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Geographies of making: rethinking materials and skills for volatile futures

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Keywords
rethinking, materials, skills, volatile, futures, geographies, making

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Keywords

Skills, manufacture, materiality, craft, climate change, industrial cultures

I Introduction

Making is fundamental to our being - as humans we make bodies, homes, identities and memories every day. As a society we make landscapes, cities, decisions and structures for governing. And in daily work, the stuff that surrounds us is made. Successive decades' focus on financialization, digital technologies and the 'knowledge' economy has nevertheless muted discussions of the ways the material world is produced (Kinsley, 2014). And yet of course, across the world, millions are still occupied making material objects. Meanwhile the rise of 3D printing and smart robotics, increasingly complex commodity chains, and shifting labour processes all suggest a radically reconfigured world in which the things around us come to be via challenging methods and routes (Bryson et al., 2008; Birtchnell and Urry, 2013a, 2013b). Such shifts in the sites, means and methods of production alone demand intense scrutiny. In this article, we seek to shift the focus even further, onto the making that produces the physical world around us, suggesting new – and urgent – research agendas, for geographers concerned with making amidst increasingly volatile environmental futures. Our argument is that ecological crisis demands more, rather than less, attention to materials and making processes that constitute our world – in ways that build upon but push beyond existing political-economic frames.

A focus here on making as a cultural and economic process is a deliberate attempt to reframe some of the more orthodox thinking about economy and society – where the presumption has been that a broad shift in the character of the contemporary economy has both euthanized manufacture in the Global North, and excised material production from tasks of design, intellectual property and marketing (Berger, 2013). That shift arguably first emerged with the demise of the guild system, where early industrialists argued that innovation was being constrained by the dominance of carefully guarded oral and haptic methods of skills transfer – and thus separated intellectual functions from material production, social and spatially (Vercellone, 2007). It gathered pace in post-war industrialized countries where capitalists, in efforts to fragment and extract maximum value from labour, reorganized modes of production – and the shop floor – to separate 'mind' tasks (design, finance) from 'body' tasks (assembly, manual

fabrication) (Guéry and Deleule, 2014). In time the embodied tasks of manual labour were typecast as repetitive and even demeaning, while the mind tasks became associated with higher levels of education, skill, economic value and intellectual satisfaction.

Beyond such generalizations, the relationship between manufacturing and other fragments of capital has become even more complex and often confrontational (Weller and O'Neill, 2014). In the Global North, twenty-first century financialization processes have either stopped the making, or placed it elsewhere. So persistent is the binary of 'old' and 'new' economy (Ettlinger, 2008), and associated dialogue around shifting to a post-industrial future, that making has arguably entered a realm of shame. Depictions of this popular narrative arc draw variously on images of the maligned cities of the US rust belt (Wilson, 2007) or scenes of despondent manufacturing workers filmed leaving their workplaces after the announcement of yet another factory closure (see for example http://youtu.be/cOTSHQ8fby4). The implicit suggestion is that material knowledge and work is increasingly peripheral to the formal economy. Places with strong industrial histories see manufacture as a burden of the past to be jettisoned through place marketing campaigns or creativity strategies (Hudson, 2005; Barnes et al., 2006; Curran, 2010) – or they are simply blamed for their perceived 'failure' (Peck, 2014). Meanwhile changes to city morphology and increasingly complex and opaque international commodity chains results in production, once visible in the built fabric of cities and towns, becoming 'black-boxed' or moving away entirely.

Yet, material production remains persistently central to human life. Making material things continues to drive global resource extraction and export, processing, manufacturing, logistics and container shipping (Bridge, 2009; Rossiter, 2014; Urry, 2014), and remains a fundamental component in the labour process that shapes the material sites and relations between capitalists and workers (Gough, 2003). Material things are central to what many think about as 'quality of life' (furnishing people with comfortable homes, clothes and personal goods). For those in dire socio-economic circumstances, material products – food, shelter, clothing, medicines – remain the

scarce means to survival. Counter to discourses of ‘resource triumphalism’ (the idea of humans transcending the limits of natural resources) physical making and the moving around of finished goods fuels resource- and carbon-intensive transformation of the biophysical world (Bridge, 2001). We would argue that rather than becoming increasingly marginalized and redundant, the ability to work with materials, and to make, repair or repurpose physical things are vital skills, for a future where such resources become increasingly limited, and extreme events related to a shifting climate are more common.

Against the *mise-en-scène* of industrial decline in the Global North, an almost counter-cultural renaissance in small-scale making has emerged, often within industrial cities and regions where manufacturing and urban industrial heritage confers authenticity (Curran, 2010; Causey, 2014). In this world, re-connections are being forged with themes such as quality, providence, craft, ethics, tacit design knowledge, haptic skill and the value of physical labour (see also Adamson, 2007; Sennett, 2008; Gauntlett, 2011; Crawford, 2009; Charny, 2011; Hatch, 2013). There are many geographically situated contributions to these studies. They include an examination of worker agency (Warren, 2014), practices of repair (Bond, DeSilvey and Ryan, 2013; Gregson et al., 2009), intersections between craft and the creativity discourse (Banks, 2010; Jakob 2013; Luckman, 2015), expertise and gender (Warren, 2015), and scrutiny of the role of craft enterprises and contemporary guilds in producing the region (Thomas et al., 2013). We share such interests, but here also seek to transcend a historically recurring binary, where small-scale 'craft' traditions (cast in the mould of pre-Fordist artisanal production) are pitted against large-scale ‘manufacturing’. Rather, as we argue below, across the full spectrum of ‘making cultures’ are suggestions of sensibilities and dispositions that are centred on a deep and considered relationship with materials.

In the remainder of this paper, we aim to build a case for a sustained, reflexive and critical approach to geographies of making across three analytical perspectives. First, we define the contours of a necessary shift beyond the binary of small-scale ‘craft’ and large-scale

'manufacturing' to a focus on making (as disposition and practice across and within both scales and modes of production). Second, we trace a path through a diverse literature that explores connections people have forged with materials through processes of making. This trajectory aims to pull together a collection of thoughts from an epistemic community whose perspectives bring together the vitality and capacity of the material world, with legacies of human skill and creativity. Third, we negotiate the fraught relationship that has emerged between industrial cultures of making and climate change. This, we argue, has been narrated into an un-productive (and ultimately false) counter-position in which industrial workers are positioned as part of the problem, rather than part of a solution. We conclude by suggesting that questions of making are much broader than either a craft revival, or economic geographies of manufacturing, and are necessarily deeply entwined with ontological and political debates of what kind of society we wish to become, how we might make and re-make amidst environmental crisis, and thus how humans relate to, transform and are transformed by the wider material world. Makers – within and across craft and large-scale manufacturing – must secure a key voice in these debates.

II From manufacture versus craft, to cultures of making

Let us be clear at the outset what this paper is not seeking to achieve: it is not intended as an appraisal of craft modes of production (cf. Adamson, 2007; Sennett, 2008). Nor is it a review of the shifting economic geography of industrial manufacturing (see instead Daniels and Bryson, 2002; Gough, 2003; Ettlinger, 2006, 2008; Weller and O'Neill, 2014). Rather we focus quite explicitly on *making,* and potential future research agendas within the context of urgent ecological change. The semantic and ontological shift from manufacturing or craft, towards making, is an attempt to reframe debate about 'economy' (Massey and Rustin, 2014), and to capture the need to move onwards from the modern capitalist paradigm of profit-driven, high throughput production of physical things, towards other ways to furnish humans with material comforts.

Prior to exploring geographies of making, it is nevertheless important to acknowledge complementary advances in the respective literatures on craft and manufacturing. Research on

craft has explored dynamic (new) relationships between individualized and collectivized forms of production and consumption. Crafting often reconnects ‘mind’ and ‘body’ in the sites and processes of production, therefore potentially reconstituting labour process in ways that ascribe agency to workers (cf. Coe, 2013; Guéry and Deleule, 2014). In multiple spaces of craft making (at home, in collectives, in community maker spaces) researchers have documented possibilities for makers to resist norms of gender and neoliberal entrepreneurial subjectivities – findings ways and spaces for ethical practice to predominate (Moloy and Larner, 2013; Morrow 2014). Across the commercial/noncapitalist divide, maker cultures celebrate forms of proximate sociality (being strongly network-based, and emphasizing ‘community’) and forge closer connections between producers and consumers (Warren and Gibson, 2014). Craft makers appreciate provenance of input materials, and emphasise the value of human skill embodied in high quality things made to last, intended as ‘heirlooms’ (Rexrode 2014). Greater degrees of material self-sufficiency stemming from craft practice and DIY culture also promotes autonomy outside of conventional governance modes (Pickerill and Chatterton, 2006), and thus informs localized responses to climate change framed around resource preservation and stewardship.

Nevertheless, where crafting and hand-making cultures grow beyond immediate use value, towards a commercial imperative, ‘pleasure and self-fulfillment are often exchanged for what might otherwise be felt to be unstable, precarious, and even exploitive work’ (Dawkins, 2010: 261; see also Luckman, 2012; Barnes 2014). Where profit motive reigns, the result is less a radical restructuring of the workplace and more a reconstitution of petite bourgeois modes of production. While crafting cultures provide genuine alternatives to high-throughput commodity production and consumption, associated discourses of ‘handmade’, ‘crafted’ and ‘bespoke’ have all too easily become appropriated as marketing buzzwords by companies selling conventional products (from soft drinks to sneakers), which are made in conventional ways that do nothing to challenge the status quo. Meanwhile categories of artisanal expertise are situated and gendered in ways that reproduce lingering hierarchical legacies (Herzfeld, 2004). Such tensions and contradictions have endured through several cycles of revival since the emergence of the Arts and Crafts movement

over a century ago (Lears, 1981). Then a radical emancipatory response to the alienation of factory labour, craft production was deftly relegated to leisure time and its objects rendered a source of elite consumption, when it became clear that the structural conditions that divided the affluent from the poor were insurmountable.

We also acknowledge the importance of critiques of the political economy of manufacturing within the capitalist space economy. In this regard, like Cook (2004), we are inspired by David Harvey's (1990: 422) call for radical geographers to 'get behind the veil, the fetishism of the market', to 'make powerful, important, disturbing connections between Western consumers and the distant strangers whose [making] contributions to their lives were invisible, unnoticed, and largely unappreciated' (Cook, 2004: 642). The things we make and use in life are core to this. Accompanying political economy, our agenda is to suggest existential reassessment of how we could approach making differently, incorporating anthropological and cultural perspectives on a broader set of material practices amidst volatility (Ingold, 2010). In other words, within a moment of profound material crisis (and emboldened by the notion of Anthropocene), we wish to look beyond existing modes of industrial production, towards opportunities to revisit fundamental questions of how humans manipulate materials, compose objects and construct economies and societies around material things – as well as how this might be done differently.

Within the traditional manufacturing sector the mood is becoming more open to such debates. A half-century of international economic restructuring has seen manufacturing subject to, amongst other things: the removal of tariff protection; offshoring and subcontracting of production in ever more diverse countries in search of cheap labour for exploitation; replacement of highly skilled labour with mechanized equipment; re-scaling of state-capital-labour relations, and sharper divisions between design/knowledge/managerial control and manual/repetitive tasks undertaken by exploited (frequently female) labour (Burawoy, 1986; Gough, 2003; Wright, 2006; Rutherford and Holmes, 2014; Urry, 2014). A high-throughput model, premised on financialisation, subcontracting, economies of scale, offshoring, mass marketing, ever-increasing consumption,

disposability and cultures of rapid replacement, has successfully furnished consumers in the Global North with endless cheap products (with no real clue as to their provenance), and it remains the default for global manufacturing capital.

Yet all of this is looking more and more like a historically contingent phase in the *longue durée* of capitalism (Vercellone, 2007: 32) – a relatively brief period since World War II in which the promotion of manufacturing and mass consumption served governmental rationalities of prosperity and compliance (Birtchnell, 2013). There is a degree of re-shoring and revival in industrial heartlands (and associated critique – see Ettlinger, 2008; Hatch, 2013; Bailey and De Propris, 2014; Christopherson et al., 2014; Greco and Di Fabbio, 2014). Moreover, a growing sense of looming ecological and economic crisis is premised on recognition that the modernist model cannot be sustained, or will collapse regardless under the weight of climate-induced economic crisis (Gilding, 2012). Making is inextricably tied to these debates in terms of embodied energy and emissions in physical production of things. There is increasing recognition of the need for both producers and consumers to act as stewards for materials and finished physical commodities (Lane and Watson, 2012). Belatedly, stronger regulation is catching up with whole-of-life management of materials to minimise waste, and auditing techniques are revealing the fuller contours of emissions linked to physical production of goods in offshore locations for rich consuming nations (Bergmann, 2013). Although there are no clear theories (yet) for how capitalist nation-states might be transformed as a consequence of planetary climate change (Wainwright and Mann, 2013), it is impossible to imagine the long-term viability (in either economic or environmental terms) of complete offshoring and endless, unregulated high-throughput production.

Moreover, precipitating a conceptual shift from manufacture to making have been transformations in manufacturing itself. The idea of manufacture as a discrete, stable and segmented component of the contemporary economy no longer stacks up against increased complexity, dependence on massive and sophisticated circuits of resource extraction, logistics management and financial

capital (Bridge, 2009; Bryson and Ronayne, 2014; Weller and O'Neill, 2014). Some forms of material manufacture are now governed by the logics of design and advanced materials engineering rather than cheap mass production – reconnecting 'manual' with 'mind' tasks and personal relationships between makers and purchasers (Bryson et al., 2008; Hatch, 2013). Complex subcontracting arrangements (not just for low-cost assembly, but for prototyping and resource recovery and recycling), the rise of additive manufacturing, and increasingly blurry boundaries between design, services, place marketing and making have all fragmented and challenged traditional notions of factory production (Daniels and Bryson, 2002; Rusten et al., 2007; Bryson et al., 2008). In his best-selling book *Makers* (2012: 127), Chris Anderson describes the many 'advantages' that the touted 'new industrial revolution' promises for industries like car production, including a democratization of design and production processes through open source models. New designs can be brought to market through such democratized and distributed maker-models 'faster, cheaper and better than the conventional way of small teams working behind closed doors'. But for all the enthusiastic emphasis on innovation, prototyping and new production models, assembly line production still persists for a huge range of consumer goods, albeit often further from view of those who purchase them. Pursuing geographies of making therefore enables consideration of diverse forms of manufacturing at a range of scales, but does not limit analysis to a singular industrial process or sector.

Moreover, making pays attention to the lives of materials that transcends their configuration as things or objects at a singular point in time (Cook et al., 2007; Gregson et al., 2010; Ingold, 2010; Hudson, 2012). The specificities of commodity form and biography, as well as details of assembling and manipulating materials, deeply shape the labour process (Gough, 2003), but also extend 'upstream' and 'downstream' beyond manufacture to shape particular geographies of material resource entanglements as well as spatially variegated consumption cultures (Fine and Leopold, 1993; Castree, 2004; Cook, 2004; Molotch, 2005). And, as the cases of food processing, plastic packaging, coal and oil demonstrate, what exactly constitutes 'manufacturing', and how this relates to routes of extraction, processing, mobility and consumption, has become much

more open-ended, semantically, ethically and ontologically (Atchison et al., 2010; Hawkins, 2011; Mitchell, 2011). Meanwhile new reconfigurations of business activity in repair and maintenance, resource recovery and waste management have blurred boundaries between manufacture and green services.

Making as the central practice under investigation provides a more multivalent point of entry. Unlike both craft and manufacturing that come with their own baggage, 'making' almost defies precise definition. One starting point is the composition and/or manipulation of materials that brings into being new or revised objects. Focusing on making means being able to consider who is doing the making, as well as materials, their skilled manipulation, circulation, redeployment, and their agency, in the same breath across a much wider set of spaces and circumstances. Heterogeneous cultures and sites of making emerge into clearer view, including industrial modernists, but also antimodernist vernacular and noncapitalist making (Luckman, 2013; Morrow, 2014); domestic craft production (Barnes, 2014); creative material manufacture (Sennett, 2008; Luckman, 2015), and high-tech fetishists (Birtchnell and Urry, 2013a) – as well as cultures of thrift and scavenging (Lane et al., 2009); maintenance and repair (Graham and Thrift, 2007; Gregson et al., 2009; Bond, DeSilvey and Ryan, 2013); and recycling (Crang et al., 2013; Gregson et al., 2013). Making also broadens the scope of inquiry beyond the archetypal craft or industrial worker in the Global North, to acknowledge the plethora of extraordinary creative practices being performed by those outside the west, either in waged work, or from sheer necessity, without a hint of counter-cultural aesthetics or nostalgia. For instance, making encompasses the ingenuity of fluid, locally situated and adapted technologies (de Laet and Mol, 2000), and disassembly of things as they flow 'down the value chain' from the affluent to be appropriated elsewhere (Gregson et al., 2010), making objects of profound use value from otherwise 'worthless' things (Klocker and Mbena, forthcoming). The palette of diversity signals the kind of broader debate – with all its political-economic, philosophical and cultural dimensions – that we wish to promote.

III The social life of making

Making speaks in vivid dialogue with two associated themes: material and skill. Normative ideas about how making proceeds tend to focus on bringing skill to bear on material (cf. Sennett, 2008). For Tim Ingold, this represents a problematic hylomorphic model, where making is the imposition of pre-conceived form – *morph* onto matter – *hyle.* In this model, an artefact is simply the materialization of a thought that pre-dates it (Ingold, 2013). Further, the matter from which things are made is rendered neutral and pliable, inanimate, and somewhat homogeneous. Yet matter, as Bennett (2010) has persuasively argued, is clearly none of these things. Rather, matter and materials are lively and require attention. Materials continue to thwart in unpredictable ways: decaying and breaking down, or wearing or breaking under force. Re-interpreted in this context, making becomes an informed study in compromise, with the skill of the maker a mediating factor, and decay a force for a 'collaborative interpretative ethic' beyond entropy (DeSilvey, 2006). For Ingold (2010; 2012; 2013), attending to the process of making opens up prospects for following the lead of the material, where the properties of the materials themselves shape the direction in which making proceeds. Increased familiarity with materials results in a more flexible understanding of its bounded form and porosity of surface (Paton, 2013:1077). A maker following this path performs a series of negotiations and concessions with the material, working within a realm of possibilities that are afforded by its particular properties. Those possessing the skills and inclination to repair, re-use and recycle the materials around them would likely regard this approach as a given.

Following materials in this way calls for a more productive view of the concepts of failure, error and adjustment, where these are considered vital to the process of making, rather than obstacles to be overcome (Crawford, 2009). Under such conditions, making becomes a process of iteration, and a maker works with this iteration prolifically. When the material pushes back, resisting the way it is being handled, a maker tries a different way. The material offers no reflection on ability in this moment; it is just an efficient way of working. Conceiving of making in this way compels

renewed respect for the liveliness materials bring to the process (cf. Bennett, 2010). Making becomes a material conversation – a physical provocation and a response, iterated over and again, working with the material to understand its capacities, analyse error and make adjustment.

Ingold further extends this thinking by drawing a distinction between material iteration and itineration. The latter, he proposes, allows for 'continual correction, in response to an ongoing perceptual monitoring of the task as it unfolds' (Ingold, 2006: 76). Here space is made for improvisation in the face of changing context, acknowledging that things do not come into being in a physical or temporal vacuum. More simply, 'makers work in a world that does not stand still' (Ingold, 2010: 93). In such contexts, 'creativity' involves not merely a spark of innovation or the execution of artistic inspiration, but the capacity to respond to unfolding iterations with materials, to use slowly accrued haptic knowledge to manipulate processes on the fly, and to judge how to counteract error and seize opportunities as they evolve. Such conceptions of creativity encompass 'expert' making (as governed within guild and formal apprenticeship systems), but also unheralded acts of adjustment with routine production, and diverse and prosaic forms of material manipulation and repurposing among the poor (cf. Wilson et al., 2006; Wilson and Keil, 2008; for lively examples, see also www.mkshft.org).

Iteration (or itineration) also gives scope to re-think how the idea of reinvention is applied to things in everyday life, and implications for the way things are made. In the hylomorphic model, once making is complete, the 'ontological labour' has long been done and is not revisited. Something new has been brought into existence and the world is re-ordered around it. But in conceiving a world where both materials and the processes of making are given more emphasis, iteration becomes a way of working the potential for mixing, blending or combining matter that already exists in new combinations (Edensor, 2011). The capacities of materials to be redeployed, and of humans to perform the requisite labour, become more explicit. An assemblage of old and new materials, methods and techniques can be productively drawn together. Those who prefer to work with their hands would appear to sit comfortably within this world.

Collecting is an example of a pre-emptive activity that people who are skilled with their hands commonly share. In an extended ethnography of skilled tradespeople working in steel production (Carr, forthcoming), participants talked about saving encountered materials, knowing that one day they would find a use. Practices of collecting were revealed in sheds full of discarded motors, pulley systems, garden pots, broken chairs and assorted sheets of steel, timber and plastics. These items would normally be considered rubbish, but to those who have the skills to resurrect them – cutting, folding, welding, connecting – they are only ever temporarily resting, waiting for a use to arise.

Collecting assists us to see potential in situating everyday things within the kinetic world that Heidegger describes in the 1939 essay, 'On the essence and concept of *Phüsis* in Aristotle's *Physics B I'*. The things that are made (as an outcome of *techné*) are easily taken for granted because they are 'finished', and thus it is easier to dispose of them, rather than to repair or remake them (Tonkinwise, 2003). At pains to distinguish between these 'made' things and *phüsical* things (which reside in the natural world), Heidegger draws on Aristotle's term *entelecheia* to describe the way a *phüsical* thing is always evolving or moving, yet always remains itself (Heidegger, 1939 in McNeill, 1998: 217). A tree for example never stops becoming (growing), yet it is always a tree. Such *phüsical* things (like trees) have not 'made' themselves, nor have they been made, they just are. But their movedness contrasts with the perception of 'finishedness' (and stability) that accompanies artefacts brought into being through making.

The distinction becomes important when we consider how the process of making draws on materials of the *phüsical* world. A table – to use Heidegger's own example - is made from the timber of the tree, but only becomes recognizably a table when it is completed, 'wherein the generating of the table – the movement – comes to an *end'* (Heidegger, 1939 in McNeill, 1998: 217-218; see also Bower 2009). Heidegger described this 'made' world of everyday things as ready-to-hand *(Zuhandenheit)*, where the focus is on the performance of an action, rather than

the things themselves, which become invisible. Everyday life is enacted through these invisible things whose becoming has 'ended'. Further, consumers increasingly distanced from the sites and methods of making tend to forget their becoming or their making – of course until they fail. The 'invisibility' of the (finished) world-at-hand, conspires with a growing inability and disinterest in how things are made (and consequently how they are repaired). It thus becomes easier for affluent consumers to leave in their wake a trail of broken, empty, forgotten things while continuing to seek out more. Tonkinwise (2003: 9) argues that by attending to the remaking of things – and to the retrieval and repair of things that already exist (like the collectors in the example above) – an opportunity exists to sustain what is made through its 'changing ways of being'.

Unfortunately, contemporary design has taken making in other directions. As Anusas and Ingold (2013) point out, the formal language of design has notably shifted to a space dominated by the smooth and opaque surface. Such impenetrable surfaces make it easy to forget that the materials from which it was made are kinetic, that it is their will to decay or change state (Paton, 2013). Hitchings (2006: 368) argues a similar line from a different perspective: that materials can only ever be partially harnessed or 'cultured' – 'sooner or later their individual physical propensities are sure to come to the fore'.

Here, instructive insights can be gleaned from maker cultures where skill, knowledge relation and lived experience derived from working with organic material resources are unique. As the traditional practice of Hawaiian wood crafting literally testifies, makers see canoes in trees, for example (Gibson and Warren, 2014). Further, among makers *techné* is as much sustained through embodied and emotional relations with the material world, as through accumulation of rational manipulations. The visualisation of potential in materials, and the gathering of this information through haptic relations is part of the making process – implicating the *phüsical* world more directly in the things around us.

It is useful at this point to consider how a revaluation of making might be expanded to blur boundaries with other material interventions, such as repair and maintenance. Within building construction, for instance, the term ‘make good’ is often notated on architectural drawings, to indicate to the builder where ‘patching’ or repair is required, usually to an older section of a building, so that it is functional and in keeping with its surroundings. In this context ‘make good’ is as much a smoothing of surfaces and a continuity of function, as it is restoration to a prior state. The builder does not distinguish between making and repair, but simply ‘bring[s] together what is needed to re-make whatever is at hand’ (Pink, in Bond, DeSilvey and Ryan, 2013). Such instincts to repair are quintessentially human: we feel compelled to repair not only the things around us, but also our bodies, souls and relationships (Spelman, 2002). ‘Making good’ - is about maintaining continuity with the past, in the face of efforts to rupture that continuity. As Graham and Thrift (2007) suggest, whereas we pay most attention to the need for repair after catastrophic or spectacular failure, repair is a remorseless and necessary process that keeps society ticking over.

A concern with continuity highlights another related practice that further confounds simplistic interpretations of making. Maintenance anticipates and negotiates the need to repair. Ingold (2013: 48) draws on the evocative thoughts of architect Alvaro Siza to convey how the making of a building does not stop when the building work is (temporarily) finished, but rather only really begins upon occupation, when the work commences of maintaining the building’s integrity against an onslaught of wilfully destructive elements – insects, rodents, fungal infestations, corrosion, damp, harsh sun, water, wind. The work of maintaining is central to many cultures of making – and is often included as a calculated phase of artisanal apprenticeship training in order to condition perseverance and establish authority (Herzfeld, 2004). Indeed, in Marxian terms, the labour time devoted to maintenance, repair, and fixing likely exceeds that for the making of the thing itself. Swanton (2013: 283) illuminates the rhythms of breakdowns and scheduled maintenance processes that accompany ‘the stuttering business of making steel’, a consistently invisible, yet critical element. Elsewhere the block-check routine performed in a multi-story

housing estate illustrates how the high-rise building is a living structure (Strebel, 2011), where inspectors perform a cycle of on-going problem-solving in maintaining and securing the building in the face of myriad disturbances. Such examples point to the resourcefulness that is critical to maintenance work, where human labour and ingenuity with materials are requisites of continuity in all kinds of contexts.

And yet, specificities of product type form, design and production process constrain abilities to exercise such ingenuity (Molotch, 2005). In the case of the so-called 'new industrial revolution', the argument is that the more software-driven a car is, and the more the physical car is conceived of as a kit of parts assembled by small collectives or even owners, opportunities to replace or upgrade components rather than the entire car become more readily available (Anderson, 2012). But what happens to the broken or superseded part – or to the computer chip at the heart of the object's performance, once the software updates are no longer compatible? While a shift to swap-in, swap-out componentry changes the scale (replace the part not the car) and site (at home rather than a big factory) of intervention, such processes offer limited scope for variation or innovation, for improvisation or 'hacking'. A future where repair and maintenance become redundant in favour of replacement entirely misses the point.

The respect makers have for the vitality of materials offers instead a renewed opportunity to consider one of the critical challenges of climate change: doing more with less. While environmental critics have been otherwise occupied with the mistakes of the modern paradigm and the surplus of stuff that has resulted, those who make things – and who have the skills to sustain the life of something, through repair and re-appropriation – have been overlooked. Across diverse maker cultures are people *already equipped* with the sensibilities and disposition to conceive of things-at-hand as only ever temporary gatherings of matter and idea, which can disperse and be reassembled elsewhere in new combinations. In the following section, we expand on why it is absolutely imperative that the experiences of those who make things become part of the debate on shifting to a less resource-intensive future.

IV Making room for making in responding to climate change

Debates about how to reframe 'economy' in light of more catastrophic futures have thus far seldom intersected with questions of making, especially within industrial cities and regions (though see Weller, 2012). Our interest in this final section is to broker such a connection, and to expand on the locally situated ways in which people acculturated with making are equipped to plan for, adapt to, and negotiate the effects of a variable climate. In particular, we are interested in how concepts and critiques of resourcefulness, resilience and everyday practice (e.g. Strengers and Maller, 2012; MacKinnon and Derickson, 2013) intersect with various scales of making, and what this means for a future where disruption to entrenched patterns of production and consumption appear inevitable.

The thoughts here have emerged from our current investigations into the fine-grain of a steel-making city (Carr, forthcoming). Here, industrial modernists dominate making culture, but unlike crafting and other counter-cultural scenes, there is no cache attached to manual work. The normative characterization of industrial cities is one of carbon-intensive production, guzzling behemoths where workers are relentlessly enrolled in the production of 'stuff', placing grave strains on natural resources and energy infrastructure, within industries that are viewed as old-fashioned, dependent on coal or oil, or simply doomed (Gibson et al., 2011). Yet beyond the dominant media and policy narrative of industrial decline, the manual workers, tradespeople and technicians that constitute the manufacturing workforce know how to make things – and how to fix them, often with expertise and ingenuity. As economic pressures have forced companies to re-examine their methods and markets, so too have employees professionalized ways to extend the life of materials. In an extended ethnography (Carr, forthcoming), one interviewee, a mechanical engineer for more than 20 years, describes the culture of his workplace (a steelworks) in recent years, 'They've worked for a lean, mean company where they've learned to do things with little money and few people'. Creative frugality with materials is very much a part of the culture of

industrial regions, but also maps onto notions of reducing resource intensity in light of climate change.

Such workers know intimately the properties of materials: how they can be assembled, how they can be taken apart and how they can be re-assembled in new configurations. This kind of skill with material embodies a spirited, thrifty and *creative* sense of encounter, which is not a recent development, but one with a long history stretching at least to 'mend and make do' campaigns during the Great Depression and World War II (Hackney, 2006). In Australia, significant post-war migration from Mediterranean countries and Eastern Europe boosted populations in industrial cities. Strengers and Maller (2012) pointed to the themes of materiality, scarcity and diversity that characterize practices many such migrants brought to their new homes. The availability of materials, a diversity of skills and personal biographies inherently built on dealing with scarcity have contributed to an industrial maker culture where ingenious practices proliferate such as hoarding metals and components, lending power tools, hacking new objects and home improvements from found materials or those 'liberated' from the workplace (Carr, forthcoming). Examples range from the prosaic replacement of broken timber handles on garden tools with a welded steel rod, to sophisticated irrigation systems constructed entirely of surplus but valuable copper pipe sourced from workplace scrap. Such examples literally embody the type of small-scale sustainable practice that speaks to resourcefulness in everyday practice. And so ironically, an ability to cope with volatile futures may indeed lie in the fine grain of the very industrial cities and regions we seek to displace in normative discourses of climate-sensitive futures.

In a race to narrate a shift to the 'information age', subtler discussions have been neglected – regarding the cultural values that emerge in seemingly imperilled industrial places where physical materials are encountered in everyday work and life, and where things are made (Warren and Gibson, 2011). Re-engaging with such workers and practices illuminates an untapped reservoir of skill beyond 'craft', and outside of existing frames of climate change adaptation (which tend to use bald demographic data to model static vulnerability to geophysical risks – see Gibson, Head and

Carr, 2015). People who are skilled in dealing with the material world in the face of disruption offer a powerful challenge to the idea of the industrial city as terminally ill or lacking resilience, and a place whose whole economic and social structure lies in the path of the 'new' economy.

Yet this resource is clearly endangered. As the literature on craft repeatedly emphasizes, the ability to work with materials in skilled ways is under threat from automation, deskilling and labour precarity (Warren, 2015). It has been estimated that as many as 47 percent of all manual jobs are at risk of future computerization (Frey and Osborne, 2013). Counter to the hype of 3D printing, massive un/der-employment as a result of automation cannot be romanticized under any conditions. In the face of 'remorseless competition from factory production and its globalization', artisans 'need all the ingenuity they can muster' (Herzfeld, 2004: 1). And it is concerning that diverse skills with materials are being lost at a time where climate change raises issues of technological and material uncertainty. Recent work on global environmental change has shifted its attention from the need to maintain gentle transition to instead comprehend radical transformation (Park et al., 2012). This raises the questions of how to provide alternative means to sustenance and comfort that do not depend on resource abundance, and who is best placed to deal with material scarcity, should rationing and shared sacrifice become more widespread necessities (Head, 2013). Initiatives such as the Circular Economy, the field of industrial ecology and investigations into product stewardship offer a range of approaches (Lane and Watson, 2012). Further investigation into diverse cultures of making – within western industrial modernist maker culture, within prosaic collecting/remaking cultures across the Global South, within crafts such as woodworking, lutherie and cabinet-making that are grappling with new conditions of raw materials scarcity and tight regulation – is another important avenue. Manual skills and the re-use of materials can be guided in a productive response to climate change.

At the urban and regional scale in the Global North, the debate is also about what options are present for industrial cities, and what kinds of political interventions and transformations might be possible amidst – or beyond – the constraints and contradictions of capitalist societies

(Eisenschitz and Gough, 2011). Industrial cities and regions of the Global North might well become reconfigured laboratories for climate-induced ingenuity, as anticipated (in often fraught ways) in Green Jobs discourse (Pearce and Stillwell, 2008). Beyond waged labour, there is potential for industrial cities and regions to act as repositories of skill for other kinds of material repurposing, repairing cultures and enterprises with more overtly non- and anti-capitalist intentions (Martin, 2014; Morrow 2014). Such potential must nevertheless be gauged against the critical filters of class, gender and geography. Much rhetoric surrounds transitioning industrial regions and cities to the 'green economy', and to other types of work. Education, re-training and re-skilling are often cited as a panacea to industrial decline, requiring affected cities or regions to redirect working populations toward more 'in-demand' (and presumably less material) skills. But this approach fails to take into account the specific nature and value of industrial cultures (Byrne, 2002). It makes the assumption that places where things are made are rooted in the past and need to change, without recognizing that making cultures in industrial places have evolved over time, and continue to persist.

We thus seek to advocate for geographies of making to be more clearly pinned to a range of wider debates: on moral economy and ecological crisis (Hudson, 2012), progressive manufacturing and innovation policy-making driven by an ethic of care for the long-run viability of neighborhoods and communities (Clark 2012), the mundane and material ways in which economies are 'made' (Lee, 2006), emancipation of both domestic and waged labour (Gibson-Graham et al., 2013; McDowell 2014), and normative critique of the 'rightness'/'wrongness' of forms of production and commoditization (Castree, 2004, 32). There are existential questions for society and for the state, about a productive basis for society, who makes the things we need, whether via formal industrial organization and specialization or decentralized models of self-sufficiency (cf. Massey and Rustin, 2014). Geographers have for at least two decades been among the vanguard in commodity activism around labour conditions (Hale and Shaw, 2001), and more recently have used teaching initiatives, interactive and social media in order to track unethical geographies of making, connect consumers with producers, and raise public awareness

of social and environmental impacts (see for example, Ian Cook and colleagues' *Follow The Things* project - http://followthethings.com; Cook et al., 2007; Cook, 2011; Cook and Woodyer, 2012). A focus on making provides a potential parallel means to connect the urgency of environmental crisis to critiques of production and consumption (and thence to material aspects of daily life) in ways that make practical sense to people. Ultimately, geographies of making invites debate on what kind of economy we want to become and what kind of social roles we ascribe to manual skill. At stake are paid jobs, but also, individually and collectively, responsibilities to access, use and value material resources ethically.

Conclusion

Making is central to who we are as individuals - what we make as part of everyday practice forms our identities and place in the world. The mundane experience of making, and thus of labour, is 'resolutely political, a geographical imperative, and a critical means of operating a meaningful relationship with this material life' (Paton, 2013: 1084). In an era whose economic geography is increasingly painted in the hues of financialization – with an often peculiarly virtual feel (almost as if even the tangible products around us have been 3D-printed into existence by digital technologies) – it is salient to remember the massive extent to which workers in factories, workshops and in homes are still occupied making material things. All manner of deeply profound material knowledges, haptic practices and forms of manual work are still present at the heart of global economies. As Hudson (2012: 374) has argued, 'knowledge of what it is materially possible to produce is a necessary pre-condition for consideration of alternative conceptions that challenge the hegemony of capitalist material interests and imagine alternative ecologically sustainable and socially just visions of the economy'. Making is also central to our legacy as a society – materially, economically, ecologically, and socially. Generations to follow will be dealing with our made objects, buildings, and associated detritus just as we are dealing with the asbestos, lead and concrete cancer from things made in previous generations.

In this paper we have sought to open up for discussion geographies of making as a distinctive field of inquiry that links persistent questions of economic geography and labour process to a wider set of looming debates about our collective response to ecological volatility. Human geography is, we would argue, a fertile place for making such connections. One obvious but important conclusion is that the macro-structure of the economy clearly has to change (Park et al., 2012), in ways that confront powerful financial interests (Wainwright and Mann, 2013). The black box production of stuff around us requires us to think of new things to make for evermore. That this cannot happen within a modern political economy leads us straight into our current trajectory: a crisis of profit-production-accumulation. We argue that focusing on making and its geographies at a range of scales – from the maker's bodily interactions with materials to the industrial region, and beyond – provides a means to both debate and respond to this crisis.

If makers ought to be more clearly part of the debate, how exactly might this transpire? Part of the task is to find the conduits and infrastructures that can be cobbled together so that the voices of makers are more audible, and that others listen (cf. Kanngieser, 2012), and in so doing to ambitiously gather a collective commons around materials. Collaboration and collective dispositions within both 'mainstream' and 'alternative' forms of manufacturing (Cornwell, 2012; Clark, 2014) suggest this is possible. Fresh views on 'making' and 'manufacture' will be needed to unlock ethico-political possibilities in the face of environmental-climate change crisis. We do not purport to have all the answers, but nevertheless we do suggest that renewed focus on labour process, skills and materials provides a constructive path forward.

To this end the proliferation of craft literature has focused important attention on the processes, materials and affect of making and the blurring of productive/domestic, sub/urban and private/public binaries (Bain, 2013). Such contributions also draw attention to the endangered status of particular vernacular or professional skills or ways of working with (and thinking about) materials, in the process offering an important historical framework for contemporary investigations into making (Thomas et al., 2012; Luckman, 2012). Like discussions of repair and

remake cultures borne out of sheer necessity (Gregson et al., 2010), they are also firmly rooted in context, often evocatively sketching out the relations between material and place.

But our point is not to suggest that craft-based modes of production, through their perceived smallness and localness, provide the preeminent alternative to manufacturing. That, as we argued at the outset, falsely reconstructs the modernist binaries of home and waged production, of artisanal pre-industrial trades against big manufacturing. For even within the industrial behemoth, exemplified in the massive complex of the steelworks, there are small-scale examples of making, repair and non-capitalist provisioning for surrounding households and communities. Meanwhile in the small-scale culture of domestic craft enterprise there is a rapidly expanding, fetishized and globally networked economy premised on continued consumption of stuff. Signals for a constructive path forward are indeed present in experimental alternatives opened up by small scale, noncapitalist and self-provisioning crafting, but – and here is our key point – they are also present deep within the modernist manufacturing enterprise.

Pursuing an on-going dialogue around such signals across diverse cultures of making will thus require not only transcending old binaries, but also encouraging difficult conversations and more open listening across domains of professional and disciplinary expertise (Kanngieser, 2012), in ways that invert expected flows of communication and critique: social scientists and humanities scholars listening to industrial designers and engineers (and vice-versa); office-bound professionals listening to factory workers, builders and repairers; women and men acknowledging diverse forms of work in making. The challenge will be to break outside entrenched positions, and for researchers, to link careful analyses of microspaces and actors to broader debates about climate change, economic collapse and capacities to cope with and adjust to extremity. Making has a much broader context than either the manufacturing or craft sectors alone. Across diverse modes of production – craft-based, assembly line, maintenance, repair – are diverse skills and dispositions that open possibilities. In order to make this shift, we need to consider the micro-encounters of making, but also making as a whole system, that includes consumption and

consumers as central. Making is a critical and complex part of the discussion about how we connect the (over)-production of stuff with the climate change discourse, and how we comprehend alternatives within the exigencies of everyday life and work.

The big overarching questions persist – can we take profit out of the material process, and yet still provide means for workers to security of income and occupation? Powerful interests will see to it that profit remains a core presence – including interests in finance and property outside of production itself (cf. Massey and Rustin, 2014). There is, we believe, hope in cultural initiatives built on the recognition that people can connect with making as grounded, social and geographical activity, and that people make sense of environmental uncertainty via their connections with material things (Strengers and Maller, 2012). We also need to acknowledge that making practices and cultures are themselves increasingly diverse, and have different things to offer. Potentially progressive dispositions and skills around making also persist *in* modernist manufacture, in huge, run-down, industrially scarred and polluted landscapes occupied by a purportedly redundant old-industrial workforce. Through drawing attention to this, we hope to go some way towards reanimating a debate about combatting environmental crisis in new ways, from perhaps the most unexpected spaces.

And amidst all this is the sense that many things will remain the same. Societies will still need people working with their hands doing somewhat mundane yet skilled things: bricklaying, carpentry, hairdressing, cleaning, mending, and making clothes. Many such tasks cannot be automated. Other 'big' things – ships, bridges, buildings – will still need to be somehow made, in ways that necessitate large-scale production complexes (cf. Crang, 2010). Beyond a selection of digital technologies and techniques the material world has not so much been revolutionized, but has 'crept along' alongside rise of technology from mid 20th century – new products adding to the existing model rather than usurping it, while other forms of material innovation have simply stalled. The things invented in the modern period – cars, jets, fridges, washing machines – still proliferate. The question will be whether it is possible to find our way towards systems of provision for

material goods that sustain livelihoods and quality of life while doing more with less. The high-throughput model of make-sell-dispose is a race to the bottom that will always end badly. To echo a recent argument of Doreen Massey's (2014: 22), we have all the choice in the world in terms of products, but very little choice in terms of the kind of economy within which those things are made, accessed and used. And certainly we have little time to change things radically. This makes the debate about how and why we make things all the more urgent.

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