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Biosecurity: securing circulations from microbes to the macrocosm

Abstract

Biosecurity poses the problem of how to live with and manage the complex, contingent and emergent circulations of life. This excess of circulating life manifests in a host of different circumstances: from the biopolitical attempt to sort 'good' from 'bad' circulations disrupted by a zoonotic virus making use of air transportation networks; to fluid microbial topologies that challenge the bounded individual body; from a biosurveillance network signal prompting anticipatory governance responses; to the intersection of financial and microbial geographies in the risky practices of industrial agribusiness. The 'shock of the real' from these eventful and everyday occurrences not only illuminates empirical connections between circulating bodies, microbes, knowledges, electronic signals, seeds, capital, food and anxiety, but also highlights that the complexity of securing processes that are elaborating new forms of life cannot be fully captured through any one theoretical lens. In this review article I consider the burgeoning field of biosecurity studies through attention to these differing concepts of circulation, and suggest neglected circulations for future research.

Key words: Biosecurity, circulations, borders, biopolitics, surveillance, political economy.

Introduction

*"[W]e want a world in which people are as free as possible to travel and to exchange goods and ideas, but ... we **need** a world in which most other living things stay put "*, the environmentalist Chris Bright espoused (1999, 200). Biosecurity is popularly imagined and frequently experienced as the practical enforcement of that need – as the strict imposition of territorial integrity; of enclosures, borders and boundaries separating the safe inside from the dangerous circulatory currents outside; of separation, containment and purification (Hinchliffe, 2013). Teams of biosecurity officers armed with x-ray machines and sniffer dogs policing national borders with lists of the permitted and not permitted; automated barn doors designed to keep cows in and badgers out.

Despite the potency of this understanding of biosecurity as a rigid bordering logic, social science explorations of biosecurity as a form of spatialised environmental governance quickly dovetailed with diverse understandings of mobility and circulation. Travelling across disciplines, trespassing epistemological boundaries, concepts of circulation capture both accelerated life processes, but also the production of capital, information and power. Here I utilise it as a heuristic device – a way of drawing together different theoretical strands and empirical concerns in the issue complex of biosecurity. By disentangling four different modes of circulation – trade and travel, viruses, information and capital - overlapped by alternative theoretical conceptions of circulation, I hope to demonstrate the capacity of biosecurity as fertile empirical ground for theoretical development.

Biopolitical circulations: Facilitation; Acceleration; Cessation

Influential earlier work on constructions of disease, native/non-native species and national natural identity were strongly inflected with Foucauldian concerns over space, power and categorisation. The specific mining of the issue of biopolitical circulation following the publication in English of Foucault's *Security, Territory, Population* in 2007, however, has led to a wealth of insights into the relationship between biosecurity and the facilitation of life (Foucault, 2007). From simply arresting circulation through the categorisation, demarcation and protection of territory, biosecurity came to be understood as a practice concerned with its facilitation and optimization (Dillon and Lobo-Guerrero, 2009, 11; Foucault, 2007). Rather than in conflict with global trade, travel and contemporary neoliberal life more broadly through the imposition of import/export requirements, bag searching and other movement impediments, biosecurity instead emerges as a practice that facilitates these flows, by attempting to remove their risky or negative elements (Adey, 2004). In the context of WTO trade disputes, biosecurity arrangements operate as a badge of assurance for market penetration, a guard *against* the arbitrary imposition of trade barriers (Maye et. al. 2012; Potter, 2013). Law and Mol (2008) offer a further example in their exploration of the material politics of boiling pigswill, when they argue that biosecurity bordering practices operate by allowing circulation in such a way that maintains differences either side of a boundary – between diseased and disease free, but significantly also between rich and poor regions. Trade and financial circulations, they demonstrate, occur not simply in spite of these boundaries and the differentials they support – but are facilitated by these differentials. Circulation is an outcome of biosecurity.

One particular quote resonates through this work, where Foucault describes biopolitical governmentality as -

'a matter of organizing circulation, eliminating its dangerous elements, making a division between good and bad circulation, and maximizing the good circulation by diminishing the bad' (Foucault, 2007:18).

The difficulty for biosecurity practice is that this involves separating consequential flows. The same conduits opened up, promoted, sustained, invested in for the facilitation of 'good' circulations provides opportunities – conceptualized in the biosecurity lexicon as 'pathways' - for 'bad' circulations, to which they are tightly coupled (Dillon and Lobo-Guerrero, 2009). As tourists travel with viruses, goods with invasive species, animals with infectious microbes, food with contaminants; these things emerge as the dark side of globalisation: a direct result of the active incitement of circulations (Budd and Warren, 2011). Securing the contingent freedom of circulations necessary for the flourishing of a particular form of neoliberal life moves beyond a sorting of the 'good' from the 'bad' (Anderson, 2012; Dillon and Lobo-Guerrero, 2009). Biosecurity must negotiate a balance between too much and too little regulation, as in the spaces where it operates it is not the only concern, competing with a manifold of circulations, driven by different forces - the need to produce and distribute good, cheap food; the reproduction of natural identities; the reinforcement of family ties; the sustaining of economies (Bingham and Lavau, 2012; Barker, 2010). These flows cannot be simply halted or suppressed if liberal life is to survive and flourish. Identifying risky movements and determining the appropriate level of intervention involves an industry of risk

assessments and profiling, cost benefit analysis and bio-economic modelling (Mumford, 2013). Finding the right balance between regulating or temporarily halting circulations to preserve and protect circulations is not easy. For the 2001 Foot and Mouth Disease response in the UK, the 'closure of the countryside' has been criticised for the huge financial losses within the tourist industry; for the 2009 response to H1N1 the closure of schools and the mass prophylactic administration of Tamiflu brought costs, risks and disruptions outweighing those wrought by the virus itself (Barker, 2012; Chambers *et al* 2012).

It is not simply circulations with negative side effects that draw a security response, but those with the potential for perpetual escalation, such as infectious disease (Elbe, 2009). A threatening circulatory crisis, as Beck's work on the risk society shows us, undermines normal risk management, avoids containment within acceptable limits, and is marked by its widespread disruptive influence (Elbe, 2009; Beck, 1992). It is the potential for these circulatory threats to drastically reduce or cease other circulatory flows, of people, goods, transport, of (heaven forbid) the 'perpetuum mobile of circulation' which defines capitalism, that invites the security response (Marx, 1976). This insight underpins a vein of research within biosecurity studies into 'vital systems security' and the logic of preparedness (Anderson, 2010; Lakoff and Collier, 2008), in which the focus of security is on arrangements for maintaining or rapidly rehabilitating vital infrastructures of circulation (information, finance, power, water) after a generalized insecurity 'event'.

For Hinchliffe *et al* (2013), however, this sorting and securing of circulations as part of the facilitation of neoliberal life through biosecurity practices remains a

'will to closure'. Underpinned by a bordering spatial logic of disease as an external threat, the success of these practices, they argue, is measured by their ability to limit the flow – *incursion* or *invasion* - of fully formed unwanted organisms from 'over there' to 'here' across territorial space. Desired circulations become 'walled in' through attempts to enclose them in disease-free conduits, while the role of industrial agriculture in producing the conditions for disease are neglected. While this implies excess attention within both biosecurity accounts and practice into the distribution of disease over its production, any easily made distinction between disease emergence and distribution has been challenged through explorations into the productive potential of circulation, as the following section reviews.

Microbial geographies: Molecularisation; Emergence; Association

Foucauldian analyses of biopolitical circulations incorporate attention to nonhumans, material 'liveliness' and the non-discursive realm (Philo, 2012). To fully capture biosecurity as a key biopolitical domain of the present, however, further theoretical resources have been drawn on to consider how life is characterized and constituted through circulation. In particular, understandings of life as molecular; as emergent, vital and multiple; and as formed through or comprised of associations, composites and assemblages, have made important contributions to our understandings of biosecurity realms.

Nicolas Rose, amongst others, has advanced the thesis of contemporary life as 'molecularized' (Rose, 2007). Through the reorganization of the gaze of the life sciences the human body was imagined as sub-cellular processes and events. As a predominant imagination structuring who we are, this molecular body has

become subject to a host of pastoral expert knowledges and self-management—thus engendering forms of somatic individuality (Rose, 2007; Novas, 2000). In biosecurity literatures this image of a self-contained molecular ‘human’ body has been replaced by that of a shifting, collegial (or not so collegial) inter and intra-active assemblage of associated organisms (Haraway, 2008; Hird, 2010). Through biosecurity concerns our porous and sticky composite body has been politicized for its potential to enable the mobility of unwanted entities – taking us from forms of somatic to *symbiotic* individuality (Barker, 2010). When coupled with an understanding of modern life – particularly cities – as networked spaces, this vulnerable geopolitical body embedded in chaotic and unpredictable molecular contexts becomes less a personal project than a potential global pathway (Ali and Keil, 2008; Braun, 2007).

Biosecurity theorists have drawn this engagement with mobile life at the molecular level together with concern over the mutability of viruses in expert discourses, into conversation with work on immanence, emergence, vitality and contingency (Braun, 2008; Deleuze, 2004 [1980]; De Landa, 1999). Life becomes characterized by its inherent mutability and multiplicity, by the ‘*excess of being over classified and calculated being*’ (Dillon and Lobo-Guerrero, 2009, 8; Shaw et al., 2010). Alongside these manifold possible disease futures contained within the present, further fracturing and multiplication occurs through the practices that attempt to make viruses knowable. A significant theme within the biosecurity literature, indebted to Annemarie Mol’s empirical philosophy, explores different knowledges about disease not as competing perspectives on the same thing, but as multiple enactments, multiple realities produced through

the intersection of materials, knowledges and practices (Mol, 2002; see Law and Mol, 2008; Enticott, 2008, Mather and Marshall, 2011). Crucially, however, nonhumans have been shown to be mobile, mutable, emergent – and hence uncertain – not just through their dealings with humans, but through life’s own productive capacities (Clark, 2002; Clark, 2003).

In the context of biosecurity concerns, emergence is intimately related firstly to mobility – as viruses circulate, drifting, mutating, evolving and re-assorting - rendering circulation a life-producing force. As they travel through populations, influenza viruses from pigs, sheep and humans meet, mix, mingle and join forces. Through small adaptations viral barriers between species are broken down, or prions replicate and multiply - in defiance of established science (see Hinchliffe 2001 for an extended discussion of BSE; Hinchliffe, 2013). Secondly and following on, emergence is a function of connectivity or association – with disease increasingly understood as a co-evolutionary or relational achievement (Hinchliffe, 2013; Dillon and Lobo-Guerrero, 2009). Through this continuous mixing or enmeshing – of bodies, environments, hosts, viruses – opportunities for new life occur as divisions are circumvented. For the management of infectious disease, the mobility, motility and associative potential of life leads to the ongoing production of new diseases; the potential for shifts in the transmissibility and virulence of existing disease; and the possibility that viruses will achieve the capacity to cross species barriers. For Hinchliffe *et al* (2013), the implication of disease emergence as a relational or associative achievement enabled through industrial agricultural environments has not been fully accounted for. Building on Enticott’s (2012) work on disease expression which

challenges disease presence or absence as the distinction between healthy and unhealthy bodies or spaces, they argue: *'Being healthy may not simply mean being free from pathogens, but a matter of immunocompetence; that is, the ability to live with a variety of other organisms that are always in circulation'* (Hinchliffe *et al* 2013, 7). They argue that it is the intensity of relations that compose space rather than movement along a network through which disease gains its effectiveness. While circulation and association can be seen as co-constituting elements of disease emergence, the metaphor of overflowing intensities here, rather than the breakdown of boundaries over there, is a vital realignment of powerful biosecurity worldviews.¹

Biological life understood as emergent phenomena presents the continual possibility of producing new, unknown and unpredictable biological threats, which exposes biosecurity practice to the impossibility of full knowledge, and necessitates, it is argued, attention to nonspecific biological threats in a generalized context of emergency (Cooper, 2006). The capacity or success of biosecurity regulations and practice to incorporate a response to biological indeterminacy and radically open futures varies across biosecurity issue areas and regimes of practice. For zoonotic infectious disease - 'naturally occurring', accidental and nefarious - a range of anticipatory governance approaches to this indeterminate generalized threat (such as forms of precaution, preemption,

¹ There are difficulties relating these insights to other contexts of biosecurity concern, where, for example immuno-incompetence is not a product of industrial human-animal relations but of geological-biological relations - the fragile island environment rather than the fragile chicken body. This points to a wider issue within the biosecurity literature. Just as Philips (2013) critiques the captivation of eventual over everyday biosecurities in our accounts, there exists a tendency to extend theoretical insights from one mode of biosecurity to a generalized biosecurity - with animal disease emergencies dominating understandings of what biosecurity is.

preparedness) have been extensively detailed by biosecurity theorists (Anderson, 2010b; Anderson, 2010a; Braun, 2007).

For invasive plants and plant diseases, the inherent unpredictability of relational life leaves national and international governing bodies and international trade agreements scrambling to keep up, and poses problems for risk assessments based on current observations – as good behaviour in one environment fails to guarantee docility in another – particularly in the context of climatic shifts. This is leading to pressure for ‘white lists’ of permitted plants and products over ‘black lists’ of not permitted, which can permanently lag behind the inventiveness of life. A notable response in this sector has been the promotion of sterile hybrids and cultivars as alternatives to popular yet invasive garden plants within New Zealand’s ‘Plant Me Instead’ initiative – an example of the targeting of ever-earlier points of intervention in the emergence of pests.

Biosurveillance and Informational Governance: Extension; Presence; Anticipation

One key response to the emergent potential of epidemics and invasive events operates through a further circulatory current. Biosurveillance - the production, analysis and circulation of information on potential invasive events or epidemics - is a preeminent response to invasive threats, a growing area of public and private investment and a significant feature of national biosecurity regimes and international disease protocols.

In Eugene Thacker’s terms disease surveillance networks are engaged in a real time battle between infection and communication, with surveillance networks

contending dispersed emergent biological networks that achieve circulation across vulnerable bodies and highly connected nodes of transportation and transmission such as airports and hotels in globally networked cities (Thacker, 2005; see also Ali and Keil, 2008). In an effort to replicate this indeterminate and inventive expansiveness, a host of different practices and technologies are drawn into the surveillance net, as epidemiology is mapped through ever more complex and immediate forms of infodemiology. Data on pharmaceutical sales, electronic information generated through internet use (Google searches, social media status updates or automatic searches of news stories), and even information on work absenteeism is being enrolled in the broader agenda of the security state, casting the medical/security gaze ever further (Parry, 2012; Eysenbach, 2002).

Just as the disease 'network' is made up of technological, biological, human and non-human agencies, these surveillance networks are not just automated information exchanges but relational intra-actions of computers, information, hospitals, health professionals, x-ray machines, calipers, sniffer dogs, publics. This plethora of humans, nonhumans and technologies perform different practices - counting, photographing, reporting, sniffing, x-raying, measuring, swabbing, weighing, scanning, recording, collecting, sampling - through which biological markers (saliva, antibodies, a specimen of a pest) are transformed and circulated through these networks as information, 'data doubles' (Ericson, 2000), informatic holograms. Dillon and Lobo-Guerrero (2009) refer to the 'liquidification of 'information'', as information is reduced to digital bites electronically, and molecular code biologically, which flow through systems of information exchange. This information can then be rematerialized in different

forms (reports, publications) and reattached to a material referent (samples) (Latour, 1987). In this way occurrences of ill-health, disease or sightings of pests can be combined and transformed into forms that can be responded to politically. This begins to blur Thacker's portrayal of biological networks on the one hand, and informational networks informing our understanding of these networks of life on the other. Instead, Dillon and Lobo-Guerrero point to '*a widespread account of life as informationalised, complex, adaptive and emergent*' (Dillon and Lobo-Guerrero, 2009, 6).

These globally extensive informational processes attempt to make visible the specific topology of an infectious disease or invasive event – where it emerged, how it has traveled along different pathways. They are an attempt at calculability, at anticipating the oncoming epidemic, allowing time to put preparedness strategies into play (Adey and Anderson, 2012; Anderson, 2010a). They also function as systems of traceability, as a tool of recall and reconstruction (Bingham and Lavau, 2012). Their existence therefore anticipates biosecurity failure – embodying the discourse of '*not if, but when*'. This anticipatory framework could be argued to be generative of disease events, as this highly sensitized global surveillance infrastructure interacts with the underdeveloped capabilities of preparedness strategies to act in a reduced capacity in the event of mild pandemics (Barker, 2012).

The International Health Regulations (IHR) requires states to notify about any event occurring in their territory that may constitute a 'public health emergency of international concern' (World Health Organization's WHO, 2008:2). This necessitates monitoring possible signals of infectious disease, putting pressure

on struggling public health services, diverting attention and funds. In addition, supposed 'dual-use' technologies involve the sharing – or co-opting - of public health surveillance networks for security concerns (Fearnley, 2008). The discourse of global health citizenship and the universal exchange of information belies the ways in which this tends to the whims of the rich rather than the needs of the poor (Ingram, 2005).²

The main aim of surveillance is to reduce the invisible presence of a virus or organism in a country, the period of 'silent spread' prior to detection. Intervening earlier is more cost effective and has a greater likelihood of success. But we also need to attend to the political and economic work these networks perform in producing and stabilising a visible absence. This entails proving you don't have certain pests or diseases – such as foot and mouth in your national herd or fireblight in your exported apples - in order to participate in global trade, prove compliance to WTO standards, open up and maintain market access, and generate confidence for tourism (Higgins and Dibden, 2011; Law, 2006; Maye et al., 2012). The visualization of absence involves information management and circulation through continual report writing and publishing in a variety of formats. Every moment of surveillance, every report of a sighting, every 'false positive', becomes a possible disruptive presence that requires intensive work to stabilize as an absence (Froud et al., 2008). This requires continual reproduction, as surveillance practices and the surveillance architecture need to be made visible to succeed in securing international trust. This constructs a general global

² The extent to which the One Health Movement – which seeks to link research and policy initiatives in the securing of animal and public health – replicates this co-opting of resources through the privileging of concerns about zoonosis and contagion over more mundane yet lethal health issues has yet to be subjected to significant research (but see Hinchliffe 2013b).

state of insecurity, to the disadvantage of those countries where proof of absence is too expensive to achieve. Information and its circulation, not just conditions of knowledge such as uncertainty/indeterminacy, is therefore a driving force of biosecurity management.

Commodifying life: Surface; Intensification; Scale

The final form of circulation and area of theoretical attention I will consider attends to the question of how globalization processes and global financial circulations impact upon biosecurity agendas in the interdependency of economic and microbial systems of circulation (Elbe, 2007). Borrowing from work on the ways in which urban features can be viewed as surfaces for the materialization and circulation of financial value (Sassen, 2000; Simone, 2011), research within this area must ask what, for biosecurity, are the significant surfaces to which the circulation of financial, but also cultural and political value, attaches. By highlighting two possible surfaces of and for research, I hope to draw attention to this comparatively under investigated area of biosecurity research. These are, firstly, host bodies, and so, for example, the political economic processes that are driving the intensification of agriculture and rapid movement of animals; and secondly the viruses/microbes/pests themselves.

A focus on host bodies as a surface for the circulation of value integrates attention to the political economies of agribusiness and global finance with viral ecology, as disease becomes the fallout of concern for multinational profitability. Wallace (2009), in considering the story of the bird flu virus H5N1, explores the viral opportunity structure of liberalized economies in regions of the world

where unregulated agribusiness is pressed against peri-urban slum development. This provides viruses with enhanced evolutionary options in terms of transmission, virulence, and diversity. Rather than disease as something circulating through agricultural environments – a threat from the outside for which we need barriers to protect against – it is the circulation of capital which attaches to animal bodies that generates the conditions for disease emergence within intensive agriculture. This occurs through the production of highly pressurised vulnerable animal bodies redesigned, packed together and speeded up in response to market forces (Hinchliffe, 2013; Hinchliffe et. al, 2013). These vulnerable animal bodies themselves undertake extraordinary national and international movements both before and after slaughter. In the case of the UK's 2001 FMD epidemic John Law (2006) traced how 10 initially infected animals crossed paths with 24,500 others, in a system influenced by large scale abattoir closures, the CAP system of quotas, and the wider economies of the livestock industry. Exploitative commodity production chains of neoliberal globalisation therefore produce both global bio-insecurity and local labour insecurity; environmental bads and bad food; and emerge as the most fertile breeding grounds for pathogens and pathogenic inequality (Wallace, 2009; Sparke and Anguelov, 2012).

If we look to microbes/viruses/pests as surfaces for capital accumulation and circulation, then what we are witnessing with biosecurity is the financialisation of emergent, unwanted life; not just in ways that drive its circulation as an unintended outcome, but also by capitalizing on this circulation. This conceptualisation moves beyond Elbe's (2007) discussion of how finance and

viruses *negatively* impact each other, as markets become jittery in response to new viruses, attempts to avert negative economic factors delay responses and speed up viral spread, or international political-economic factors constrain states' responses. There is a rich area of work to be built upon focusing on developments in biomedicine and the life sciences, which considers how medical and technological advances have opened new circuits of capital producing bioeconomic accounts of life in which we are understood as both molecularized and financialized beings (Braun, 2007; Cooper, 2008; Rose, 2007). Invasive species, viruses and microbes can no longer be seen simply as posing problems for capital accumulation and circulation as '*incalculable, invaluable, and opaque*' entities that threaten to halt financial circulations (Dillon and Lobo-Guerrero, 2009). They also enable other capital flows. In many ways they are a perfect surface for capital accumulation and the epitome of neo-liberal values. By removing problems of scale, flowing easily across territorial boundaries and trade barriers, and, through the ever-generative rationalities of anticipatory action, enjoying a constant and limitless captive market, they might well be regarded as the ideal commodity.

We need to concentrate research attention on the implications of these financial circulations for biosecurity, and the precise and differing nature of the intersection between biosecurity and neoliberalisation in specific contexts. There are those related to pharmaceutical companies through the production of antivirals and vaccines - something that has come under scrutiny both through Indonesia's exertion of viral sovereignty by refusing to freely share its viruses whilst being locked out of the distribution of resulting vaccines or profits - and

through accusations of the undue influence of these firms on the global political community's response to H1N1. There are the private surveillance firms selling services and new technologies to public agencies, pest eradication firms pushing pesticides or undertaking contractual work, and viruses translated into mobile and fluid networks of information that can be owned, bought and sold as intellectual property. A host of different companies have responded to the problematisation of viral acceleration and the constructed technocratic response through the logic of financial profit. While cost sharing for biosecurity has become a central question for governments grappling with the balance between public good and private industry responsibility, profit sharing also requires critical attention.

Conclusions

In exploring four different modes of circulation significant for biosecurity – of trade and travel, microbes, information and capital – circulation itself has (e)merged as a space of security and form of power; a life-generative force; an informatic projection; and an opportunity for capital accumulation. This is by no means an exhaustive account, neglecting other circulations that jostle for significance in a biosecurity worldview. Not least are the geological circulations, which, in concert with a mobile inhuman host of flora and fauna, produce a collaborative form of globalization 'from below' against which any attempts at 'biosecurity' can only be viewed with modesty and humility (Clark, 2012). Additionally, the ways in which biosecurity governance approaches (e.g. neoliberal cost-sharing), interventions and practices (e.g. risk assessment

procedures, public awareness campaigns, diagnostic kits) are mobilised and mutate from one governing context to the next through ideas of 'best practice', the sharing or sale of expertise and technology, underpinned by the demands of international protocols, is crying out for research attention. Biosecurity policy as a case study not only offers the possibility of a neat metaphor - the circulation of policy on the securitisation of circulation - to the existing rich literature on policy mobilities. The materiality of different environmental governing contexts and the disruptive agency of spatially displaced non-humans extends concerns over the adaptation of policy into different socio-cultural and political contexts in generative ways.

Biosecurity as an empirical field has become a site through which different theoretical approaches circulate, entangle and recombine, revealing that the complexity of securing the processes that are elaborating new forms of life cannot be fully captured through any one theoretical lens. Just as epidemics and invasive events act like tracer dye in the networks of global connectivity, demonstrating connections through circulations of biological, technological, cultural and political matter, the issue area of biosecurity has traced linkages between what can sometimes appear as theoretical silos. This has required the troubling of spatial assumptions and understandings of both borders and circulations, as borders are deterritorialised and circulate, and as circulations are 'walled in' reinforcing a logic of closure, of inside and outside.

Our theoretical accounts of biosecurity have perhaps reached a moment of saturation. We need to bring these insights into conversation with the reimagining of what biosecurity could entail, by investigating how alternative bios-

securitisations can be built back into the design of public and private practices. Two brief examples at different scales. Mosquitoes, moths and other insects follow their instinctive desire for the moon, embodied in the night lights of tourist and fishing boats that tempt them from one island in the Galápagos archipelago to the next, disrupting evolutionary isolation and spreading insect-borne diseases to vulnerable animal populations. Through the simple act of turning off these boat lights at a distance from shore, the hypnotic circulatory trace is broken. The intersection of geological and biological spatio-temporalities is reinstated through a techno-physical act supported by campaigning, voluntary agreements and social coercion. In a second example, a local council approves the site for a farmers market in a central urban area previously suffering as a fresh food desert, and offers grants for local urban agriculture initiatives. Residents are now able to buy, direct from the producers, organic free-range meat from robust breeds, reared and slaughtered within less than 25 miles. The animals' own immunological responses, the lower density of animals at the farm and the reduced movements from farm to fork all perform functions constraining the possibilities for the production and transmission of viruses. Biosecurity could mean drifting in a blackened boat beneath a starry sky, or sharing tasty, nourishing food.

Disease events will happen. The chains of causality in the complex social and technological circulations that cause and spread disease are open and emergent, defying prediction and control (Fish *et al*, 2011). Finding ways of living with disease within these indeterminate circulatory systems is important (Bingham and Hinchliffe, 2008; Enticott, 2010; Mather and Marshall, 2011; Philips, 2013).

So too is finding ways of living with biosecurity – if it can be remade to comprise of actions that form part of a world in which we want to live.

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