

The body as infrastructure

Luis Andueza

University of St Andrews, UK

Archie Davies

The University of Sheffield, UK

Alex Loftus 

King's College London, UK

Hannah Schling

Queen Mary University of London, UK

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Abstract

In this paper, we conceptualise the human body as infrastructure, asking what kind of infrastructure it currently is and what kind of infrastructure it could be. We therefore tease out the historically and geographically specific ways in which human bodies have been (re)produced as infrastructure, emphasising the violence of abstraction in capitalist modernity that transforms the productive body into a technology of calorific inputs and outputs. Nevertheless, through demystifying abstract labour we point to the relations of (re)production (needed for the body's ongoing repair) and the metabolic processes (responsible for both decay and repair) that are subsumed within a broader capitalist system of accumulation. In so doing, we turn to the immanent contradictions and struggles that resist the body's production as a one-sided technology of circulation and through which it is, and can become, an infrastructure for life and sociality.

Keywords

Embodied urban political ecology, infrastructure, abstraction, social reproduction theory, metabolism

Introduction

Social processes take place through – and are enabled by – human bodies. Acknowledging this simple fact suggests that human bodies could well be considered a fundamental form of

Corresponding author:

Alex Loftus, Department of Geography, King's College London, London WC2B 4BG, UK.

Email: alex.loftus@kcl.ac.uk

infrastructure. Indeed, if we take one of the most basic definitions of infrastructure from the Oxford English Dictionary – ‘the basic physical and organizational structures. . . needed for the operation of a society or enterprise’ – one could assume that human bodies all over the world function as such. More than any pipes, roads or cables, human bodies comprise society’s basic physical and organisational structures. Bodies facilitate the smooth functioning of capitalism through the production of commodities and circulation of goods. And bodies also pose a threat, a disruptive influence, to such flows, simultaneously opening up the possibility for an expansion of emotion, sociality, care and ways of being. Recognising the human’s role as infrastructure, AbdouMaliq Simone (2004) makes the argument that ‘people’ are infrastructure, a claim echoed by Silver (2014), as he writes that ‘the movements and circulations of people should be considered forms of infrastructure themselves’. Such arguments provide important contributions to critical infrastructure studies, which has, over the last few decades, done much to disrupt any notion of infrastructure as dead matter, emphasising the role of dams, pipes, roads and tunnels in reproducing particular social formations, as well as emphasising the flows (of finance, resources, labour, care and repair) needed to sustain these lively materialities (see also Appadurai (2002), Kaika (2005), Ranganathan (2014) and Truelove (2019)). To recognise that fleshy and messy bodies are also forms of infrastructure is not, therefore, to enact an analytical violence in which humans are presented as inert matter for the smooth functioning of capitalist society: instead it is to open up questions around how we might want our bodies to function in relation to different social formations, how we might ensure the love, care and repair that is necessary to sustain our fleshy forms when confronted with the violence of capitalist abstraction (Sayer, 1987; Loftus, 2015). And it is to point to the way capitalist abstraction operates through the multiple, uneven and violent differentiation of bodies. Indeed, the kind of body one has matters profoundly: bodies are more than the material locus of social processes, rather, social process are themselves fundamentally embodied.

To foreground the body – rather than people – as infrastructure therefore shifts attention from more general understandings of social infrastructures to the form that infrastructural bodies take depending on the conditions of any given society. At the same time, in recognising the care, love and effort required to sustain bodies – and the forms of social reproduction involved in sustaining lives – we challenge the abstraction of the ‘body’ from personhood. Building on this observation, we claim that the violent forms of abstraction characteristic of capitalist modernity reduce human bodies such that they *seem* to function as simple technologies of circulation – a means through which an energy input (food) is transformed into an output (labour power) from which a commodity might be produced. Accumulation for accumulation’s sake – the senseless reductionism through which capitalism functions – transforms bodies into particularly constrained forms of infrastructure. In analysing such an inversion, however, we uncover that abstraction is also a process of mystification. Bodies may well be infrastructures but sustaining those infrastructures are: (a) processes of metabolism that function in different ways in different bodies and that insert bodies differentially into differentiated environments; (b) relations of care and sociality that sustain life itself. And challenging such abstraction are (c) acts through which workers refuse to become appendages to any machine. Within these bodily metabolisms, these forms of social reproduction, and these organised acts of refusal, we therefore see cracks and contradictions in a process of capitalist abstraction. Through exploiting such contradictions, through prising open such cracks, we want to remind ourselves that bodies simultaneously function as something very different from constrained technologies of circulation and surplus value production. Bodies are also the *loci* of lifeworlds. They are infrastructures ‘for life and sociality’ (Berlant, 2016), and the multiple forms of meaning that compel social reproduction.

We begin the paper by laying out why the body should be understood as a form of infrastructure and how recent writings on the body and on critical infrastructure studies help us to better make sense of this role. Turning to what we understand as a process of real abstraction, we demonstrate how, within capitalist modernity, bodies as infrastructural forms are produced as one-sided technologies of circulation. We then go on to explore the cracks and contradictions within this process of abstraction. Beginning with a focus on bodily metabolism, we look at the ways in which energy inputs – derived from food sources that are themselves bound up in a relational matrix encompassing colonial and capitalist production networks – produce uneven bodies (Rioux, 2015b). These uneven bodies connect to environments in different ways and function differently as technologies of circulation. Simplistic assumptions that energy will flow smoothly through infrastructural bodies – captured in the expression ‘muscles burn sugar’ (cf. Kiciloff and Starosta, 2007) – are disrupted when different bodies react differently to what are often assumed to be uniform processes. In the following section, we further demystify the body as a technology of circulation showing how its repair and maintenance is entirely dependent on forms of social reproduction conventionally ignored by capital. Without the (often unpaid) labour necessary to reproduce the body as infrastructure – as with any other infrastructural form – those bodies would cease to function. The taken-for-grantedness of the body as infrastructure is thus challenged by important feminist Marxist work on social reproduction. Finally, through the work of Bolívar Echeverría (2011), we argue that capitalist accumulation proceeds through an unstable grounding in definite forms of social and cultural meaning. The values, meanings and purposes that give socio-ecological and bodily metabolism their social form must be approached as an inherently open field of contestation. Pointing to the ways in which people refuse to be treated as one-sided technologies of circulation and instead seek to forge new infrastructural ways of commoning, we therefore build on Echeverría’s claim that contestation takes place between the imperatives of valorisation and the vernacular cultural grounds on which it unfolds. Concluding the paper, we suggest ways in which, against the violence of capitalist abstraction, bodies might instead function as ‘infrastructures for life and sociality’ (Berlant 2016: 403), resisting their fungibility and production as one-sided machinic forms. That is to say, as Saidiya Hartman (2018: 469) has put it, ‘the activity required to reproduce and sustain life is [...] an art of survival, social poiesis’, or, in Brecht’s terms, a practice of creating the conditions ‘for a life worthy of human beings’ (Kuhn and Constantine, 2018).

Bodies are infrastructures

While ‘the body [...] has always been at the core of Marxist attempts to theorize uneven development’ (Heynen, 2008: 33), the connection between the urban body and infrastructure has been consistently underdeveloped. This lacuna is all the more surprising given that historical materialist approaches to corporeality have flourished in recent decades. Such approaches have a firm grounding in Marx’s own writings, which, as Scarry (1987), Fracchia (2008) and Rioux (2015a, 2015b) all note in different ways, are suffused with references to corporeality, with concrete studies of the labouring body and with metaphorical references to the bodily implications of capitalist relations. For Fracchia (2008), understanding Marx’s mobilisation of the body deepens the sense of ‘the corporeal depths of [Marx’s] concept of immiseration’. Through a deeply relational approach, Fracchia (2008) therefore teases out the manner in which the workplace comes to be organised in a way that integrates human bodies (as so brilliantly captured in Charlie Chaplin’s *Modern Times* (Fracchia, 2008: 44)) and how capital ‘simultaneously writes its messages on the body of labour in a script not immediately decipherable by others’. Focusing in particular on

capital's pursuit of absolute and relative surplus value, Fracchia thereby draws out the tension between corporeality and the machine-like qualities of human bodies. Indeed, Fracchia appears to move towards a conceptualisation of the body as infrastructure – even if not referring to it as such – when writing:

outdoing Kafka, Marx sketches a portrait of workers not only forced to produce, but also forced to *be*, the conditions and the instruments of their own torture [...] workers themselves animate and activate the instruments of their own torture that then choreograph the movements of the organic human body with a mechanical script. (Fracchia, 2008: 61)

Such a historical materialist approach to the body has, of course, also been developed enthusiastically within the geographical literature. Thus, for Harvey (1998: 402)

the body is not a closed and sealed entity, but a relational 'thing' that is created, bounded, sustained, and ultimately dissolved in a spatiotemporal flux of multiple processes. This entails a relational-dialectical view in which the body (construed as a thing-like entity) internalizes the effects of the processes that create, support, sustain, and dissolve it. The body crystallizes out as a 'contingently bounded permanence' within the flows of multiple processes.

Orzeck (2007), in slight contrast, notes something of a tension within historical materialist approaches between the impulse to de-naturalise bodies – seen in Harvey's emphasis on relational construction – and the recognition that bodies have certain transhistorical needs and powers. Reviewing a vast body of work, Orzeck points to a potential resolution to such a tension within the work of Lukács. More importantly for our own project is Orzeck's attention to the question of how sameness and difference are simultaneously produced. Thus, as bodies are enrolled in the production process, becoming appendages of the machine, the apparent evisceration of difference in no way occludes the simultaneous social production of new forms of alterity. Indeed 'differently marked bodies can be enlisted to perform different functions at different rates of remuneration': bodily differentiation is therefore as crucial as (and is simultaneous to) the flattening effects of capitalist abstraction. Indeed, as Esch and Roediger (2009) analyse, in the USA's labour management history, scientific management and race management emerged deeply intertwined with each other.

Rioux (2015a: 201), similarly, seeks to emphasise the social production of difference through bodily processes, writing that

An anti-racist queer feminist materialist approach to body formation...insists that racial hierarchies, gender orders and heteronormativity are not constructed out of thin air but rather through biological processes, corporeal practices and physiognomic attributes that are mobilized as physical markers of differences, and which support an uneven geography of exploitation, oppression and discrimination actively engaged in body formation.

The basis for such an approach, Rioux (2015a) argues, can be found in a rapprochement between historical materialist approaches, political ecology and social reproduction theory. Elsewhere Rioux (2015b) demonstrates, through a detailed analysis of the production of uneven bodies in 19th-century Britain, the ways in which a gendered division of labour, along with an expanding imperial project, re-shaped the diets of a deeply gendered working class. Repeatedly, he emphasises how the wage form and the commodity labour power occlude understandings of the necessary reproduction of actually existing bodies. Social reproduction theory, for Rioux (2015a), is thus fundamentally concerned with demystifying,

denaturalising and defetishising the wage form to demonstrate the social relations that extend well beyond the workplace, enabling the reproduction of both capitalism and bodies.

If Rioux's work is deeply concerned with the inputs and outputs enabling processes of (re)production, and if the debates that preceded his work served to emphasise the relational production of bodies within a capitalist system of accumulation, it should be brought into conversation with those on infrastructure. One way of doing so is to emphasise the point that bodies are themselves a form of infrastructure. Making this point draws attention to the forms of decay that bodies undergo when functioning as infrastructure, as well as the necessary repairs to counter such decay. Furthermore, such an analysis demands a focus on the flows through which bodies are maintained, disabled and repaired, as well as on the very flows that bodies themselves serve to reproduce, whether as one-sided capitalist technologies of circulation or as infrastructures for life and sociality. Finally, such an approach enables new conversations with literatures on environmental justice and social reproduction, as well as with emerging scholarship on the politics of human metabolism. Developing such a conversation then extends and complicates the contentions of the 'infrastructural turn'.

Perhaps the most obvious bridge between literatures on infrastructure and those on the body might be found in Simone's (2004) conceptualisation of 'people as infrastructure'. In writing of people as infrastructure, Simone thereby seeks to capture the mobile, flexible and informal ways in which everyday practices reproduce life in the city. Such 'social infrastructures' (McFarlane and Silver, 2017) exceed the formal technologies – pipes, dams, grids and cables – that have tended to be the focus of research in urban political ecology. This turn to social infrastructures is part of a broader and emerging critical infrastructure studies (Anand, 2017; Anand et al., 2018; Bjorkman, 2015; Ranganathan, 2015 among others). This body of work builds upon a wealth of previous writings that mirrors historical materialist and feminist materialist interest in the body, thereby emphasising how political, economic and social relations are embodied within – and expressed by – specific infrastructural forms. Thus, in their seminal work, *Splintering Urbanism*, Graham and Marvin (2001) express such a relational understanding of infrastructure in order to make sense of the splintered infrastructural forms that emerge alongside the breakdown of the Keynesian Welfare State. For Kaika and Swyngedouw (2000), furthermore, infrastructures are fetishised forms of broader social relations, comprising modes of (re)production, as well as the phantasmagoric desires of capitalist modernity. Such work has often drawn attention to the visibility and invisibility of infrastructural networks (see also Larkin, 2013) as well as the ways in which urban infrastructures come to be sensed at times of breakdown.

Beyond writings on social infrastructures, perhaps the most evocative 'ironic political myth' to capture the body as infrastructure is found in Donna Haraway's figure of the cyborg, 'a hybrid of machine and organism'. Adopted enthusiastically since the inception of urban political ecology, the cyborg myth has guided attempts to capture the lived social relations through which specific ecologies emerge. Swyngedouw's (1996) initial gestures to the cyborg thus gave way to Gandy's (2004: 28) conceptualisation of cyborg urbanisation as the 'interface' between the body and the city in which 'urban space [becomes] a prosthetic extension to the human body' (Gandy, 2004: 29). As Gandy emphasises, citing Otter, the emergence of urban municipal infrastructures 'required incessant inputs of capital and human labour' to resist entropic disintegration. Not only are bodies in such a prosthetic relationship with municipal infrastructure, these infrastructures require ceaseless bodily labour to continue to function (Doshi, 2017). Such labour is both paid and unpaid, made visible or invisible and always needs to be understood through the broader sets of social relations in which it is positioned.

Almost invariably stripped out of accounts of cyborg urbanisation, however, is the socialist-feminist project that guided Haraway's original manifesto (as Callard (1998) had previously noted, the same can be said of Haraway's commitment to socialism and materialism, also ignored in the rush to put the cyborg myth to work in different contexts). Thus, within much of the literature in urban political ecology, while cyborg bodies might well be hybrids of human and machine, they appear unmarked by gendered divisions of labour, as well as stripped of any raced or sexed social relations. We argue that cyborg urbanisation needs to take seriously questions of social reproduction and of embodied difference: one way of doing so might be through building on understandings of the body as infrastructure and the forms of social reproduction needed for its care and repair.

(Re)producing the body as a one-sided technology of circulation

As infrastructure, bodies undergo a peculiar process of inversion within capitalist modernity that sheds new light on Gandy's prosthetic conceptualisation of infrastructure. Urban infrastructural space functions less, as Gandy has it, as a prosthetic of the human body; instead, bodies become recalcitrant extensions of an urban infrastructural space, increasingly subsumed under the requirements of the smooth circulation and accumulation of capital. We write under COVID-19 in the United Kingdom as workers are being forced back to work and onto unsafe, infectious transport systems, and migrant workers and people of colour are dying faster than the wealthy and the white. Concurrently, the global Black Lives Matter movement could not make clearer how people exceed and resist the ways in which their bodies are produced as racialized and gendered infrastructures. At this moment of pandemic, the dangerous interfaces of how embodied circulation is necessary to produce capitalist value are brought into violent relief. Capitalism requires that bodies return to work, and is revealed as indifferent to those bodies' material vulnerability. Inverting Gandy's formulation, then, is significant in terms of our contribution to differential understandings of the relationship between bodies and infrastructure within the framework of urban political ecology.

The epitome of such a transformation may well lie in the contemporary micro-chipped employee or the data-obsessed employer insisting on fitness trackers at work in order to ensure the smooth flow of value within the affective labours of her personnel. The *reductio ad absurdum* of this subsumption, moreover, can be found in the 120 hour weeks of Silicon Valley executives living in the office, consuming buttery coffee, running meetings from the treadmill, and swallowing sleeping pills after 20 hour to stop the mind briefly, before harnessing up again to the task of capital.¹ These supremacist banalities are the ironic end to a much broader tendency captured in Marx's understanding of the human as time's carcass or in his description of the inversion of the capitalist labour process:

Time is everything, man is nothing; he is, at the most, time's carcass. Quality no longer matters. Quantity alone decides everything; hour for hour, day for day; but this equalizing of labor is not by any means the work of M. Proudhon's eternal justice; it is purely and simply a fact of modern industry (Marx, [1847] 1999).

Elsewhere, Marx writes that 'it is no longer the worker who employs the means of production, but the means of production who employ the worker' (Marx, 1990: 425). The expansive movement of subsumption captured in these passages has been one of the distinctive features of capitalism since its origins. In the former, Marx points to how the capitalist constitution of modern industry develops through the subsumption of the concrete labouring

body to the abstract determinations of time, a ‘real abstraction’ emergent from – and reproduced as – a fact of capitalist relations of production (Sohn-Rethel, 1978; Thompson, 1967; Toscano, 2008). From the point of view of capitalist production, the concrete, proletarian body is reduced to an infrastructural condition – a ‘carcase’ or a vessel – through which something else is taking place, whatever purposes or inclinations the worker might possess. The body becomes a technology that circulates something other than itself as it becomes enrolled in the process of production. In the body, we are arguing, the ‘something else’ in circulation is the production of the capitalist form of value.

In her pathbreaking discussion of the value theory of labour, Diane Elson (1979: 150) highlights such an inversion through emphasising how the abstract aspect of labour comes to be objectified, thereby establishing the dominance of abstract labour. Crucial to the playing out of the historical process charted by Elson is the subsumption of multiple aspects and dimensions of human practice – and we might add metabolic processes – to the abstract aspect acquired as part of the wider system of commodity exchange and accumulation. This process of subsumption underpins what Scarry calls ‘the disturbingly graphic concept of the severing of the worker from his own extended body [which is] central to *Capital*’ (Scarry, 1987: 250). Nevertheless, for Elson, this dominance is never complete: indeed, Marx’s analysis ‘also recognises the *limits* to the tendency to reduce individuals to bearers of value-forms’ (Elson, 1979: 174). It may also recognise the limits of the tendency to reduce individuals to infrastructures serving accumulation for accumulation’s sake.

Returning to bodies and the value form, in the capitalist infrastructural form we have described, the human body is treated by capital as a specific technology. Work is done according to the imperatives of socially necessary labour time. The result is the peculiarly capitalist social form of value. As Mann (2010: 177) writes, following Postone (1993), ‘[v]alue is best understood as a form of social wealth constituted by a spatially and temporally generalising social relation of equivalence and substitutability under, and specific to, capitalism’. Such a generalising relation of equivalence and substitutability has unsurprisingly received much attention from political ecologists in recent years, focusing in particular on the transformation of social and socio-ecological relations (see Huber, 2018; Kay and Kenney-Lazar, 2017; Walker, 2017). Nature is produced in the image of capital – in Smith’s earlier phrasing ‘[i]n search of profit, capital stalks the whole earth. It attaches a price tag to everything it sees and from then on it is this price tag which determines the fate of nature’ (1984: 54). As Matt Huber argues, for generalised commodity exchange to function, societies need to continually abstract from concrete labours and concrete natures. Thus ‘money necessarily abstracts from and conceals the real ecological conditions that sustain us’ (Huber, 2018: 50). For Mann, substitutability is as important as equivalence: he therefore captures what Berlant (reading Taylor, 2002) refers to as the ‘violent fungibility and displacement of all production and life in contemporary capitalism’ (2016: 408). In short, the form of abstraction associated with the dominance of the value form captures the process through which concrete labour, conducted by real persons in qualitatively different environments, comes to be objectified in a single, universally applicable measure. Breathless debates on the threat to ‘high-skilled’ labour from ‘Artificial Intelligence’ clarify the stakes here, as AI (or indeed ‘lecture capture’ for academic personnel) comes to represent the phantom of fungibility hovering over the professional classes. This phantom has, however, long been understood by labour movements to be the kernel of workplace struggles, and a further expression of the contradictory and crisis-ridden nature of valorisation – a social form that, while absolutely dependent on human labour, tends to simultaneously displace that labour from the production process (Postone, 1993).

Crucial to the understanding that we outline above is Marx's re-conceptualisation of Ricardo's labour theory of value. For Marx, labour only constitutes value as part of a social totality; a totality in which transformations in technology, labouring practices or the availability of raw materials find their expression in value terms. Thus, abstract labour (and ultimately value) is read in its social articulation as 'socially necessary labour time', that is to say, as part of a social totality. In Elson's terms, cited earlier, abstract labour is objectified in the form of value (Elson, 1979). Since the re-conceptualisation of the labour theory of value in this way, a debate has taken place over the relative importance of the relational (historical) and material (transhistorical) aspects of Marx's concept of abstract labour. In many respects, the debate points to the tension noted by Orzeck (2007) around social constructionism vs. transhistorical human needs and powers. In one of the more recent iterations of such a debate Kiciloff and Starosta (2007), taking their cue from Haug's recourse to the insistent fact that 'muscles burn sugar', argue that abstract labour is a transhistorical category that specifies the calorific content or energy transferred to a given commodity within the production process. Within such a conceptualisation, the human body becomes an infrastructure for the transfer of energy from one source to another. In capitalist societies, this abstract labour takes the social form of value. There are, of course, similarities here with the method of energy accounting as a means for interpreting social practice as used within the cultural ecology tradition (for an excellent summary see Cederlöf, 2019). Nevertheless, what distinguishes Marx's theory of value is his understanding of how this material process, which might be abstractly transhistorical, articulates a *historically specific* form of social mediation among the 'free' members of capitalist society. He describes a process in which human bodies become one-sided technologies of circulation – in which energy is input in the form of food and output in the form of labour power – always seeing this as historically specific and therefore mutable. The dominance of abstract labour and its expression in the social form of value not only transforms the labour process, it turns the bodies of workers into infrastructures for the input of calories and the output of surplus value. This real subsumption of social and bodily metabolism to the abstract determinations of socially necessary labour time is what constitutes capitalism as a regime of value. To return to our definition of infrastructure from the OED, human bodies are 'the basic physical and organizational structures...needed for the operation of a society or enterprise', in this case for the operation of capitalism as a regime of value.

Contradictions

If bodies can be understood to be infrastructure in such a way, it is not to argue that this is *all* that bodies are. Crucially, the relational production of the body as infrastructure is utterly reliant on relations of (re)production, and capitalist modernity cannot be entirely reduced to the systematic logic of capitalist valorisation and its demands. Indeed, as a purely abstract determination, value cannot posit any substantive content of its own. On the contrary, because it is dependent on concrete labour and use-value, it is also dependent on the concrete and qualitative dimensions of social reproduction. Real people are not only the basis of value production as the source of abstract labour, real people produce the cultural forms that both enforce and resist the demands valorisation places upon social reproduction. Bodies may well be technologies of circulation but those bodies exist within broader social formations in which meanings are constructed, in which love, care, anger and repair are all felt, experienced and acted upon.

Our analysis therefore demonstrates the need to move beyond a simple consideration of the body as a metabolic technology of circulation in order to better attend to the practices of

social reproduction through which energetic and nutritional inputs arrive at the body. We simultaneously need to consider how inputs can be sustaining or destructive: at times – we might think of sugar – calorific inputs can be both. While the circulation of energy in the form of food and fuel (Swyngedouw, 2006) enables bodies to act, degraded environments simultaneously disable bodies from acting in the ways assumed of them, or indeed in the ways people may desire or hope for themselves. This is true both in terms of the environments people live in and the stuff that sustains them. Alcohol, for instance, can be a form of psychic repair after work but can simultaneously mean the decay of value for capital. Escaping the plantation – or burning it down – is a form of social repair for the maroon while constituting the decay of value for capital. The predictable irony of capital is that precisely through such forms of contested repair, bodies come to be marked for oppression. Forms of oppression flow not only from the subsumption of the labour process, but from the contested subsumption of social reproduction to the value form. It is necessary, therefore, to make visible the vernacular practices which resist (and also reproduce) processes of abstraction and disciplining, the attempted transformation of bodies into technologies of circulation serving the needs of accumulation for accumulation's sake. However, we must do so with a keen awareness of how the contradictions of a regime of value are neither monolithic nor constant ('labour' intervening into 'capital'), but cut through with the qualities and specificities of particular forms of social reproduction within their own historical geographies.

Attending to these historical geographies requires analytical work on a range of different scales and needs to move beyond the simple abstraction of the body as a capitalist technology of circulation. In drawing attention to bodily metabolisms, to relations of (re)production, and to forms of vernacular resistance to the abstract processes of capitalist modernity, we suggest some focal points for such analytical work. These focal points also demonstrate the potential value of recognising the body as infrastructure and the kinds of connections which such a conceptualisation enables.

Bodily metabolisms

While the concept of metabolism has been of insurmountable importance to political ecology (Heynen et al., 2006), it is generally articulated at the scale of society and not at the scale of the body. Political ecologists acknowledge the concept's 18th-century roots in interpretations of the body and its relationship to broader environments (see Swyngedouw, 2006) but rarely dwell in much depth on what that means for bodies in the contemporary moment. Thus, while the metabolic rift (Foster, 2000) takes us to dried-up flows of nutrients in the soil, or excess flows of toxins into oceans, thinking about metabolic crisis *inside* the body might instead take us to the excess flows of nutrients in the clogged arteries of heart disease, or the dried-up flows of nutrients in malnourished bodies. These excesses and dearths are differentially produced and differentially lived through being intimately tied to the social production of class, race, gender and age. In recognising that the body is infrastructure, we therefore ask whether it is helpful to consider how these broader flows encompass the (re) production of differentiated bodies as metabolic technologies of circulation. Indeed, our conception of bodies as infrastructure can be extended through greater attention to the metabolic incorporation and exclusion within flows and circuits of value.

As our discussion of abstraction implies, the body as infrastructure in capitalist modernity suggests a homogenising influence. Indeed Engel-Di Mauro argues that 'capitalism is an attack on people's ability to function ecologically, as organisms, by disciplining the body to behave as if it were mechanical, thereby striving to homogenize human corporeality' (2006:

71). Certainly this is one part of the story; however, in considering the excesses and dearths of energy inputs – the production of uneven bodies, as Rioux (2015a, 2015b) refers to it – we open political ecology to a further range of determinants comprising differentiated bodies as well as a range of relations comprising urban political ecologies. Contemporary work on nutritional epigenetics by Hannah Landecker and on obesogenic environments by Julie Guthman suggests that political ecology needs to better understand both the spatiality of the body and its processes of decay and repair – processes that we argue mirror those of other infrastructures within capitalist modernity, with which they are imbricated (Doshi, 2017). And while research on the Political Ecology of the Body is beginning to emerge – more often than not through the paradigm of health-environment geographies (Agyeman and McEntee 2014; Guthman, 2011; Mansfield, 2008; Shillington, 2013) – this approach does not yet connect a theorisation of the production of bodies to those of infrastructure and urbanisation. Food is essential to think with here, connecting the material body to the material world. Landecker is therefore right to characterise food as environmental ‘exposure’, in her demonstration of how human metabolism demarcates the impossible boundary between nature and culture ‘not at the surface of bodies, but deep inside them [...] in the space and time that is not quite the organism nor quite the environment, but the moving zone in which the two become one’ (2013).

As Marx and Landecker (2011, 2013) remind us in their different ways, the anabolism and katabolism of the body takes time. Reducing this to a one-sided abstraction when the body functions as a simple technology of circulation, occludes the socio-environmental metabolisms that produce and are produced by muscular metabolism. Understanding the body through such a one-sided abstraction facilitates labour regimes which use such bodily technologies without being implicated in how those same infrastructural bodies become available for the next day of work, or how its necessary nutrition is produced and delivered. For instance, Rioux’s analysis draws out the significance of the increasing role of sugar in the working-class diet. Our emphasis on the body’s infrastructural condition extends Rioux’s consideration of sugar to the wider landscapes of sugar production, as well as the bodies produced within and through those landscapes. In so doing, our approach reiterates the material interdependencies between production and consumption confirming previous scholarship on sugar such as Mintz’s (1985), while also emphasising two further points. First, concepts of metabolism in political ecology have, in one sense, been insufficiently embodied once we consider that production and consumption are metabolically interdependent. Second, understandings of socio-ecological metabolism can take greater account of the extended nutritional landscapes of imperial and post-imperial historical geographies (Davies, 2019).

Although never rooted in an understanding of the body as infrastructure, we see hints of such an approach emerging in the work of Guthman (2015: 2527–2528) for whom specific inputs shape the body as a socio-ecological fix, rather like Harvey’s framing of a spatio-temporal fix within the infrastructure projects of the modern world. Thus:

Food literally grows and energizes workers and thus is an essential ingredient for capitalist labor processes from which profits are amassed. It is bodily consumption that produces the material laboring body. This is because labor power itself derives not only from the obviously social—and often commodified—processes of household provision of food, shelter, and education, but also the taking in and expelling of substances like food, air, and water, as well as the restfulness of sleeping, and the many other ways in which bodies interact with the environment to create the energy that allows active transformation of materials into commodities through labor processes. It is not surprising that Marx referred to the labor process as a metabolic one.

As should be clear in our discussion of metabolism, we do not simply dismiss the real abstraction of the body as a technology for the circulation of capitalist values, the homogenising influence captured so effectively by Engel-Di Mauro. Such an abstraction is neither fiction nor mere ‘object of theory’: instead it can be understood as both conceptual and real, ordering the world in which we live.

For instance, we can draw on one of the authors’ fieldwork projects on migrant workers in employer-provided dormitory accommodation. Alcohol plays an important role in processes of social reproduction and bodily recuperation in such dormitories. As people, these workers’ hungover bodies do not, therefore, burn sugar *for capital* in the ‘smooth’ and desired abstraction of compliant, fungible labour power. However, they are still expected to perform in this way, upon condition of having a place to live in the tied housing of the dormitory, and a means to reproduce their lives in the form of the wage, within the regime of social reproduction and value (Schling, 2017). The simple act of refusing to get out of bed is still dangerous, perhaps more so, with a hangover. Nevertheless, it is in differential, incomplete ways, and with differential, undetermined effects that bodies come to be enlisted as capitalist infrastructures when wrapped up in the circulatory dynamics of value production. The bent spines and stooped shoulders of those carrying water to households in the global South relate differently to the landscape of infrastructure within and beyond the home (Loftus, 2007, 2012). Articulating the body’s relationship to infrastructure within urban political ecology through understandings of metabolism and the production of uneven bodies is to put this corporeal abrasiveness and inertia in the foreground, against the characterisation of bodies as fungible, permeable constituents of smooth flows.

Demystifying the (re)production of infrastructural bodies

As Tithi Bhattacharya (2015), among many others (e.g. Dalla Costa and James, 1972; Federici, 2012; Katz, 2001; Weeks, 2011), makes clear, the pursuit of profit – maximising surplus value within the production process – is a battle waged not simply in the workplace. The struggle to maximise relative surplus value takes place within the home through the cheapening of inputs needed to reproduce the commodity of labour power. Bhattacharya (2015) refers to E.P. Thompson’s historical research into the ‘regular dietary class war’ (Thompson, 1963: 315) waged on the English working classes in the 18th-century transformation of a wheat based diet into one primarily based on potatoes. Building on this understanding, Bhattacharya (2015) goes on to cite Sandra Halperin’s (2004) research into the processes of colonial extraction that served to cheapen foodstuffs and suppress working-class wages. Bhattacharya’s focus on social reproduction necessitates a move beyond the simple abstraction of ‘muscles burn sugar’ to a consideration of the qualitatively different calorific inputs and care labours that (re)produce the labourer. Salvatore Engel-Di Mauro has also emphasised the need to attend to the ‘ecological dynamics of bodies’ thereby mapping some of the directions to take from Sylvia Federici’s work (Engel-Di Mauro, 2006: 70). Bodies need more than calories to materially reproduce themselves, and these nutritional inputs are grown, harvested, prepared and cooked by people under historically and geographically specific social relations (De Castro, 1932).

For Marxist and materialist feminist scholars, starting with the question of who performs the – often unpaid – labour of reproducing bodies as labour power necessitates a fundamental reworking of the relational understanding of the body. Thus, for Rioux (2015b) while women’s bodies were responsible for ‘absorbing the worst effects of capital’s inability to provide stable, let alone progressive forms of social reproduction’, the emergence of a welfare state in Britain can be seen as beginning to occupy that role. In another example,

Katrine Marçal (2015) asks ‘Who Cooked Adam Smith’s Dinner?’ With this apparently innocent question, she disrupts the analytical assumptions of classical political economy, in particular its notion of the self-interested and isolated economic subject. Adam Smith’s abstract musings on this atomised subject acting in ‘his’ own self-regard – the isolated Robinson Crusoe so loved by political economy – were utterly dependent on the love and labour of his mother who acted in a way that was profoundly contrary to her ‘own self-regard’. Smith’s mother, in her concrete acts, therefore undermines the very basis on which her son’s political economy proceeds. The production of value-producing bodies – just as with the reproduction of Adam Smith’s theory-producing mind – depends entirely on a process of social reproduction that entails a complex set of social relations – and which remains implicated in the reproduction of gender, race, migrant status and other intersecting planes of social ‘difference’.

The functioning of the body as infrastructure, that is to say, is uneven, contested and incomplete. It spans the realms of both production and social reproduction. While recognising the ‘practical truth’ that under capitalist relations the body does function as a technology for the input and output of calories, and to ignore the reproduction of labour power as a commodity, is to risk reasserting the real abstraction taking place in the capitalist subsumption of relations of (re)production. Ignoring reproduction is to occlude the concrete, lived reality of difference and the uneven violence inflicted on socially differentiated bodies. This difference is internal, not external, to capital’s regime of value (Werner et al., 2017). Saidiya Hartman’s exploration of ‘Black Women’s Labors’ shows – in the historical context of slavery (Hartman, 2016: 168), but with deep relevance for our argument – how social reproduction and social differentiation are part of what constitutes value regimes. Bodies themselves are reproduced so as to be available as labour power, as producers of abstract labour. But people themselves breach the bounds of mere labour power: they are obviously so much more than the infrastructure of value production. To put it another way, abstract labour is produced only by the reproduction of concrete living labour (De Genova, 2016). This (re)production of living labour remains inextricably bound up with historically and geographically specific forms of social difference and multiplicity, which become an internal determination in the movements of the value form itself. Melissa Wright’s analysis of the role of gender in the production of disposability in the political economy of the maquiladoras on the US–Mexico border is just one of many examples of such internal determination (Wright, 2001).

While workers’ autonomous practices are conditioned by their subsumption to the logic of accumulation, they cannot be reduced to it. The body is one of the sites where the tussle between the demands of abstraction and concrete processes of social reproduction plays out. To return to the migrant workers’ dormitory, struggles over time in the Czech Republic’s labour regime demonstrate how migrant workers navigate temporal clashes between the industrial shift system and bodily circadian rhythms (Schling, 2017). The subsumption of life to work brings us to the question of what bodily regimes are implied (and demanded) by particular regimes of value. What becomes visible is the constitution of differentiated bodies within the elisions and contradictions between value and social reproduction – a differentiation which we have here explored in terms of an infrastructural condition positioning the body as a technology of circulation. Furthermore, it turns our attention to the vernacular practices that resist abstraction and discipline. It takes us, also, to the conditions by which, and through which, social reproduction functions.

Resisting: Bodies always exceed exchange value

The fundamental contradiction expressed in the dual character of labour is reflected in Marx's analysis of the commodity as social form. While value is defined by the category of abstract labour,² use-value is determined by the commodity's actual relation to human needs. These needs are themselves determined by those social and cultural values which give human life, and social reproduction, their qualitative meanings. For Bolívar Echeverría, capitalist modernity is in this way

...ruled simultaneously by two structuring principles which are inherent to it; two coherences or rationalities in contradiction to each other: that of the mode or the 'natural form' of life and its world and that of the mode or the 'value form' ... of the same. They are, in addition, two 'logics' in which the second, that of 'value', is permanently in process of dominating over the first, the 'natural', of 'subsuming' it. (2011: 281, our translation)

By 'natural' here Echeverría is not making reference to some essential proclivity of humanity rooted in nature, but rather to the constitutive lack of it: to be human is to be faced with the necessity of giving cultural form and meaning to social reproduction. The concrete form of capitalist society, therefore, expresses a perpetual struggle through which social reproduction and its vernacular meanings are dominated and subsumed by their own inversion in the alienated, 'spectral objectivity' of the value form. Social reproduction is structurally 'devalued' and becomes a mere means for the unending treadmill of valorisation: valorisation is constituted as the structural social *telos* of capitalist society. In this way, the social metabolism becomes subjected to a constitutively meaningless imperative, a situation whose absurd and catastrophic nature is made manifest in the different facets of capitalist crises, and reproduced through the stratified forms of oppression which are the hallmarks of capitalist modernity in all its stripes. But, given that valorisation remains irreducibly reliant on the qualitative dimension of social reproduction (i.e. use-value), bodies and social reproduction remain recalcitrant processes. While infrastructures cannot decide to push back against their fetishisation or abstraction, embodied subjects can. It is not only the rule of capital that needs to be articulated on the permanently shifting cultural grounds that give social reproduction its multiple meanings, but it is also from these grounds that any possible political composition of resistance must emerge. In so far as resistance to abstraction can only be rooted in the variegated field of meaning that constitute the use-value dimension of social reproduction, its forms must be by definition multiple – thus the main challenge facing their political composition is, as succinctly formulated by the Zapatista movement, that of 'a world in which many worlds fit'.

The contradiction Echeverría (2011) describes permeates all aspects of social reproduction within a capitalist system of accumulation. It is materialised in the built environment, unfolds through its ecology, and is lived in the embodied experience of capitalist modernity. The torn existence of bodies as both infrastructures for abstract labour, and as their own sites of purpose and meaning, is the hallmark of the lived experience of capitalist relations of production, and of the struggles through which they unfold. Understanding bodies as infrastructures also raises the question of standpoint: from the perspective of capital, a worker's body is a means of production and a conduit for the production of value. From the perspective of a loved one, that same body is the subject of desire, love, care and respect.³

Conclusion: Infrastructural commoning

Bodies are infrastructures. They lift and carry, become technologies of circulation, function as accumulation strategies and enable socio-ecological fixes. In and through their uneven infrastructural work, they are differentiated. Bodies as infrastructures also break down, decay, and are repaired. The acts of decay and repair of bodies cannot, however, be thought of outside of the metabolic processes sustaining different bodies, relations of social (re) production, and the vernacular forms of resistance that point to life's grounding in concrete social acts. If conceptualising the decay and repair of bodies as infrastructure necessitates a turn to practices of social reproduction that sustain life, it might also enable a conversation with Berlant's reading of infrastructures of commoning, infrastructures 'of patience and appetite, an unusual pair' (2016: 409). This unusual pair posits the material and ontological relationality of bodies – our continuity with each other and our environments – and figures social reproduction as that which connects, and constitutes, what we share and how we care. As Berlant puts it, 'whatever makes it possible to bear each other will not come from belief in abstraction' (2016: 413). The multiple texture of the word 'bear' here – to tolerate, to support, to carry – captures the bodily work within communal life that social reproduction theory and Marxist feminism has for so long been insisting upon. This returns us to Diane Elson for whom 'the objectification of the concrete aspect of labour is universal, but the objectification of the abstract aspect of labour is not: it is specific to capitalist social relations' (Elson, 1979: 150). As Scarry puts it, one of Marx's core assumptions is 'first, the presence of the body in artifacts and second, the making of the human body into an artefact' (Scarry, 1987: 244). For Scarry, 'the frequency of [Marx's] allusions to the body, his structural dependence on them in arriving at his overall political critique [...] their cumulative weight [...] announce[s] his sober recognition that the large Artifice has about it the character of living matter' (Scarry, 1987: 246). That is to say that abstraction never escapes the body, and, as we have argued, that abstract labour and abstract value both rely on the infrastructure of the body.

This objectification of abstract labour transforms the body into a source of socially necessary labour time and, from the standpoint of capital, bodies as infrastructures become a real abstraction, a simple set of inputs and outputs, of sugar-burning muscles, that are simultaneously the source of value. Nevertheless, Marx's analysis asserts the dual character of labour: labour is always both concrete and abstract. And, though subsumed by capital, labour continues to be the product of a concrete body carrying out concrete acts, pursuing particular purposes. Similarly, though subsumed by capital, social reproduction continues to be the product of concrete bodies, carrying out fleshy, messy, indeterminate acts (Katz, 2001), the multiple meanings of which far exceed the imperatives of accumulation. As Hartman puts it,

the forms of care, intimacy, and sustenance exploited by racial capitalism, most importantly, are not reducible to or exhausted by it. These labours cannot be assimilated to the template or grid of the black worker, but instead nourish the latent text of the fugitive. (Hartman, 2016: 171)

Recognising that the body is infrastructure therefore requires understanding labour's struggle against its own abstraction (Holloway, 2010) as a struggle of concrete bodies and lived lives, in and against real abstractions. Harvey's (1982) Afterword to *Limits to Capital* touches on such themes. Tinged with a certain regret, pointing to a romantic yearning for a life freed from the

constraints of capital (and suffused with universalist understandings) Harvey considers an important point that we have troubled somewhat throughout this essay:

We should never forget, however, that though labour power is a commodity the labourer is not. And though capitalists may view them as ‘hands’ possessed of stomachs ‘like some lowly creature on the sea-shore’, as Dickens once put it, the labourers themselves are human beings possessed of all manner of sentiments, hopes and fears, struggling to fashion a life for themselves that contains at least minimal satisfactions. The conditions of production and reproduction of labour powers of different quantity and quality exist at the very centre of that life. And though susceptible of all manner of influence through bourgeois institutions and culture, nothing can in the end subvert the control workers exercise over certain very basic processes of their own reproduction. Their lives, their culture, and, above all, their children are for them to reproduce. (1982: 447)

While we may empathise with Harvey’s sentiments, this essay points to how ‘certain very basic processes of . . . reproduction’ have most definitely been subsumed by capital and coloniality. Harvey presumes a universal experience of the family, and neglects the fact that, for many, the particular ways in which their familial relations are gendered and racialised mean the state is never far away from determining how ‘their children are (not) to be reproduced’. We need only think about Hartman’s work on motherhood under slavery, or, more recently, the incarceration and separation of migrant children and parents on the USA–Mexico border to problematise such a claim. Subsumption does not stop at what Federici has called ‘the periphery of the skin’ (Federici, 2019). Bodily metabolism – the relational body itself – and the processes which sustain it, are not beyond the targeting scope of the value form. Subsumption, however, rather than a category of domination, is always one of contradiction, crisis, and struggle (Holloway, 2010). Processes of reproduction have always been, and continue to be, one of these sites of contestation. A social reproduction analysis highlights how the space of ‘hope’ lies not in the supposedly autonomous ‘outside’ sphere of reproduction – but in the contradictions and indeterminacies embedded within the contingent relations which form a totality of social relations (Gidwani, 2004). The struggles *against* the reduction of the body to infrastructure and in *favour* of the sustenance of diverse life in the face of abstraction are ongoing. As Saidiya Hartman put it, ‘survival requires acts of collaboration and genius’ (2018: 470). Political ecology’s investigations must commit to this collaborative genius of survival, which opens and closes around each act of resistance, and each act of care.

Highlights

- The paper is the first to conceptualise the body as infrastructure
- The paper develops a rich conversation between feminist and historical materialist approaches
- The paper troubles dominant understandings of metabolism through considering the decay and repair of the body as infrastructure

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ORCID iD

Alex Loftus  <https://orcid.org/0000-0002-8136-1224>

Notes

1. <https://www.theguardian.com/technology/2018/aug/23/elon-musk-120-hour-working-week-tesla>
2. This category refers to how the value form of labour (Elson) reduces the qualitative complexity of the metabolic relation to nature to a partial, quantitative, aspect of it: namely, the way in which it constitutes a portion of the total social labour integrated into the system of commodity exchange.
3. Which is not to deny that in some labouring conditions, 'love and care' are also simultaneously a site of value production, such as in waged care labour.

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