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Materialist returns: practising cultural geography in and for a more-than-human world

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This paper surveys the return to materialist concerns in the work of a new generation of cultural geographers informed by their engagements with science and technology studies and performance studies, on the one hand, and by their worldly involvements in the politically charged climate of relations between science and society on the other. It argues that these efforts centre on new ways of approaching the vital nexus between the bio (life) and the geo (earth), or the 'livingness' of the world, in a context in which the modality of life is politically and technologically molten. It identifies some of the major innovations in theory, style and application associated with this work and some of the key challenges that it poses for the practice of cultural geography.

Thinking is neither a line drawn between subject and object nor a revolving of one around the other. Rather thinking takes place in the relationship of territory and earth...involving a gradual but thorough displacement from text to territory.¹

Something/happening

It seems pertinent, even unavoidable, to begin by confessing that I still feel something of an outsider in the 'cultural geography' camp – at least as it came to be configured in the formative years of my research career in the late 1980s as the rise of 'cultural studies' in the UK gained disciplinary purchase in the guise of 'the new cultural geography'.² That project's signature concerns with the politics of representation and identity cast my obdurately earthy interests in cultivation and property, growing and eating, in a very unfashionable light. At that time such interests found a more convenient if not very permissive home in political economy – where the 'matter of nature', as Margaret Fitzsimmons so memorably put it, was marginally less marginalized.³ So, in a small but not insignificant way, my being invited to present the *cultural geographies* annual lecture⁴ is testament to some kind of realignment of intellectual energies underway; that moment of *fabulation* that Deleuze conjures⁵ in which cultural forces regroup and start to generate their own stories: stories which enter the world as envoys of 'something happening' – giving that something/happening both shape and momentum.

This paper might best be thought of as just such a self-conscious act of storytelling – an envoy of the recuperation of ‘materiality’ that is gathering force in this something/happening through energies as diverse as postcolonial, feminist, landscape, urban, legal and performance studies.⁶ Through these diverse currents, cultural geographers have found their way (back) to the material in very different ways that variously resonate with what I take to be amongst the most enduring of geographical concerns – the vital connections between the *geo* (earth) and the *bio* (life).⁷ The durability of these concerns bears the hallmark of geography’s history, which (like anthropology and archaeology) took shape before the division of academic labours into social and natural sciences became entrenched. It is a division with which these disciplines have never been entirely comfortable, and with which they continue to wrestle more self-consciously, and sometimes productively, than others. With the advent of the ‘new cultural geography’, this *earthlife* nexus was written out of, or more accurately, into the ancestral past of cultural geography – at least in the Anglophone research community.⁸

I argue here that this nexus is currently being recharged and taken in unfamiliar directions by a new generation of cultural geographers, not least through multiple engagements with the ‘geo/bio-philosophy’ of Deleuze and Guattari⁹ from which this intervention pushes off. Such engagements have been direct, through close readings of their work and the philosophical industry that it has spawned, and indirect, through the twin intermediaries of science and technology studies and performance studies in which it is differently, and variously, inflected.¹⁰ A common commitment in such work is a view of science and philosophy as projects in which theory does not take on a representational function, but rather an active and practical one, such that every theory acts as a ‘mechanics’ – simultaneously a technology of practice and an intervention in the world.¹¹ But this storytelling of cultural geography’s recuperation of the material works against forging ‘it’ into the latest in a weary and wearying succession of ‘new turns’ that have been written into the intellectual history of cultural geography, still less one that is uniformly or exclusively Deleuzian.

Instead, I want to emphasize that this recuperation manifests a rich variety of analytical impulses; philosophical resources and political projects that don’t ‘add up’ to a singular ‘new’ approach, let alone one that has a monopoly of insight or value. To this end, I use the language of *returns* to suggest that what is new (as in different) about the something/happening in cultural geography is a product of repetition – turning seemingly familiar matters over and over, like the pebbles on a beach – rather than a product of sudden encounter or violent rupture. Just as importantly, what is different or innovatory about these materialist returns is generated as much by the technologically and politically molten climate that informs cultural geographers’ intellectual investments and worldly involvements as by any academic repositioning. In this case, I think there can be little doubt that the materialist returns of cultural geography today are bound up with the proliferation of what Bruno Latour calls ‘matters of concern’¹² and Michel Callon calls ‘hot situations’¹³ associated with the intensification of the interface between ‘life’ and ‘informatic’ sciences and politics. This intensification has been witnessed in serial public controversies since the 1990s, from GM to nanotechnology,¹⁴ in which the practices of social, as well as natural, scientists have been caught up.

These involvements are reflected in cultural geography's reworking of substantive topics (like domestication and sensory perception) in unfamiliar, and sometimes unsettling, directions such as the burgeoning interest in animal cultures,¹⁵ 'post-humanism'¹⁶ and geographies of 'affect'.¹⁷

I want to start by articulating the broadest sense of this claim that a new generation of cultural geographers is returning to the rich conjunction of the *bio* and the *geo* – or, for want of a more felicitous expression, to what the writer Jeanette Winterson calls the 'livingness' of the world.¹⁸ My argument is that the most important difference (a big claim, I know) in the 'something/happening' in cultural geography's materialist recuperations is that this return to the livingness of the world shifts the register of materiality from the indifferent stuff of a world 'out there', articulated through notions of 'land', 'nature' or 'environment', to the intimate fabric of corporeality that includes and redistributes the 'in here' of human being.¹⁹ In this it shares the same impulse as Derrida's frequently articulated insistence on addressing philosophical enquiry to 'the entire field of the living, or rather to the life/death relation, beyond the anthropological limits of "spoken language"'.²⁰ Importantly, however, this redirection of materialist concerns through the bodily enjoins the technologies of life and ecology, on the one hand, and of prehension and feeling, on the other, in refiguring the ontological disposition of research – drawing cultural geographers into new conversational associations; research practices and modes of address that collectively mark what I have called 'more-than-human' approaches to the world.²¹ I will tease out this rather bold claim by sketching some of the key facets of the materialist returns now in play, as I see them, and the kinds of challenges that they pose.

Materialist recuperations

In the last edition of the *Dictionary of human geography*, Denis Cosgrove in his entry on cultural geography distinguishes 'classical' from 'new' styles of cultural geography by reference to their approaches to the study of landscape.²² The former, associated with the work of Carl Sauer and the Berkeley school that he inspired, has as its reference point his iconic essay 'The morphology of landscape' in which

cultural landscape is fashioned from a natural landscape by a cultural group. Culture is the agent, the natural area the medium, the cultural landscape is the result.²³

By contrast, 'new' cultural geography is associated with the flowering of cultural studies in Britain, as signalled by the no less totemic essay of Daniels and Cosgrove introducing their book *Iconography and landscape*, in which landscape is defined as

a cultural image, a pictorial way of representing... surroundings. This is not to say that landscapes are immaterial. They may be represented in a variety of materials... in paint on canvas, in writing on paper, in earth, stone, water and vegetation on the ground.²⁴

The point I want to draw from these exemplary quotations is rather different from that for which they have come to stand in demarcating a 'new' from a 'classical' regime.

Despite the significant differences they articulate, what I find most striking about them is that they share an overriding common currency, namely that they both cast the making of landscapes (whether worked or represented) as an exclusively human achievement in which the stuff of the world is so much putty in our hands. On these accounts, as I have suggested elsewhere, 'the world remains untroubled and untroubling, waiting impassively for us to make up our minds and making no difference' to the landscape (or knowledge, or environment . . .) in the making.²⁵ By the same token, cultural geography's investments in questions of identity and culture have remained largely wedded to that most vociferously silent and self-evident subject of the social sciences, the 'in-here' of human being. So it is that recent contributions have sought to do (at least) three things. The first has been to re-animate the missing 'matter' of landscape, focusing attention on bodily involvements in the world in which landscapes are co-fabricated between more-than-human bodies and a lively earth.²⁶ The second has been to interrogate 'the human' as no less a subject of ongoing co-fabrication than any other socio-material assemblage.²⁷ The third in my list has been the redistribution of subjectivity as something that 'does not live inside, in the cellar of the soul, but outside in the dappled world'.²⁸

This redistribution of energies puts the onus on 'livingness' as a modality of connection between bodies (including human bodies) and (geo-physical) worlds. In turn, that acts as a rallying point for geographers (and others) working against the lexical cast of the 'new' cultural geography and the humanist commitments of cultural geography more broadly, bringing all manner of philosophical resources to bear on their efforts. These include the corporeal materialisms inspired by Foucault's bio-cultures, Merleau-Ponty's ontology of the flesh and the feminist corporeal ethics of Diprose²⁹ and others; and the energetic materialisms inspired by the relational ontologies of Spinoza, Whitehead and Deleuze (amongst others), such as Stengers' co-fabrication or 'working together'.³⁰ In conjunction with the molten question of what 'livingness' means in a life science era,³¹ such resources and energies redirect materialist concerns in ways that have profound ethical and political, as well as analytical, consequences. As the political theorist Jane Bennett recently put it, they attempt to hold onto the relational and emergent imperatives of material force in which the 'thing-ness of things' – bodies, objects, arrangements – are always in-the-making and 'humans are always in composition with nonhumanity, never outside of a sticky web of connections or an *ecology* [of matter]'.³²

If these are some of the lineaments of the differences/innovations wrought by the materialist returns of a cultural geography attentive to the livingness of the world, how is this attentiveness playing out in terms of more specific research directions and impulses? I want to outline four commitments being taken forward in diverse ways in such work that strike me as being of particular importance.

The first is a shift in analytic focus from *discourse* to *practice*. Inspired by numerous and non-additive efforts to work against the grain of the logocentric conception of social agency – 'I think therefore I act' – that is a familiar mantra of orthodox social science. This shift is associated by some with the so-called 'practice turn'³³ and a variety of approaches which relocates social agency in practice or performance rather than

discourse – thinking and acting through the body – and reworks discourse itself as a specific kind of practice.

The second is a shift from an onus on *meaning* to an onus on *affect*. The bodily register of current work reopens the interval between sense and sense-making, and multiplies the sensory dimensions of acting in the world and the milieu of intercorporeal movement. Affect refers to the force of intensive relationality – intensities that are felt but not personal; visceral but not confined to an individuated body. This shift of concern from what things mean to what they do has methodological consequences for how we train our apprehensions of ‘what subjects us, what affects and effects us’ or ‘learn to be affected’.³⁴

The third redirection of effort is towards *more-than-human* modes of enquiry. Such modes of enquiry neither presume that socio-material change is an exclusively human achievement nor exclude the ‘human’ from the stuff of fabrication. Animals and technological devices have variously been used as ‘agents provocateurs’ in tackling the question of difference and rigorously working it through the specific materialities and multiplicities of subjectivity and agency.³⁵ Such modes of enquiry attend closely to the rich array of the senses, dispositions, capabilities and potentialities of all manner of social objects and forces assembled through, and involved in, the co-fabrication of socio-material worlds.

The fourth shift is from a focus on the *politics of identity* to the *politics of knowledge*. Here two currents come together in addressing concerns with the ways in which knowledge is produced, hardwired into the social fabric and contested in a variety of public forums. One of these concerns the redistribution of expertise attendant on the recognition of multiple knowledge practices and communities that bear on the framing of inherently uncertain socio-technical problems.³⁶ The other concerns the practice of science (including social science) in constituting the phenomena that it studies as ‘reliable witnesses’ where that reliability is guaranteed by allowing phenomena to work against, or to exceed, our experimental expectations.³⁷

Practising more-than-human geographies

For if the look purchases the transcendence of the human only at the expense of repressing the other senses (and more broadly the material and the bodily with which they are traditionally associated), then one way to recast the figure of vision (and therefore that with which it is ineluctably associated) is to resituate it as only one sense among many in a more general – and not necessarily human – bodily sensorium.³⁸

I have sought to argue that the creativity of cultural geography is generated not by a succession of ‘new’ turns but by the gathering force of constant re-turns to enduring preoccupations with the processes and excesses of ‘livingness’ in a more-than-human world. Trying not to solidify the heterogeneity of ideas and practices at work in the recuperation of materiality in cultural geography into the latest such ‘turn’, I have outlined some of what I see as the most important aspects of an ongoing realignment of intellectual energies. It is a realignment that promises much in terms of equipping geography in the life science era, but one that brings real and pressing methodological

and political challenges in its wake. Before one gets carried away with their claims to novelty, it is worth recalling earlier efforts to marry the 'bio' and 'geo' in cultural geography. Thus, for example, buried in his 'morphology of landscape' essay is an appeal by Carl Sauer (following Vidal de la Blache) that

Geographers should avoid considering the earth as the scene on which the activity of man (sic) unfolds itself, without reflecting that this scene is itself living.³⁹

In similar vein, current interests in performativity are anticipated in J.B. Jackson's concerns with the 'vernacular landscapes' generated by what he saw as the inexhaustible capacity for improvisation in people's everyday ways of making themselves at home in the world with and against the grain of 'aristocratic' or political designs.⁴⁰ That said, the differences are profound, as these preoccupations with the intersection between the 'bio' and the 'geo' become charged with the socio-technological possibilities, political registers, cultural sensibilities, and intellectual enthusiasms of a new generation of geographers. The next edition of the *Dictionary of human geography* is a few years off, but some glimpse of the ways in which the treatment of landscape in the updated entry on cultural geography might be recharged by this work are signalled in Cary Wolfe's observations on the bodily sensorium, quoted at the start of this final section.

So what difference do the materialist recuperations and research directions in cultural geography that I have sketched above make to the question of how, as Karen Barad puts it, 'matter comes to matter'?⁴¹ On the one hand, such work is clearly marked by the distinctive axes of academic exchange that inform it, notably the burgeoning fields of study emerging between disciplines – such as science and technology studies, performance studies, and feminist studies. On the other, it is their engagement in matters of public controversy and everyday concern taking place in a proliferation of other cultural and political forums that most stands out. Here, what makes the question of materiality matter is the molten climate of relations between science and society, technology and democracy⁴² in which the knowledge practices of social and natural scientists, civil servants and corporate lawyers, NGOs and direct action groups, citizens and consumers rub up against one another in the event of all manner of knowledge controversies. Such controversies (around genetic engineering, MMR injections, pharmaceutical patenting, stem-cell harvesting, reproductive cloning, for example) are at once about the most mundane and intimate aspects of social life – food, health and kinship – *and* the sites of prolific inventiveness in the life sciences. Taking the working example of what we might call 'bio-geographies', a field set to explode in the cultural geography literature, it seems,⁴³ I want finally to illustrate some of the differences in the ways in which cultural geographers are currently recuperating the material, and to signal some of the major challenges that they pose.

The first major difference is that 'life' itself has changed, to become the latest addition to that peculiar socio-material assemblage called 'natural resources'. The treatment of animals and plants as biological resources is hardly new, but with the rise of genetic and, more particularly, post-genomic biotechnologies any vestige of difference between the ability to manipulate and commodify their bodies and human bodies

has been removed. This disturbing levelling of biological differences, reinforced by the re-materialization of biological entities in the guise of machine-readable informatic codes,⁴⁴ has profound effects on what bodies count and what counts as bodily in the work of cultural geographers today.⁴⁵ Not least are the considerable additional skills required to study the detailed knowledge practices involved in the production and circulation of such bio-technological artefacts, if cultural geographers are to get to grips with the *specificity* (as against the originality) of knowledge objects like artificial life forms. The cultural potency of 'artificial life' suggests that it might be possible to learn from the repertoire of techniques employed in artistic work that engages science and/or scientists to stage public experiments in the possibilities of reworking hum/ani/machine interfaces through robotic, neurological and genomic amplifications or extensions of bodily competences and temporalities.⁴⁶ For example, the Australian performance artist Sterlarc, who has worked with robotics scientists at Sussex University in devising an 'exoskeleton', seeks to produce a choreography of movements in which

instead of seeing the human body as the choreographer and the robot as the instrument, I really see the two working together. That is how it becomes an artistic performance. I have no desire to control the machine I am open to its doing the unexpected. In this sense the human body has always been a kind of cyborg. . . . I am not satisfied with just theorising about it. I want to experience what actually happens and then try to articulate what that means.⁴⁷

A second major difference is the changed relationship between science and society in which new scientific knowledge claims and/or artefacts, particularly in those fields that touch the visceral vernacular of social anxiety relating to food or health, have become routinely controversial matters. Such controversies take cultural geographers to unfamiliar forums. At one end of the spectrum stand the law courts in which the artefacts themselves are called upon as material witnesses⁴⁸ in the determination of competing claims to the 'intellectual property' in new biological artefacts.⁴⁹ At the other are the proliferation of impromptu 'hybrid' forums that swell in the face of new technologies – like GM or mobile phone masts – gathering to them all manner of concerned citizens and/or consumers; seasoned advocacy groups; scientific dissidents and the like that can change the commercial and regulatory fabric of such technologies in unpredictable ways. How do social scientists, including cultural geographers, position themselves in these forums? As the clamour grows for greater 'interdisciplinarity' as a way of addressing such knowledge controversies, cultural geography's rich tradition of experimentation provides a valuable resource for resisting the pressures on us (from within and outside the discipline) to assume the position of 'interpreters' between concerned publics and natural scientists.

As I see it, perhaps the greatest challenge presented by these 'more-than-human' styles of working is the onus they place on experimentation and, by implication, on taking (and being allowed to take) risks. Let me dwell momentarily on just two aspects of this experimental imperative. First is the urgent need to supplement the familiar repertoire of humanist methods that rely on generating talk and text with experimental practices that amplify other sensory, bodily and affective registers

and extend the company and modality of what constitutes a research subject.⁵⁰ Second, the experimental demands of ‘more-than-human’ styles of working place an onus on actively redistributing expertise beyond engaging with other disciplines or research fields to engaging knowledge practices and vernaculars beyond the academy in experimental research/politics such as the ‘deliberative mapping’ exercise pioneered by Gail Davies and her collaborators in relation to xeno-transplantation.⁵¹ I hope and trust that *cultural geographies* will continue to play its part as a leading journal in which scholars can take risks and experiment; in which the worldliness that has been the hallmark of geographical endeavours is reinvigorated; and in which conversations and politics proliferate in generative ways rather than hardening into orthodoxy.

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Notes

- ¹ G. Deleuze and F. Guattari, *What is Philosophy?* (French original 1991), trans. Graham Burchell and Hugh Tomlinson (London, Verso, 1994).
- ² See C. Philo, ed., *New words, new worlds: reconceptualising social and cultural geography* (Lampeter, Dept of Geography, Saint David’s University College, Lampeter, 1991).
- ³ M. Fitzsimmons, ‘The matter of nature’, *Antipode* 21 (1989), pp. 106–20.
- ⁴ This is a version of the *Cultural geographies* annual lecture given at the centennial conference of the Association of American Geographers (Philadelphia, March 2004). My thanks to the journal’s editors, Mona Domosh and Philip Crang, for the challenging invitation to present the lecture, and to Hodder Arnold for sponsoring the event.
- ⁵ Deleuze is here following Bergson. See G. Deleuze, *Negotiations* 125 (New York, Columbia University Press, 1995), p. 125.
- ⁶ Exemplary of these recuperations of the material in various fields of cultural geography are the following: in relation to the postcolonial, I. Cook and M. Harrison, ‘Cross over food: re-materialising postcolonial geographies’, *Transactions of the Institute of British Geographers* 28 (2003), pp. 296–317; in relation to feminist scholarship, C. Nash, ‘Genetic Kinship’, *Cultural studies* 18 (2004), pp. 1–34; in landscape studies, J. Wylie, ‘On ascending Glastonbury Tor’, *Geoforum* 33 (2002), pp. 441–54; in urban studies, A. Latham and D. McCormack, ‘Moving cities: rethinking the materialities of urban geographies’, *Progress in human geography* 28 (2004), pp. 701–24; in relation to legal geographies, D. Delaney, ‘Making nature/markings humans: law as a site of (cultural) production’, *Annals of the Association of American Geographers* 91 (2001), pp. 487–503; and in relation to performance studies, J.D. Dewsbury, P. Harrison, M. Rose and J. Wylie, eds, ‘Enacting geographies’, special issue of *Geoforum* 33 (2003).

- ⁷ There are clearly other ways of conceiving of the re-materialization of cultural geography that owe more to anthropological traditions in the study of material culture; see e.g. P. Jackson, 'Rematerialising social and cultural geography', *Social and cultural geography* 1 (2000), pp. 9–14.
- ⁸ Notable exceptions include the institutional hold of cultural ecology in the Nordic countries and its persistence as an active research grouping in the Association of American Geographers. It should also be noted that reservations about the 'linguistic' turn in British cultural geography were articulated even at its height (see esp. Philo, *New words, new worlds*).
- ⁹ Both 'geo-philosophy' (see J. Bonta and J. Protevi, *Deleuze and geo-philosophy: a guide and glossary* (Edinburgh, Edinburgh University Press, 2004)) and 'bio-philosophy' (see K. Ansell-Pearson, *Germinal life: the difference and repetition of Deleuze* (London, Routledge, 1999)) provide useful ways into the work of Deleuze and Guattari.
- ¹⁰ Hence e.g. Latour's famous quip that the acronym ANT (Actant Network Theory) could just as easily have been ART (Actant Rhizome Theory). See T. Crawford, 'An interview with Bruno Latour', *Configurations* 1 (1993), pp. 247–68.
- ¹¹ T. Murphy, 'Quantum ontology: a virtual mechanics of becoming', in E. Kaufman and K. Heller, eds, *Deleuze and Guattari: new mappings in politics, philosophy and culture* (Minneapolis, University of Minnesota Press, 1998), p. 213.
- ¹² A term he uses in contrast to 'matters of fact' and as shorthand for refusing the distinction between what is controvertible (e.g. values) and what is not (e.g. observational data). B. Latour, *Politics of nature: how to bring the sciences into democracy* (Cambridge, MA, Harvard University Press, 2004).
- ¹³ A term he uses to describe situations in which 'everything becomes controversial [in] the absence of a stabilised knowledge base'; M. Callon, 'An essay on framing and overflowing', in *The laws of markets* (Oxford, Blackwell, 1998), p. 260.
- ¹⁴ See H. Nowotny, P. Scott and M. Gibbons, *Rethinking science: knowledge, and the public in an age of uncertainty* (Oxford, Polity, 2001).
- ¹⁵ C. Philo and C. Wilbert, eds, *Animal spaces: beastly places* (London, Routledge, 2000).
- ¹⁶ N. Castree and C. Nash, eds, 'Mapping posthumanism', theme issue of *Environment and planning A* 36 (2004).
- ¹⁷ D. McCormack, 'An event of geographical ethics in spaces of affect', *Transactions of the Institute of British Geographers* 28 (2003), pp. 488–507.
- ¹⁸ J. Winterson, *Gut symmetries* (New York, Knopf, 1997), p. 85.
- ¹⁹ See P. Sheehan, ed, *Becoming human: new perspectives on the inhuman condition* (Westport, CT, Praeger, 2003).
- ²⁰ J. Derrida and E. Roudinesco, 'Violence against animals', in *For what tomorrow ... a dialogue*, trans. J. Fort (Stanford, CA, Stanford University Press, 2001), p. 63.
- ²¹ S. Whatmore, *Hybrid geographies: natures cultures spaces* (London, Sage, 2002).
- ²² D. Cosgrove, 'Cultural geography', in R.J. Johnston, D. Gregory, G. Pratt and M. Watts, eds, *The dictionary of human geography*, 4th edn (Oxford, Blackwell, 2000), pp. 134–38.
- ²³ C. Sauer, 'The morphology of landscape' [1925], in J. Leighley, ed., *Land and life: selections from the writings of Carl Ortwin Sauer* (Berkeley, University of California Press, 1963), p. 343.
- ²⁴ S. Daniels and D. Cosgrove, 'Iconography and landscape', in S. Daniels and D. Cosgrove, eds, *The iconography of landscape* (Cambridge, Cambridge University Press, 1988), p. 1.
- ²⁵ S. Whatmore, 'Generating materials', in M. Pryke, G. Rose and S. Whatmore, eds, *Using social theory: thinking through research* (London, Sage, 2003), p. 92.

- ²⁶ For instance, S. Hinchliffe, ‘“Inhabiting” – landscapes and natures’, in K. Anderson, M. Domosh, S. Pile and N. Thrift, eds, *Handbook of cultural geography* (London, Sage, 2003), pp. 207–26.
- ²⁷ See e.g. K. Anderson, ‘White natures: Sydney’s Royal Agricultural Show in post-humanist perspective’, *Transactions of the Institute of British Geographers* 28 (2003), pp. 422–41.
- ²⁸ B. Latour, ‘Body, cyborgs and the politics of incarnation’, in S. Sweeney and I. Hodder, eds, *The body* (Cambridge, Cambridge University Press, 2002), p. 140. See e.g. Wylie, ‘On ascending’.
- ²⁹ R. Diprose, *Corporeal generosity* (London, Routledge, 2002).
- ³⁰ I. Stengers, *Power and invention: situating science* (Minneapolis, University of Minnesota Press, 1997).
- ³¹ See R. Doyle, *Wetwares: experiments in postvital living* (Minneapolis, University of Minnesota Press, 2003).
- ³² J. Bennett, ‘The force of things: steps to an ecology of matter’, *Political theory* 32 (2004), p. 365 (emphasis original).
- ³³ T. Schatzki, K. Knorr-Cetina and E. Von Savigny, eds, *The practice turn in contemporary theory* (London, Routledge, 2001).
- ³⁴ Latour, ‘Bodies, cyborgs and the politics of incarnation’, p. 140.
- ³⁵ E.g. C. Wolfe, *Animal rites: American culture, the discourse of species and posthumanist theory* (Chicago, University of Chicago Press, 2003).
- ³⁶ See Nowotny *et al.*, *Re-thinking science*.
- ³⁷ Stengers, *Power and invention*, p. 85.
- ³⁸ Wolfe, *Animal rites*, p. 3.
- ³⁹ Sauer, ‘The morphology of landscape’, p. 321.
- ⁴⁰ J.B. Jackson, *Discovering the vernacular landscape* (New Haven, CT, Yale University Press, 1984), pp. 7–8.
- ⁴¹ K. Barad, ‘Posthumanist performativity: toward an understanding of how matter comes to matter’, *Signs* 28 (2003), pp. 801–32.
- ⁴² M. Callon, P. Lascoumes and Y. Barthe, *Agir dans un monde incertain: essai sur la démocratie technique* (Paris, Seuil, 2001).
- ⁴³ In the context of giving the *cultural geographies* lecture, I was responding here to a number of sessions at the Centennial Annual Meeting of the Association of American Geographers at which I was speaking, and thinking in particular of the ‘Geographies of biotechnology’ sessions organized by Beth Greenhough and Emma Roe.
- ⁴⁴ See Doyle, *Wetwares*.
- ⁴⁵ See P. Thurtle and R. Mitchell, eds, *Semiotic flesh: information and the human body* (Seattle, Walter Chapin Simpson Centre for the Humanities, 2002).
- ⁴⁶ O. Dyens, *Metal and flesh* (Cambridge, MA, MIT Press, 2001).
- ⁴⁷ Quotation from www.stelarc.va.com.au.
- ⁴⁸ See M. Strathern, *Property, substance and effect: anthropological essays on persons and things* (London, Athlone Press, 1999).
- ⁴⁹ See Delaney, ‘Making nature/markings humans’.
- ⁵⁰ For an example, see S. Whatmore and S. Hinchliffe, ‘Living cities: making space for urban nature’, *Soundings: journal of politics and culture* 22 (2003), pp. 37–50.
- ⁵¹ See G. Davies, J. Burgess, J. Eames, M. Mayer, K. Staley, A. Stirling and S. Williamson, *Deliberative mapping: appraising options for addressing the kidney gap* (Wellcome Trust Final Report Grant 064492, 2003). See also: <http://www.deliberative-mapping.org>