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Title:
Varieties of Biosocial Imagination: Reframing Responses to Climate Change and Antibiotic Resistance

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Abstract

The authors present climate change and antibiotic resistance as emergent biosocial phenomena – ongoing products of massively multiple interactions amongst human lifestyles and broader life processes. They argue that response to climate change and antibiotic resistance is often framed by two varieties of biosocial imagination. Anthropocentric imaginations privilege the question of human distinctiveness. Anthropomorphic imaginations privilege the question of whether biosocial processes can be modelled in terms of centres of moral and causal responsibility. Together, these frame the matter of response in terms of deliberate human action. The authors argue that, considered as emergent biosocial phenomena, climate change and antibiotic resistance ‘diffract’ deliberate human action and thus limit the value of this frame by rendering the human/nonhuman and intended/nonintended distinctions that are crucial to its practical operation locally irrelevant. Alternative biosocial imaginations currently developing around climate change and antibiotic resistance that allow for ‘diffraction’ and therefore frame response differently are considered.

Keywords: Climate change, antibiotic resistance, emergence, biosocial, anthropocentric, anthropomorphic, Whitehead

Foucault (2007) argues that dominant understandings of the threat of famine underwent fundamental change in early modern Europe. At first, famine was interpreted as an act of God and, sometimes, as retribution for sin. Responses were arranged accordingly. Deployments of grain that were understood as motivated by avarice were discouraged. Thus, bulk storage and international trade, each of which could generate large profits during shortages, were, on some occasions, outlawed. In time, as governments focussed on what Foucault calls the ‘security’ of populations, both famine and responses to it were reframed as matters of economy. It then appeared that responses designed to counter avarice had reduced incentives to invest in the development of farmland, perversely increasing the likelihood of famine. Further, restrictions on international trade had closed off potential relief through import and export. A host of new policies now treated the desires of farmers and traders to generate profit as a key resource in governmental efforts to secure grain supply.

Today, famine is joined by fresh challenges to human wellbeing such as climate change (CC) (Giddens 2009, IPCC 2007) and the evolution of resistance to antibiotics (AR) by some bacterial pathogens (Drlica and Perlin 2011, Soulsby 2005). Each can be characterised as a ‘biosocial’ phenomenon formed through specific conjunctions of human lifestyles and other life processes (Lee and Motzkau 2012). Further, each can

be characterised as an ‘emergent’ phenomenon, a pattern of vulnerabilities produced on an ongoing basis as the outcome of massively multiple interactions (Weinstock 2010). Much recent discussion of CC emphasises the failure of international bodies to organise effective responses (Held et al 2011, Shearman and Smith 2007) and much recent discussion of AR suggests that the era of antibiotic treatment of infection may come to an end within decades (Arias and Murray 2009, Soulsby 2005). Like famine in the early modern period then, CC and AR present questions of appropriate response and of how the search for, selection of and implementation of responses are framed.

Foucault (2007) emphasised the differences between responses to famine formulated within a theocratic frame and those formulated within a nascent ‘biopolitics’. This enabled him to present issues of human relation to the non-human world, of problematisation and of response as matters of practically and contextually oriented imagination rather than as a-historical conundrums. In a similar vein we examine the contemporary framing of the matter of response to CC and AR by ‘biosocial imaginations’ (Lee and Motzkau 2012). We will draw attention to the extant variety of such imaginations especially to those that, as yet, have relatively limited currency. It is our intention thereby neither to present ‘better’ responses, nor to criticise any specific response, but to highlight the possibility of productively reframing current debates on responses to CC and AR.

We argue that two complementary forms of biosocial imagination frame much consideration of what it is to respond. Anthropocentric biosocial imaginations focus on the ‘deliberateness’ of human activity, placing a premium on it as a source of effective response to biosocial phenomena. This imagination is also concerned with the possibility that human activity, considered as the outcome of evolutionary or neurological processes, may, at base, be no more ‘deliberate’ than any other life process. Anthropomorphic biosocial imaginations attempt to grasp complex biosocial processes on the basis of analogies with human experience and posit the existence of moral and causal centres of responsibility for events. They are also concerned with the possibility that such analogies are destined to fail. Together these imaginations ensure that the matter of what it is to respond is currently made intelligible through the figure of ‘deliberate human action’. This figure enjoys common currency across a range of domains of response including legal bids to establish fault and liability (Grossman 2003), policy development and implementation where it conditions the ‘tractability’ of biosocial problems (Latour 2004, Shiffman 2009), and everyday practices of will and motivation (Fennell 2009). Thus, we argue, the question of what it is to respond to phenomena like CC and AR is often approached as if it were subordinate to the question of whether humans are distinctive within the wider matrix of processes that compose human and non-human life.

We suspect that issues of human distinctiveness are not amenable to general or permanent settlement (Lee and Motzkau 2012). We would instead see them in terms of a ‘separability’ (Lee 2005) that enables partial and temporary distinctiveness in some sets of circumstances. So, in what follows, we do not seek to engage directly with those debates. Instead we suggest that CC and AR entangle life processes and social, economic and political forces so tightly and on such a range of scales that, first, it is often difficult to identify stable sites of causal and moral responsibility and, thus, suitable moments of intervention and, second, that responses often have perverse outcomes. This disturbs the narrative links between intention and outcome that

underpin concepts of deliberate human action and, we argue, diminishes the pragmatic value of anthropocentric and anthropomorphic imaginations as applied to CC and AR. This leads us to consider CC and AR as phenomena that ‘unask’ (Hofstadter 1979) the question of human distinctiveness and thus make space for new biosocial imaginations.

To draw attention to the variety of biosocial imaginations, we develop a perspective on CC and AR that presents them as ‘emergent biosocial phenomena’ (EBSP). Our use of this term is not intended to distinguish CC and AR from ‘non-emergent’ phenomena. Rather, we draw on process theory (Whitehead 1927-8[1985], Motzkau 2011, Stengers and Chase 2011) to posit that all phenomena, human subjects or otherwise, owe their existence to relational dynamics of emergence. We find this approach helpful in broadening the biosocial imagination of response since it offers a vantage point that is at some distance from anthropocentric and anthropomorphic concerns. It portrays human distinctiveness as a local and temporary product of some states of affairs, rather than the measure of all. Thus, as we later suggest, even as it makes good sense to describe many individual humans as deliberate ‘agents’, not all human activity fits this template (Sawyer 2005). A key insight of this approach concerns what we, following Haraway (1997) and Barad (1995, 2007) call the ‘diffraction’ of deliberate human action. Seen in the frame of EBSP, deliberate human activity has inescapable non-intended outcomes. For example, even as a person uses an antibiotic pharmaceutical as part of a series of deliberate actions, rationally conceived and aiming at a specific outcome such as the treatment of infection in a post-operative wound or the suppression of bovine mastitis, they are also establishing local selection pressures relevant to bacterial evolution that play a role in precipitating AR (Walther et al 2008).

The key distinction our perspective then allows us to make is between biosocial imaginations that encounter such diffraction as if it were a fault to be repaired and those that encounter it as if it were an inevitable feature of action and a potential resource to guide and develop responses. Once we have laid out these matters, we will examine examples of contemporary responses to EBSP selected from the fields of CC and AR to illustrate the notion that ‘response’ can be framed in novel ways.

Anthropocentric Biosocial Imaginations

Various pairings of ‘bio’ and ‘social’ have accomplished a range of orienting and navigational effects within the human and social sciences. Explicitly ‘biosocial’ approaches to human behavioural science (Matson 1985), for example, tend to see each as a source of causal factors in the shaping of human behaviour. Here, the pairing establishes the central concern of the approach posing the question of how examples of the two ‘interact’ (Gibson and Tibbetts 2000). At a different scale, Wilson’s ‘sociobiology’ (Wilson 1975) used the pairing to draw questions of social order into an evolutionary perspective. In response, Rabinow (1992) recast the pair as ‘biosociality’, a pairing predicated on humans’ increasing technical capacity deliberately to intervene in life processes in line with socially defined objectives. Where sociobiology presented human conduct as one element of broader evolutionary processes that lack overall deliberation and design, biosociality emphasised deliberate human action in shaping life processes.

In our view, the cluster of different ‘bio’ and ‘social’ pairings we have considered so far shares an anthropocentric character. We do not suppose that each offers a consistent position that simply advocates human supremacy or distinctiveness. It is clear, for example, that behavioural science often splits humans into those research subjects whose behaviour is understood as caused and those consumers of research whose professional decisions are full of choice and deliberation. Likewise, Wilson (1975) accepts that humans have distinct characteristics but bids to account for them with the same techniques and concepts he would apply elsewhere. Rather we call these ‘anthropocentric’ biosocial imaginations because each is organised by the *question* of whether humans are distinctive amongst other life forms in their capacity to act with deliberation. As we see it, the anthropocentric biosocial imagination is a web of controversy that distributes possibilities for discussion and foci of curiosity. In doing so it foregrounds the question of whether and how humans are distinctive. We argue that as long as this question enjoys primacy, then the matter of response to biosocial phenomena like CC and AR will remain framed, for good or ill, by the figure of deliberate human action.

One recent manifestation of anthropocentric biosocial imagination neatly draws the connections between imagination and response. Current debate concerning responses to CC frequently addresses the issue of whether the evolution of human cognition conditions our ability to respond (Weber 2006, Rachlinski 2000). The question of whether our cognitive powers and emotional investments are such as to make us incapable of sufficient coordinated deliberate action tends to foreclose wider debate (Giddens 2009). As Dyer (2010) has it in his discussion of CC responses;

‘We are a mammalian species...evolved to live in bands of a few dozens...each of them perpetually at war with all of its neighbours...’
(ibid:210)

Thus questions about ‘response’ are often framed in terms of the nature of humanity. This framing can limit credible responses to CC to a range of ‘emergency’ measures like the expansion of nuclear energy and geo-engineering (Lovelock 2006, Dyer 2010).

We would stress that even as we distance ourselves from anthropocentric imaginations, we do not suppose that deliberate human action is impossible. There are many circumstances, such as the eradication of smallpox (Crawford 2007) and the reduction of atmospheric CFCs (Zerefos et al 2009) in which deliberate human action, has been successful. As we will shortly argue, however, there are reasons to think that CC and AR maybe unlike these circumstances.

Anthropomorphic Biosocial Imaginations

Even as they hold human distinctiveness open to question, anthropocentric biosocial imaginations generate the hope that humans are distinctive within the wider matrix of life processes and, thus, that deliberate human action will provide effective responses. Anthropomorphic biosocial imaginations advance the complementary possibility that certain features of human experience provide a fair model for events within that wider matrix of life processes. Anthropomorphic imaginations are evident in the popular reception of the concept of ‘emergence’.

Over the past century (Lewis 1875) the term ‘emergence’ has been used to describe the capacity of multitudes of interacting elements to produce patterned outcomes without the intervention of a central organising agent. It has been used to account for collective behaviour amongst flocking birds, schools of fish, and slime moulds (Clayton and Davies 2008). Even though the concept of emergence expresses a continued commitment to the causal explanation of phenomena in the life sciences and elsewhere, it still carries a mystique. As Porter Abbott (2008) argues, for some, any order seems to require an order-making agent, whether this takes the form of human will, a non-human person such as a deity, or a genetic essence. Considered against that backdrop of expectations, emergent order can resemble ‘something for nothing’. The deficit sensed here is not a thermodynamic one. Rather, there is a perceived absence in another register, an absence of directed ‘effort’ such as would be measured out by a person. In this context, emergent states of affairs would appear remarkable in that they have orderly existence but are not the result of any determinable ‘effort’ or ‘will’.

This expectation of central responsibility is a key aspect of anthropomorphic biosocial imagination and the hope it offers that deliberate human action can provide effective response to challenges to human wellbeing. Where anthropocentric imaginations are organised around the question of human distinctiveness, anthropomorphic biosocial imaginations are organised around the question of whether life processes can be modelled on the basis of expectations formed within human experience. It is closely concerned with attempts to gain ‘traction’ on events. Keller (1985) is clear that emergence can be difficult to grasp because of the prevalence of the expectation that central sources of control can and should be found. But what could lead to such an expectation?

Some speculate that evolutionary history has given human cognition a bias toward these expectations of central controlling effort as a solution to survival problems (Mithen 1996). Given that emergent eco-systems did not present themselves in whole to our human and other ancestors, but, no doubt, did present them with individual predator and prey animals, this speculation seems plausible. Such personal concepts as ‘trying’ and ‘will’ are at least compatible with such aspects of experience as relating to predators and prey. It is also possible however that these expectations derive from the application of sophisticated metaphors that draw on forms of social organisation and the patterns of accounting and response that they entail (Latour 1988). On this view, ordered states of affairs and opportunities to respond to them are often imagined on the basis of an analogy with a compelling collective human experience – social hierarchy. Hierarchies of agency, often institutionalised, enable some persons to play a greater role than others in shaping environments and outcomes and thus figure as centres of responsibility and as points of traction.

Within the terms of anthropomorphic imagination then, deliberate human action involves the formation of centralised ‘will’ but, if it is to achieve traction, it requires a corresponding concentration of moral and/or causal responsibility to apply itself to. This imagination presents a frame in which responses should be formulated on the basis of a clear retrospective account of who or what was responsible for a situation (Lee and Motzkau 2012). Examples of the application of this frame can be found in debates over the causation of climate change. The question of whether climate change

is anthropogenic has detained many in recent decades, but since an entire species is too diffuse a target to offer points of traction, the debate has moved into new phases in which causal and moral responsibility are shuffled between corporations and individual consumers or between developed and developing nations (Giddens 2009). Within the terms of anthropomorphic imaginations such debates should result in a clear narrative that can help organise response in terms of points of traction. This expectation is often confounded, however. In the case of CC the hierarchies and divisions of labour that pattern many human organisations and relationships provide poor metaphors leading us to look for stable concentrations of moral and causal responsibility where none are in evidence. If, as we will shortly suggest, CC and AR can be understood as emergent biosocial phenomena, neither presents us with a determined hierarchical superior, nor with a single causal force, nor even with a menacing predator but with the shifting outcome of billions of interactions in which human activity plays a considerable role. In such circumstances, it is difficult to mark off centres of responsibility against which traction can be obtained.

Thus far, we have described two varieties of biosocial imagination. One holds out the hope of effective response to environmental threats on the basis of a categorical distinction between human and other processes. The second holds out a complementary hope on the basis of analogies between key features of human experience and other processes. Each, as we have suggested, provides an intricate and fairly robust framing of the matter of response, but each also has its characteristic limitations. It would appear that when deliberate human action is frustrated, anthropocentric imaginations tend to respond with an intensification of deliberate action while, in the absence of moral or causal centres of responsibility, anthropomorphic imaginations have little to offer. In the following section we argue that phenomena like CC and AR can be viewed as emergent biosocial phenomena (EBSP), that this view sheds new light on the frustration of deliberate human action and that seeing this frustration through the metaphor of ‘diffraction’ can help to reframe the matter of response in potentially useful ways.

Emergence and Diffraction

It can be difficult to achieve satisfactory narrative descriptions of emergent phenomena. Porter Abbot’s (2008) study of evolutionary narratives points out that while it may be possible to describe the interactions of a few elements of an emergent order and large scale shifts in emergent order overall, the passage between those two levels is far less amenable to narration since it involves massively multiple interactions on a wide range of spatial and temporal scales, with the potential for cross-cutting influence between scales. This can be frustrating, since the new relationships, patterns of dependence between processes and relative stabilities of outcome that actually comprise emergence ‘emerge’ at just these meso-scales. Whenever a narrative grasp of an emergent phenomenon is required, when, for example research insights are communicated amongst non-specialist publics or amongst policy-makers, one solution is temporarily to present the phenomenon in terms of a fixed cast of characters and fixed set of relationships. The benefits in terms of clarity of account are offset by the failure to register that these characters and relationships themselves are subject to change. Such partial and temporary framings can be useful, but, in failing to register to novelty and unpredictability, they can be misleading.

For Whitehead (1985) this tendency to model open-ended, ongoing and unpredictable processes that generate novel entities and relationships in terms of the interaction of entities credited with static properties is a general problem for all causal account making. His core philosophical concern is to understand how novelty and change are possible, how the future can be different from and not merely pre-determined by the past. He warns against the use of frames in which the fixed cast of characters includes human subjects who are taken to stand in a predictable relationship of exteriority and control to non-human objects. The subject/object framing Whitehead objects to is identical to that comprised by the figure of deliberate human action and foregrounded within anthropocentric and anthropomorphic imaginations. Whitehead offers an alternative ontological frame that sees all entities, be they conventionally understood as subjects or as objects, as relational in essence, i.e. as constituted through the ongoing process of their situated encounters rather than as, thanks to their inherent properties, providing the motive force and determining limits to interaction. With this emphasis on emergence, Whitehead develops a different frame from that of deliberate human action. This offers opportunities for reconsidering response in the context of CC and AR.

In many framings of response, distinctions between actions that are deliberate, in the sense both of having been considered and being goal directed, and those that are not deliberate are considered to be of primary significance. Such distinctions are valuable in distributing moral responsibility for outcomes and in identifying avenues for change. In contrast, Whitehead presents the 'subject/object' distinction as one possible emergent *product* of relational encounters rather than as the foundation of such encounters. He is not alone in supposing that the deliberate/not deliberate distinction has limited applicability. As social sciences respond to concepts of complexity, for example, it is becoming apparent that there are many circumstances in which deliberate human action becomes indistinguishable from undirected activity. Sawyer (2005), for example, is content that individual humans possess agency, can reflect on their circumstances and devise deliberate responses, but he warns against the conflation of 'agency' and 'interaction'. As he has it,

'...when many agentive individuals begin interacting, socially emergent phenomena occur; but when a single agent acts in isolation, there is no social emergence...interactional regularities are... not reducible to participants' agency or intentions.'

(ibid: 207)

If Sawyer is correct, we should not expect to be able successfully to model massively multiple interactions on the basis of deliberate human action even when humans appear to be the only significant interactants. In the cases of CC and AR we then have to consider the activities of many humans as they are joined by those of many non-human interactants such as fossil fuel deposits, cattle, carbon dioxide and methane molecules or bacteria, plasmids, bodily tissues and the surfaces of built environments (Latour 2004). The application of deliberate human action in such circumstances is limited by the scope for the emergence of novel and unpredictable outcomes in such biosocial conjunctions. To examine CC and AR within the frame of EBS rather than within the frame of anthropocentric or anthropomorphic imaginations is to register

those circumstances within which deliberate human action takes on the character of undirected activity and, thus, becomes a stranger to itself.

Following Haraway (1997) and Barad (1995, 2007), we describe this aspect of EBSP in terms of a dynamic of 'diffraction'. Our use of this optical metaphor to depict the matter of response merits some exposition. When deliberate human action leads to an intended outcome, this might be described as a 'reflection' of deliberate human action. When a number of changes that are each necessary to bring about an intended outcome are effected at different speeds, this might be described on the model of 'refraction' where different materials, say water and air, slow the passage of light to different degrees. Conventionally, 'diffraction' refers to the division and relocation of light energy that takes place as light waves/photons are induced to interfere with themselves. Just like such light waves, when the concept of deliberate human action is considered within the framework of EBSP the effort it entails can be seen as divided and reorganised, outwith original intentions, and, sometimes, as interfering with itself. For example;

- the use of fossil fuels to promote human wellbeing has come to pose a threat to human wellbeing
- attempts to establish human role in precipitating climate change have been met with political resistance
- the use of antibiotics to treat infectious disease promotes the evolution of resistance to their effects amongst pathogens

It is through their capacity to show deliberate human action as diffracted and, so, to efface distinctions between deliberate and non-deliberate human action that CC and AR 'unmask' the question of human distinctiveness and reassert the question of what it is to respond. As we explore responses to CC and AR in greater detail it should become clear that some contemporary responses are framed in such a way as to treat diffraction as a resource to work with and to guide response rather than as a danger to deliberate human action.

Multiple Drug Resistant Tuberculosis as EBSP

Pulmonary tuberculosis is an infection of the lung by *Mycobacterium Tuberculosis*. It damages lung tissue and thus shortens life. It can be spread through the aerosols ejected when people cough and sneeze, has a high estimated infection rate of 22% (International union against Tuberculosis and Lung Disease 2009) and infection is promoted by poorly ventilated, high-density accommodation and poor diet. Individuals with tuberculosis can remain ambulant and infectious for decades. Multiple drug resistant tuberculosis (MDRTB) has emerged in poor, crowded communities in the former USSR, India and China, wherever patients fail to or are prevented from completing courses of treatment.

MDRTB provides a good example of 'diffraction'. Once a causally responsible agent such as *Mycobacterium Tuberculosis* is established, steps can be taken, such as the introduction of an antibiotic. The reaction expected of the pathogen is that it fails to reproduce. If all required for successful antibiotic treatment were failure of binary fission of one bacterium, this would probably be the end of the story. However, in any growing infection, many bacteria are present with varying capacity to resist antibiotics

(Arias and Murray 2009). Thus, considered as a population, a single bacterial species is capable of giving more than one response to a single human action. A series of deliberate human actions, carefully tailored to achieve a single outcome are taken up as factors in bacterial evolution with multiple drug resistance as one outcome. A number of commentators have recently argued that the use of antibiotics as a mode of response to pathogenic species is self-limiting (Arias and Murray 2009, Crawford 2007, Drlica and Perlin 2011). Some forecast an end to the era of effective antibiotics within decades (Hancock 2007). This raises the question of how response to AR may be reframed.

Farmer (2004) is an anthropologist and doctor committed to medical practice that is of direct benefit to oppressed people. He considers the global prevalence of preventable illness a major breach of human rights. He has treated individuals infected with MDRTB at a range of sites including the prison system of the former Soviet Union and in Lima, Peru. Farmer is quite clear that many of these patients would benefit from the comparatively expensive antibiotics that are still effective, could they afford them. However, at a deeper level, Farmer considers MDRTB to be a biosocial outcome of 'structural violence' in which social injustice and economic inequalities interact with disease process. In his view it is no accident that MDRTB develops amongst poor populations whose human rights are not observed. It is just one amongst a wider set of relationships that constitute their oppression.

In the case of the post-Soviet prison system, Farmer details the factors that, in interaction with the adaptive capabilities of *Mycobacterium tuberculosis*, have led to the emergence of MDRTB. These include irregular or non-existent supply of antibiotics, a malnourished population and crowded, poorly ventilated prison accommodation. A key factor for him, however, is the failure of the effective tuberculosis screening and treatment programmes that existed in the Soviet era. On his view these did not fail by accident, but as a result of transfers of public funds offshore that took place as economic and social relations were reordered after communism. He has clear views about where moral responsibility for MDRTB lies. Individuals – politicians, members of the oligarch class - have made decisions that have immiserated certain populations and denied them rights to health. When he offers an account of the past development of MDRTB, Farmer is closely concerned with the identification of centres of moral responsibility. As he turns his attention to how to respond, however, he frames matters differently.

Farmer offers this assessment of dominant responses to MDRTB;

'Authorities rarely blame the recrudescence of tuberculosis on the inequalities that structure our society. Instead, we hear mostly about the biological factors (the advent of HIV, the mutations that lead to drug resistance) or about cultural and psychological barriers that result in 'non-compliance'. Through these two sets of explanatory mechanisms, one can speedily attribute high rates of treatment failure either to the organism or to uncooperative patients.' (Farmer 2004: 147)

When discussing the development of MDRTB, Farmer is very clear about responsibilities in a way that is consistent with a frame of deliberate human action. But when discussing dominant responses he is critical of attempts to identify centres, whether microbial or human, against which to apply effort. These attempts closely

map anthropocentric and anthropomorphic imaginations as we have described them, distinguishing between human and non-human factors and searching for suitable centres of responsibility against which to gain traction. The alternative frame Farmer develops is inspired by liberation theology (Gutierrez 1971) and its commitment to making 'common cause' with the poor. Rather than seeing medicine in terms of what can effectively be done 'to' a bacterial species 'for' a group of people he considers what can be done 'along with' people and their locally available resources to reduce the pathogenicity associated with infectious disease. In these terms, pathogenicity cannot be reduced to a single causal factor because it is an emergent product of many shifting relationships. In this approach, clues to wise practice are sought in precisely the list of factors that tend, in our terms, to diffract the deliberate human activity of treating tuberculosis with antibiotics.

The factors that can negatively affect a tuberculosis treatment programme are the same as those involved in the emergence of patterns of vulnerability to the disease - hunger, poverty, violence and other forms of social injustice. For Farmer, dominant modes of response treat these as if they were unusual obstacles obstructing the normal course of medical activity. Their effects certainly are registered in dominant responses, but only in the abbreviated form of the negative psychosocial characteristics ascribed to the populations at risk. This framing of populations as 'non-compliant' is driven by the anthropomorphic need to detect centres of tractability. In our terms, it underestimates the complexity of AR, evident when considered as an EBSP. For Farmer the social injustices that appear to be 'obstacles' to medical practice lie at the very heart of pathogenicity. To address them and thus adequately to respond to AR requires the advice and participation of those who best know social injustices, their effects and alternatives to them. Farmer argues that unless alternative responses can be found that are effective in reducing the emergent property 'pathogenicity' rather than in eliminating bacteria, social injustice coupled with antibiotic use will continue to generate AR.

Quorum Sensing and Biosocial Imagination

Farmer's work is not the only place to find alternative biosocial imaginations that respond to AR as an EBSP. The evolution of antibiotic resistance in response to anthropogenic selection pressures has certainly not escaped the attention of biomedical science. If a means could be found to reduce the numbers of or virulence of pathogens without exerting selective pressure in favour of AR, this could produce more sustainable treatments. Some research has taken precisely this turn (Fuqua et al 1994, Otto 2004, Raffa 2006). This strategy diverts attention from bacterial 'enemies' we must attack toward bacterial communication as an aspect of pathogenicity. It involves a use of diffraction as a principle of effective action that parallels Farmer's.

Quorum sensing (Fuqua et al 1994) is a form of communication that enables bacteria to exhibit group behaviours. When bacterial population densities are high enough, forming a 'quorum', chemicals produced by those bacteria known as 'autoinducers' (Raffa et al 2006) begin to act as 'signals' affecting gene expression across the population. This affords bacteria that are part of such a quorum capabilities that their conspecifics of an individual 'planktonic' habit lack, such as bio-luminescence, production of antibiotics and the production of biofilms which affect both the virulence and antibiotic resistance of bacterial pathogens (Otto 2004).

Many bacterial species are known to form biofilms consisting of layers of bacteria on the surfaces of living tissues, of plumbing systems and elsewhere (Raffa et al 2006). Biofilms play an important role in processes of infection. They anchor bacteria to surfaces and tissues, protecting their position against mechanical disturbance. Further, compared to planktonic individuals, bacteria in a biofilm are, on average, less susceptible to antibiotic attack. Individuals at the top of the biofilm absorb a proportion of the antibiotic with the result that those on lower layers are exposed to a reduced concentration. Thus biofilms are thought to play a role in the development of AR (Stewart and Costerson 2001). Some plant species produce chemicals that can interrupt quorum sensing, antagonising the production of biofilms. Since antibiotics kill individuals or prevent their reproduction, wherever they are effective they also establish selective pressures that favour the evolution and spread of AR. Interrupting quorum sensing, it is argued, would prevent the formation of biofilms but need not kill individuals or interfere with their reproductive capacity (Otto 2004).

Whether or not the interruption of quorum sensing is an effective and scalable means of tacking bacterial infection remains to be seen. Further, the notion that interrupting quorum sensing will not elicit adaptive responses from bacteria has recently been contested (Defoirdt et al 2010). It is clear, however, that this line of research does not seek centres of causal responsibility for infection. As in Farmer's case the focus is not on the elimination of selected bacterial species but on reducing pathogenicity, conceived of as an emergent property of bacteria, eukaryotic hosts and wider environments in interaction. Where that interaction takes the form of communication, as in quorum sensing, research questions are posed about the communicative and organisational capacities of bacteria and about the consequences of participating in those communications with the intent of influencing bacterial organisation.

Climate Change is not a Problem

Hulme (2009) identifies a tendency amongst CC campaigners to build CC's profile as a problem so as to galvanise a collective will to respond amongst non-expert publics and policy makers. For him, however, CC need not and should not be understood as a problem that needs to be solved. In fact, for Hulme, and some others (Prins et al 2010), responding to CC as if it were the omnipresent, defining challenge of our time that urgently requires concerted deliberate human action conjours a contagion of insolubility.

It is important to note that Hulme does not offer a version of 'climate change scepticism'. He is satisfied that climate change, in the sense of changes in temperature and precipitation measured worldwide, is taking place, and that human activity has played an important role in bringing those changes about. Rather, he takes the view that CC is not a 'problem' such that problem-solving activity is an appropriate response to it. On his account, the record of attempts to organise globally coordinated solutions to CC such as carbon trading markets and emission reduction targets is poor. Despite twenty years of assessment, negotiation and agreement:

'The world has remained stubborn... Some policy innovations have occurred here and there. Some businesses have taken the plunge into carbon markets. Direct action groups have mobilised against airport expansion and coal-fired power stations. And

many millions...have signed up for voluntary emissions reduction pledges. But emissions of greenhouse gases keep on rising – globally by 16 per cent in the decade since the Kyoto protocol was first negotiated – and so does the world’s temperature and sea level.’

(Hulme 2009:332)

The combined efforts of civil society and political and scientific expertise have, even in their own terms, failed. In other words, problem-solving activity has been an ineffective response. This record alone cannot establish Hulme’s view as valuable. It is always possible to call for greater problem-solving activity in the future to make good this failure. When this record of failure is coupled with Hulme’s assessment of the nature of CC as a phenomenon, however, the pertinence of his view becomes clearer.

For Hulme, if CC were best understood as a problem awaiting solution, it would have clear boundaries that can inform decisions about whether and to what extent it has been solved and a tractable core of identifiable causes. In his view CC has neither of these. Given that climate has varied throughout human and history and pre-history, there is no natural baseline state to return to and no global consensus about an ideal state for the global climate. CC also appears to have a protean character, overcoming boundaries between fields of activity as effort is applied to it. As attempts are made, for example, to mobilise popular support for emissions reduction by publicising relevant research, the diffraction of these efforts means that CC, considered as problem of accurate measurement of physical properties of the climate, is transformed into a problem of science communication and political controversy. As attempts are made to negotiate international legally binding commitments to emissions reduction, histories of colonialism and uneven economic development between global regions mean that CC becomes a problem of international relations. Similar expansions of CC’s character as a phenomenon connect it with energy sustainability, food security, cultures of consumption and human reproduction.

In our terms, then, a search for a tractable core of identifiable causes yields an embarrassment of riches. Everything from the sheer weight of human populations, to specific lifestyles, through the profit motive and the nature of existing political processes can reasonably be pressed into service. For us, CC is better understood as an emergent biosocial phenomenon with the potential to diffract efforts to respond to it rather than as a well-defined problem. A similar ‘non-problem’ view of CC shapes Hulme’s thinking about response.

Climate Change and Biosocial Imaginations

Hulme sidesteps questions of the distinctiveness of humans. Some may think of CC as a set of objectively determined facts such that humans may apply technical solutions across a clear subject/object divide, but, for Hulme, controversies over the ‘facts’ are as much a part of the CC phenomenon as are melting glaciers (ibid: 88). He also sidesteps anthropomorphic imaginations’ concern with traction. We may or may not be able to find causal centres that reflect the effortful centres of human experience. But, crucially, in looking for these we drastically reduce our understanding of what it is to respond (ibid: 326). A focus on causal and moral responsibility commits us to a retrospective concern with how states of affairs arose. But in the absence of clearly

defined climate baseline to return to, the retrospective view loses pertinence. Given that, climate change or no, we are inexorably moving forward in the ongoing emergence of climate, the resources currently committed to narrating the past might be better deployed prospectively asking what opportunities CC gives for other possibilities for response. If CC remains framed as a problem, and the response is to solve it, then the diffractions it enacts will multiply. Not only will this lead to frustration and disillusionment but;

‘...we will end up unleashing ever more reactionary and dangerous interventions in our despairing search for a solution... the colonisation of agricultural land with energy crops, the colonisation of space with mirrors , the colonisation of the human spirit with authoritarian government.’
(ibid: 359)

Alternatively, response can be organised on the basis of the assumption that, in the context of CC, diffraction is an inevitable feature of change. Facing forward to recognise potentials rather than facing backward in a search for centres of responsibility, climate change becomes not the object of deliberate human action, but an imaginative resource that can be mobilised across the entire range of human experience, debate and activity.

‘It can inspire new artistic creations in visual, written and dramatised media. It can invigorate efforts to protect our citizens from the hazards of climate. The idea of climate change can provoke new ethical and theological thinking about our relationship with the future. It can arouse new interest in how science and culture inter-relate.’
(ibid: 363).

We would add ‘arousing new interest in global and regional political structures’ to this list. None of these can be considered attempts to solve climate change and, set against the idea that we must solve climate change, they might appear to be distractions. But for Hulme, they are a mode of sustainable response. If, in the absence of a baseline to return to, problems with climate are not going away, then we need to ask what is desirable in the way of human life in the context of the ongoing emergence of climate.

Conclusion

The recognition that there are limits to human capacity deliberately to shape the world is to be found in such diverse cultural locations as the Serenity Prayer and sociologies of unintended outcome from Merton (1936) to Beck (1992). The tendency to respond to frustration by a redoubling and re-focussing of deliberate action in the form of capital intensive technologies is, today, just as marked. Recent interest in geo-engineering schemes to tackle climate change and calls for new lines of antibiotic drugs illustrate this. In our view, however, the current conjuncture of threats to human well-being and the disappointing record of many responses place a premium on understanding the origins of these limits and on the development, in full cognisance of the source and nature of frustration, of alternative opportunities for response. We suggest, then, that it may be possible to respond to CC and AR by framing them in terms of EBSP and thus determining ways to treat the diffraction

they enact as a resource rather than a simple obstacle. As our examples indicate, doing so entails fresh views of deliberation and of response.

Despite the dominance of anthropocentric and anthropomorphic imaginations, alternative biosocial imaginations remain possible. On some accounts 'anthropocentrism' should be replaced by 'ecocentrism' (Eckersley 1992). As we have suggested however, the biosocial imaginations that detain us do not have the structure of a self-consistent commitment or viewpoint. Instead they comprise sets of questions and qualities of curiosity that have value, local to circumstances, in orienting to and navigating the complex biosocial terrains of which humans are a part (Lee and Motzkau 2011). This structure ensures that the production of alternatives to dominant biosocial imaginations is more than a matter of conceptual critique. Thus, rather than criticising deliberate human action or subject/object dualism we have aimed to learn from those whose work involves close practical dealings with AR and CC. Our tentative contribution to their insights has been to present consistencies of imagination that may be the virtual counterpart of their actual experiences and views. In this way we have tried to breathe greater life into these alternatives.

It has been noted that the term 'emergence' plays a powerful hegemonic role in contemporary biopolitics due, in part, to its ability to problematize the distribution of causal and moral responsibility for outcomes (Cooper 2008). In the present article it has not been our intention to use this effect to rule out discussion of such figures as responsibility, cause and effectiveness of response. Rather, we have aimed to deploy 'emergence' to complexify discussion of these figures. The EBSP view does not lead to a dissolution of ethics or a failure of confidence in the effectiveness of response. Indeed, the alternatives we have presented may, each in their own way, be characterised as pursuing effects precisely through ethical stances; they variously call for more inclusive networks of communication and for action in acknowledgement of a shared predicament.

We would further observe that as EBSP overstep apparent boundaries between social processes and life processes, they bring matters of ethics and of effectiveness, of value rationality and means-ends rationality (Kalberg 1980) into fresh intimacy. It is our view that new imaginations are required to orient, to organise, to criticise and to inspire response in such conditions. Good examples of this already exist. Schrader (2010) has recently demonstrated that models of causality used in environmental toxicology are inseparable from discussion of responsibility for environmental problems. In our view, Schrader (2010) and others including Haraway (2007), Barad (2007), De la Bellacasa (2011) and Hughes (2011) are currently working in the space that ethics and effectiveness are coming to share and, from within that space, are developing scientific practices that are suited to current conditions.

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