is and was a protective, potentially life-saving material. It facilitated light, warmth, comfort and convenience, as well as fire protection, for generations of sailors whilst at sea. In demolition though, asbestos morphs. Protection mutates to become contamination as asbestos obstructs, masks and defiles the materials that co-exist with it. The work of removal consequently becomes intricate, involved and laborious. In short, asbestos' presence makes demolition hard, skilled and time consuming work and, therefore, costly work. Furthermore, disturbing asbestos potentially releases the fibres that pose such a risk to human health. Removal threatens to reanimate the inert, rendering it active, vital and potentially dangerous.

It is precisely because of asbestos' known dangers to human health that the work of asbestos removal within the EU is located in a complex regulatory frame that works to protect the worker by minimising potential exposure. Even to work in the industry in the EU requires

that workers are fully trained and certificated, and that the companies they work for are licensed to the highest level. Paper knowledge is translated into strict working protocols that are themselves subject to routine inspection by environmental regulators. A series of negative pressure chambers are used to demarcate areas of active removal from inactive (safe) areas (Figure 2).

Figure 2 about here: Negative pressure chambers surrounding areas of active removal (© Melania Calestani, The Waste of the World)

Removal is enacted through the 'wrap and cut' method, a complex process of protective wrapping, cutting and bagging. In the process of removal asbestos is constantly dampened to minimise fibre release. Cuts are only made with appropriate safety margins. PP3 filters work to trap any released fibres. Air quality is continually monitored to ensure that the number of fibres present in the air is below legal thresholds (in the UK, < 0.15 fibres/ml). Work has to stop if thresholds are exceeded; filters are changed when they become full; and workers are medically screened on an annual basis. In addition, whilst in active areas, workers wear special disposable protective clothing and masks. In the case of ship breaking (compared to buildings-related removal), protection is necessarily even more stringent. In these confined and air-restricted working spaces, full face masks alone do not suffice. An independent clean air supply has to be carried, so full face power respirators have to be worn, as do full protective suits. As a result, individual workers are limited in the time they can work, typically to two hours with a one hour break, or one hour with a 30 minute break. As with other types of hazardous materials work, then, notably working with high level radioactive waste (Zonabend, 1993), asbestos' classification as hazardous impresses itself into the corporeality of the body that works with it. Second skins are donned, and then shed, and

breathing is both assisted and literally masked by the prosthetic of the face-nose-mouth mask. As an embodied material encounter, then, to work with asbestos is distinctive. Mediated through other materials technologies that protect both skin and lungs, this is an encounter through adjuncts. It is one in which separation between material and human co-presences must be sustained. Moreover, this same separation is maintained right through the task of removal to eventual disposal, in which sealed bags of asbestos-contaminated materials are placed in skips and then delivered to licensed landfill sites, where they are swiftly buried in special advance-prepared, dampened cells or trenches.

Such is the theory of asbestos removal as it applies to ship breaking in the EU. Along with the removal of oily wastes, it is the primary component of what is termed remediation work in the industry, and is a critical precursor to the real, profitable and value re-realising business of salvaging scrap steel. When talking about their work to outsiders, be these journalists, academics or NGOs, industry representatives typically describe ship breaking in terms of a standard three stage sequence of activities. Initial preparation (removing all remaining fixtures and fittings) precedes remediation (asbestos removal, oily waste removal) and then cutting. The talk here is consistently framed in terms of a progressive chain, in which materials removal marks the visible reduction and eventual disappearance of a vessel. Occasionally, this narrative is accompanied by materials flows diagrams. These focus on the bounded space of the yard and emphasise separate materials, their safe containment, and the controlled release of materials from the yard to sites of disposal and/or re-use or revaluation. Temporally and spatially ordered, these graphic and narrative representations portray demolition as a tightly orchestrated, well choreographed and temporally sequenced activity, as bounded and contained, and an activity in which materials control accompanies the

dissolution of the object. As we show in the next section, such stylisations are a long way from the messiness of day-to-day practice.

3: Demolition in practice: the messy work of remediation[2]

Sitting in Andreas' office in a ship breaking yard in the EU, Melania is told "we keep finding more asbestos." Andreas is admitting what we already know. Already, the project to dismantle a vessel is well behind schedule. The problems here are entirely bound up with asbestos. Melania has been visiting this yard now for almost a year. The vessel has been there for some nine months, slowly disappearing in front of us. But, remediation work is still on-going. In that time two asbestos removal companies have been contracted. Up until the end of the nine months we estimate that some 14000 hours of labour time has been dedicated to the task of asbestos removal, compared with 17000 hours of cutting time. This is not as anticipated. The previous year, Andreas – an experienced ship breaker with decades in the business – had visited this vessel as part of the pre-tendering process. Working from the ship's Green Passport – a document that provides an itinerary of contents and materials at the point of tendering – a Type 3 asbestos survey and a visual inspection, he had estimated some six months for remediation activity, predicted to involve some 20 – 40 tonnes of asbestos. The latter was offset against a yield projected at some 7000 tonnes of high quality scrap steel.

[2] Methodological note: the material in this section draws on 18 months of ethnographic fieldwork conducted by Melania Calestani and Helen Watkins in ship breaking yards in the EU in 2008/9. Both sets of fieldwork have involved repeated visits to yards and a mix of formal interviewing and informal conversations both on and off yard with workers, supervisors and managers; escorted work onboard vessels; still photography and video camcorder footage. All locations and persons have been anonymised. In line with previous work (Gregson, 2009), the representational tactic in this section is to write asbestos to presence through descriptive narrative. In so doing, the intent is to write in ways that make explicit the labour and time involved in acts of asbestos removal and to enact a respect that asbestos demands. Narrative enables this and also allows us to convey something of the folded and messy qualities of working with this material's removal. In this section consequently, the focus is on key moments in the fieldwork in which asbestos' effects were admitted. They occurred in offices and onboard the vessels, through business gossip and over dinner tables and are an indication of the high levels of access that inform this paper.

But this vessel has been a constant surprise and a challenge to break up safely. "The asbestos is everywhere", says Andreas. It is not just where the survey says it is but it is elsewhere too, underneath surfaces, behind pipe work, invisible until discovered and exposed.

Onboard the vessel, the ubiquitous presence of asbestos is even more obvious. Five months after commencing remediation work, Stephan – the supervisor of the contracted asbestos removal company – is escorting Melania round, showing her the problems and how asbestos is "everywhere", even in areas that they thought were "clean". Pointing to an area they had cleaned the previous day, and speaking in the unfamiliar language of English, he says:

> "I discovered this [asbestos contamination] yesterday and then he [another worker] discovered something else, in a space we thought was clean. And then they ripped that out and behind there they found a pipe. And that will go on and go on and go on, for sure." [Video footage, May 2008]

A few seconds later, it is the same message:

> "Now we did Deck 2. I know that when they have finished that's clean. Now we saw one pipe, so it isn't really clean. But there are so many pipes under it, next to it, above it, and when they take a little bit of it away it will be opener, and after a while you will see still more asbestos." [Video footage, May 2008]

So, for those who actually do the remediation work in Andreas' yard, asbestos morphs. In the course of the work inventories and surveys are put to one side. Demonstrated to be inaccurate, in that they show asbestos to be present in areas where laboratory tested samples suggest otherwise, and to suggest absence where asbestos is actually present (Figure 3), surveys are supplanted by visual inspection and experience.

Figure 3 about here: Asbestos on board: presence and absence (© Helen Watkins, The Waste of the World)

As Stephan says, "You see it; you feel it after years of experience – its, *hard* (his emphasis)."[3] So, it is the asbestos eye, experience and the actual work of removal that uncovers more and more asbestos. And if Stephan is uncertain he errs on the side of caution, saying "If I am thinking, then I think: 'To be sure it is better to be safe'."[4] Working slowly, safely, at a pace dictated by asbestos' presence, it is possible to see why this particular breaking is behind schedule, and that surveys and initial inspections can never be more than approximations of the extent, and therefore cost, of remediation work.

Andreas' problem with asbestos is by no means exceptional. In another office setting elsewhere in the EU, organisations anticipate encountering the same problem. The provisional nature of surveys is readily acknowledged in the talk of a consultant for the contracted asbestos survey company. In talking with Helen, an early remark is:

> "We have done the asbestos survey […] so they know where all the asbestos is, or at least where we think all the asbestos is. Obviously, on a ship like that it's very difficult to find it all […] any areas which were not accessed for instance, or are very hard, or extremely solid structures […] we will go back and check those out, because obviously we cannot see it all". [Interview, February 2008]

And again, in talking Helen through the deck-by-deck survey, the recurrent discovery of more and more asbestos is anticipated:

> "They [the removers] have got to strip out ceilings like this [pointing to survey] before they can get to what is probably a relatively small amount of asbestos … but they have got to be able to expose that first […]. You can't see the stuff if it is above ceilings. […] You see where that one goes off? That pipe goes off somewhere. It's in a corridor […] and it goes off somewhere. There's some ducting. It'll be a nightmare job to get at it". [Interview, February 2008]

As Stephan says, "you will always have this problem on old ships."

[3] Video footage, May 2008.

[4] Video footage, May 2008.

Immediately, what such talk does is to problematise ship breakers' representations of asbestos removal as a smooth, temporally bounded activity that precedes the real work of cutting. The task does not simply precede cutting. At best it occurs simultaneously. At worst, as here in Andreas' yard, its protracted nature means that it gets in the way of, or interrupts, the valuable and value re-realising business of cutting. So, in Andreas' yard there is no seamless temporal sequence of activities. Neither do we see a temporally differentiated flow in materials. Rather, what there is looks more like a punctuated, stuttering, yet constant trickle of asbestos removal going on, with the work of cold and hot cutting being temporarily halted by the necessity for further asbestos removal. What goes on in this yard, then, is not the smooth order of the plan or the talk, but rather the type of messy practice that is more accordant with John Law's arguments about economies and interference (Law, 2002a).

Law's arguments about economies, economics and interference are derived from studies of types of work which, whilst they are certainly increasingly subjected to economic concerns, are not perhaps quite economic enough. Located in an ethnography of a government-funded science laboratory (Daresbury) and a failed R&D project (the TS2 – Law 2002b), these are vanguard studies in what might now be termed the knowledge economy. In other words, they are (still) a long way from private sector business, be this in manufacturing, services, or disposal. Law's empirical focus is indicative of the STS perspective that shapes his work. So, although economies and economics certainly matter here, it is as calculative agents in a scientific context that spreadsheets are shown to work their effects. For all that, there are undeniable resonances between Andreas' statements about asbestos, and the Andrew figure in Law's study whose concern is a project that is behind schedule, made visible through a spreadsheet that highlights the shortfall in person hours dedicated to it. We explore these

resonances in what follows, showing in the process how the activity of ship breaking benefits from thinking through a slightly different version of interference.

So, when Andreas says that they "keep finding more asbestos", what exactly is he saying? At one level, literally as the sub-contractors mean, just that, and that the work is therefore behind schedule. At another level, however, we want to argue that this is a way of admitting, without quite saying so, that the economics has 'gone pear-shaped'. Extremely schematically, all market-driven ship breaking activities entail a basic economic calculation, in which the profit realised by salvage activities (principally but not exclusively from the sale of scrap steel) must exceed the costs of remediation work (primarily asbestos removal). However, given the time it takes to enact a breaking (in this case, a year or more), this calculation is always a gamble with markets. The primary risk is with the key salvage material, for the price of scrap steel is volatile, varying from a low of some $200/tonne (2001/2002) to a high of > $700 in late 2007/early 2008. Such variation is intimately tied to global steel production, and therefore to key trends in the global economy. Meanwhile, although figures are not readily available, it is stated in the waste management industry that the cost of asbestos disposal has increased. This is a function of the contraction in the number of landfills licensed to accept hazardous waste material (including asbestos) and hikes in the Landfill Tax consequent upon the EU Landfill Directive. At the time that Andreas bid for this particular vessel, prices for scrap steel were sky high and still rising. They more than gave him the necessary business margins to cover the estimated cost of the remediation work. And, indeed, plenty of scrap has already been sold from this vessel. But, to keep finding more asbestos is a worry. There are three primary causes for concern. First, a fall in the price for scrap means that Andreas will lose out on what scrap steel remains to be sold. Indeed, if things keep on plummeting the way they are, it may be difficult to even sell the stuff, which will cause a further problem in

stockpiling. Secondly, finding more asbestos highlights a problem with surveys. Specifically, it shows that surveys of complex vessels such as this one can never provide more than rough approximations of the amounts of materials present. In a sense, Andreas already knows this, for – as an experienced demolition businessman – he knows that one only fully knows what one has taken on once one makes a start on demolition. More conceptually, though, what this tells us is that surveys provide insufficient calculative agency. Thus, whilst they might look like typical calculative tools (e.g. spreadsheets, balance sheets, time sheets and economic models – see Mackenzie, 2004; Mackenzie and Millo, 2003; Mackenzie et. al, 2007), the calculation they perform with materials is only skin deep. Indeed, whilst they provide a schematic of materials present, there is always the potential for these materials to surprise and to exceed. Thirdly, and perhaps most importantly, when taken in conjuncture with the downturn in the market for scrap steel, finding more and more asbestos casts doubt on the economic viability of future similar projects. It suggests that, at least in the EU, asbestos can only be extinguished economically during upturns in the market for scrap steel, and that in the current market conditions (recession) complex vessels containing large quantities of asbestos may not be the most attractive business propositions.

The third of these points may well have a bearing on future practice, and particularly on whether Andreas chooses to tender for further vessels such as this one. More immediately though, Andreas' most pressing problem is to attempt to manage the effect on his bottom line of finding more asbestos. And it is here that we see that asbestos' presence does indeed exert effects; that it performs economically. Predictably, and in line with construction projects that run into projected cost over-runs, the quick-fix solution is to make changes to contractors. Such changes, however, can have effects, which are well-rehearsed in the subcontracting field. Extremely schematically, these effects are understood as follows:

cheaper labour, different labour, working practices which, although legal and licensed, are 'greyer', ditto disposal practices. Rather than cast a moral judgement over such developments, or see it as part of an inexorable tendency of capital to drive down costs (although it is, of course, just this), our point here is that asbestos' effects can bring about changes in how work is performed. It is, then, precisely because asbestos is not contained economically – because surveys aren't sufficiently calculative as a tool and because more and more of it keeps being found - that changes can happen with contractors. And it is because of these changes that how the work itself is done mutates. Asbestos' continued coming to presence, then, shows us that material is indeed performative in an economic sense; that it has effects, and that calculative tools (and those who manage them) struggle to manage its interference.

A further, and final, point about asbestos, surveys and calculative agency is thrown into relief by yet other conversations. Sitting in another office in another city in the EU, Nicky and Helen are told by industry regulators and auditors of how they went not just once but twice to check the asbestos remediation work occurring in another ship breaking site, because they could not believe what they were being told – or, more accurately, the discordance between, on the one hand, what the survey led them to believe and, on the other, material encounters on this site compared to the experiences in Andreas' yard. With both a survey and experience suggesting the potential, indeed extreme likelihood, of asbestos' presence in a certain location on a vessel (Figure 2), what happens when scientific monitoring and the evidence of the eye combine to state that asbestos is 'not there'? Auditors check, and double check, in an effort to convince themselves. Companies worry – have they missed something? And talk and rumours circulate. So much so that - even when breakings have been completed – these sites are still talked about in terms of asbestos' presence. The limits to calculative agency, the

consequent imperatives on surveyors to 'hedge' and materials continual capacity to surprise all conjoin here to translate asbestos from the material register to the discursive, and to let loose the metaphorical ghosts of fibres 'blowing in the wind'. As such, the performative character of asbestos in economies of disposal is shown to be located not just in material transformations and the animations they effect but in the classic locus of the citational.

4: Fibres extinguished: the treatments and technologies of asbestos destruction

Ship breaking yards such as Andreas' are a key site in the social and economic life of asbestos, as are other facets of the built environment, including houses, schools, factories and offices. It is in such sites that the physical transformations wrought in demolition, or – for that matter – repair and maintenance, move asbestos from the category of the inert, and therefore benign, to a hazard potentially unbound. The conjuncture between this physical transformation and the categorisation of asbestos as hazardous ensures that asbestos is moved in particular, well-rehearsed ways and trajectories. Removed in accordance with normative processes and practices, dampened and double sealed in 1000 gauge polythene bags, and placed in skips in Andreas' yard, asbestos is then transported by a licensed waste management company to a licensed hazardous waste landfill site, where it is buried in what is known as an 'asbestos cell' (Figure 4). Recently, as a result of a reduction in the number of

Figure 4 about here: Figure 4: Asbestos disposal in landfill[5] (© Viridor)

such landfills, the increased costs of disposal consequent upon the EU Landfill Directive (1999), and an EU legislative commitment to Integrated Pollution Prevention and Control and

[5] Note the water bowser on the right of the image, irrigating the asbestos cell, and the disposable suit and mask worn by the driver.

to Best Available Technologies (BAT), landfill has begun to be challenged as the disposal route for asbestos. As Downey and Timmins (2005) acknowledge, 'the formal adoption of any asbestos treatment technique as BAT will increase the pressure for a ban on asbestos landfill' (p 2). The same authors regard such an adoption to be a significant risk to businesses involved in handling large volumes of asbestos-contaminated materials. Such enterprises would include nuclear decommissioning sites as well as firms engaged in ship breaking activities. As a result, alternative treatment technologies for asbestos disposal are being actively considered.

The two primary alternative treatment technologies for asbestos disposal currently are vitrification and thermochemical conversion technology (TCCT). Both are described as destruction technologies. One impetus for their development is that 'landfill does nothing to reduce the toxicity of (asbestos) waste, with the result that there will always be a health risk should the material be disturbed at any time in the future (Downey and Timmins, 2005: 4). In contrast, both alternative technologies destroy asbestos fibres. In the case of vitrification, a plasma gun heats the waste to temperatures of > 1600°C, and melts it to form glass. The resultant glass is then crushed and can be re-used in low grade construction applications such as road building. TCCT uses chemical treatment (fluxing agents) and heat to re-mineralise asbestos. Asbestos waste is shredded and then mixed with proprietary fluxing agents. The resultant briquettes are then heated and cooled in a water bath. The process transforms asbestos fibres to non asbestos minerals such as diopside, olivine and glass. Its proponents promote it as a process that 'takes a hazardous product […] and converts it to an inert, non hazardous, non toxic product that resembles coarse sand/gravel' (Downey and Timmins,

2005, p 8). Again, the end product is envisaged as usable in low grade construction applications.

Of particular interest to concerns here is the claim that these two alternative technologies destroy asbestos fibres. In a physical sense this is true. But what we want to suggest is that the trace of asbestos' presence remains in these treatment technologies and their products, and that asbestos remains a presence in particular materials. TCCT relies on Transmission Electron Microscopy (TEM) to confirm the absence of asbestos fibres from its sandy/gravelly product (Timmins and Cahill, 2003). Timmins and Cahill's work with TEM discloses the presence of ghosts of fibrous structures in materials heated for 10, 20 and 30 minutes. 40 - 60 minutes of heating removes all visible trace of this fibrous structure. Higher resolution TEM imagery confirms that these fibre structures are proper ghosts – in material terms the fibrous shapes are re-mineralised. Whilst they also contain forsterite and magnetite, they are primarily glass. What the TEM imagery also shows, however, is that the glass is haunted by asbestos' presence. To fully destroy this presence – that is, to obliterate all trace of a fibrous structure – can only occur with significantly more heat. To use more heat, though, costs significantly more. The same problem of costs bedevils the vitrification technique. The plasma gun technology used in vitrifying asbestos is only effective when applied to a small area of materials. Its materials throughput therefore is small, meaning that the energy costs of transforming even small amounts of materials are high. These problems are compounded by the requirement that materials be reasonably constant in their chemical and physical properties. Given that asbestos is removed in such a way that it will inevitably contain other materials (fibre glass, glass wool, plastic, iron, cement …), and that the costs of further materials separation would be prohibitive, the only means to achieve the necessary materials consistency is to restrict the materials flow rate. Consequently, the processing costs of

vitrification are prohibitive: £540 – 980/tonne, particularly when compared to an estimated £70 – 150/tonne for TCCT (Downey and Timmins, 2005).[6]

Figures such as these typically concentrate minds. They remind us that materials transformation costs, and that costs are high, often very high indeed, when it comes to transforming materials from the hazardous to non-hazardous state. Indeed, factoring vitrification and TCCT through a full Life Cycle Analysis adds further to these costs, with very real questions being raised about their value in relation to the landfill disposal option. Perhaps of greater concern still is their product. In the case of both TCCT and vitrification, transformation results in a product whose only current use is as a very expensive aggregate, suitable for low-grade construction. At a cost far in excess of other alternatives, creating markets for this material is going to be challenging. Notwithstanding that it has been physically destroyed, and therefore transformed, asbestos continues to exert its effects, in the economic costs of its fibres' elimination.

5: Conclusions

By way of conclusion we make three sets of points: we reiterate the performative qualities of asbestos fibres and the importance of materials in general to enhancing understanding of performative economies; we highlight the significance of demolition as an activity to contemporary debate in the social sciences, and we consider how a focus on asbestos contributes to the emergent debate on vital materialisms (Bennett, 2004a, 2004b; Hawkins, 2006, 2009).

[6] The comparable figure for landfill in 2005 is £140 – 180/tonne, exclusive of transportation costs (Downey and Timmins, 2005).

The paper demonstrates clearly both the obduracy and the performativity of matter. Asbestos is performative. The capacity of asbestos fibres to become free-floating once disturbed, their capacity to be inhaled by living bodies, and their capacity to lodge in lung tissue are all examples of the ways in which asbestos asserts and captures the human. And it is precisely this known capacity that is recognised in a politics of occupational health, which works to adorne the asbestos working body in the EU in particular ways, to choreograph the work of asbestos removal in specific ways, and to constitute asbestos remediation work through discrete spatialities. But, as has been shown, asbestos' capacity to remain hidden, and to keep being disclosed in the course of demolition work, means that its presence is disruptive. More specifically, these qualities interfere in calculative projections and the tools that produce and manage these. They destabilise these, questioning their authority, their claims to know this material and their calculative agency. And, precisely because asbestos interferes in these ways, it signals a more general point, that material like asbestos performs economically. Paying attention to asbestos indicates just how much the presence of particular materials can impinge on and disrupt the logic of specific economic projects. In turn, this forces us to acknowledge that economies are not at the command of the human and that there are multiple capacities at work in economies, if we are but sufficiently open to see them. Nonetheless, the power of matter is not universally constant. A key point that emerges from this paper is that the performativity of asbestos varies in relation to particular material states. Asbestos is innocuous as cladding on pipes, deadly when it conjoins with air as airborne fibres, and innocuous again when encased in polythene wrap and buried in a dampened cell, or when conjoined with glass in vitrification. Furthermore, its performativity only asserts economically when interventions are to be made in particular forms – for example, when repairs are done or, as here, when objects are dissolved. Paying close attention to asbestos, then, shows that material properties are not fixed. Rather, they change in relation to states, the

interventions made and the transformations wrought. Yet these same properties are themselves generated by the conjunctures of materials and human activity – fibres with air, fibres with tissue, fibres with paint, fibres with plastic, fibres with water are all fluxes constituted in association with the human. Asbestos, then, affirms Ingold's (2007) point, that materials should be thought about in terms of processual and relational attributes that emerge in the flux of substances and the medium that surrounds them.

Demolition emerges in this paper as one such state of flux, as a human-orchestrated re-meshing of materials in the world, and as an activity that is as important to the social sciences as the more familiar couplet of production-consumption. With the exception of Byles' (2005) cultural history, demolition has not been considered empirically. The ethnographic work reported here goes further. It shows demolition to be both multiple and a singular meta-practice. As a singular activity demolition is about the purposeful reduction of large scale objects, to the point of their disappearance and invisibility as objects. In demolition the thing is unmade. It is, therefore, about the dissolution of form. Dissolution is achieved in parallel with the reanimation of materials. As with recycling, such interventions are crossing points in Jane Bennett's terminology. But demolition goes further than thinking through thing power. Thinking demolition insists that we think beyond the object or thing. It suggests that we see objects as assemblages of material made stable. In this respect, a focus on demolition reiterates the purchase of Ingold's argument, that it is material that matters, not materials made things. For here, in demolition we see the re-emergence of all those materials that have never gone away but rather have been masked, stilled and stabilised by the object form. End-of-life ships become steel, oil, wood, gunmetal, asbestos … A thing made absent through materials. A thing that shows unequivocally that "no object lasts forever […] and that materials always and inevitably win out over materiality in the long term' (Ingold, 2007 p

10). But demolition is also multiple. Specifically, it is simultaneously about the practices of salvage and remediation. A host of other micro practices is subsumed within these broader practices, many of them occurring concurrently. Cutting, ripping, tearing, reducing, shredding, compressing, wrapping, moving, sorting, separating … And it is through some of these micro practices with materials, which together work to co-produce salvage and remediation, that asbestos is reanimated.

To elevate salvaged materials to the neglect of remediation work, as work on vital materialisms has done thus far, has therefore been to overlook that materials transformation is as much about remainder as it is about salvage (Gabrys, 2007), and that the two activities go hand-in-hand. Yet it is, perhaps, through the ways in which it underscores the ethical implications of remainder that asbestos provides most 'food for thought' for the emergent debate about vital materialism (Bennett, 2004a, 2004b; Hawkins, 2006, 2009). Asbestos' most poignant contribution to thinking about a vital materialism is its co-presence within a human body with asbestosis, struggling to breathe, and the horrible, drawn out, lingering death of mesothelioma. In this regard, the question asbestos puts to a vital materialism grounded in enchantment is 'Is it possible to be generous to material which threatens human life and which is known to kill?' Our answer to this question is a qualified 'Perhaps', for what asbestos tells us is that materials require an ethics of respect. The history of the magic mineral is one which shows a ghosting effect: the material whose contemporary removal and disposal is so problematic yet whose removal is such a ubiquitous co-presence within the twenty-first century built environment of the EU is the legacy of previous generations' quest for a material that provided insulation and also protection from fire. Asbestos' history, then, is a noble one but one that teaches us that humans can never fully know what they are doing when material co-presences are manipulated, and that there will inevitably be unintended,

material consequences of any intervention or transformation in materials arrangements and associations. This is one of the implications of admitting capacities beyond the human. But what the paper also shows is that materials continually have the capacity to surprise humans. Those involved in ship breaking, be they surveyors, managers, supervisors or labourers, think they know where asbestos is. But the stuff keeps on turning up in unexpected places, manifesting itself in places that have been designated as 'clean' or absent of asbestos. It turns out not to be where it is anticipated, and it haunts those sites where it has been. What this tells us is that built or fabricated objects are, in a sense, an inexhaustible source of material surprise. They are, therefore, always open to exploration. Without doubt, this capacity to surprise is a source of immense frustration for many of those involved in the activities discussed in this paper. As such, this shows that surprise is not, as Jane Bennett argues, necessarily the stuff of delight, and that surprises can be less than enchanting, nasty and certainly costly. Perhaps what is needed here is to mesh surprise with the humility that comes from a proper recognition of materials co-presence? Bennett begins to recognise humility's import when she writes of 'the principle of treading lightly on the earth' (2004: 157) and of modesty and 'limits in the capacity of human agents to know exactly what they are doing when they manipulate the world in which they participate' (ibid, 157). The legacy of asbestos however suggests rather more is needed than just humility. Materials like asbestos certainly require humility conjoined with a responsibility towards materials care, and they require a responsibility that transcends generations and human life spans. But the lesson from this paper is that they also demand a responsibility that admits the capacity for humans to be endlessly surprised, not just by thing power but by materials and their endless capacity to mesh differently in the world. The implication of this last point is considerable. Sequestration – the 'safe' containment and burial of asbestos as 'hazardous waste' – emerges here as no final 'disposal' solution but rather as a temporary stilling and stabilisation of a material that

has not gone away. It is, then, a reassertion of materiality over material. Down the line, though, inevitably, this material will surprise, again. The question is how, and in what ways. Whilst it is impossible to answer these questions, admitting them is a necessary first step in developing an ethics of respect of the type materials such as asbestos command.

It is for all these reasons, but particularly for its capacity to underscore the importance of materials to a performative economy, for its capacity to show that materials vitality is not fixed but processual, relational and distributed, for its capacity to insist on the importance of remainder alongside salvage, for its insistence that remainder will always surprise, and for its demonstration that the built environment and its 'unbuilding' is a source of endless surprise, that it matters to pay attention to a material like asbestos and to salvage the activities of demolition from the scrap heap of cultural economy.

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