

Agro-Food Studies in the ‘Age of Ecology’: Nature, Corporeality, Bio-Politics

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IN THIS PAPER it is argued that the theoretical purview and contemporary political relevance of agro-food studies are significantly weakened by their methodological foundations, still largely unexamined, in modernist ontology. A critical element of this ontology, shared with orthodox social science, is the dualistic separation of nature and society. Nature is theorized in externalized and mechanistic terms, and thereby abstracted from the social domain. The modernist ontology thus supports the objectification of nature and its de-politization, undermining coherent engagement with the bio-politics and ethical principles of environmental organizations and Green movements. The ubiquity of the modernist nature/society dichotomy and its disabling consequences are examined by analysing several recent theoretical perspectives in agrarian studies. The merits of actor-network theory in surmounting these ontological and epistemological limitations then are considered using three brief case studies of the highly contested bio-politics of agro-food networks.

These bio-politics, it is argued, are grounded in two constituent and specific properties of agro-food networks: a dual set of metabolic relations – eco-social production and human food consumption – and the polyvalence of these relations, namely, the continuing availability or ‘openness’ of agro-food networks to alternative organizational patterns of production and consumption. The metabolic relations of agro-food networks involve a two-step process: *on the land*, where agricultural nature and its harvest are co-produced and co-evolve with social labour, and *at the table*, where these co-productions are metabolized corporeally and symbolically as food.¹ The notion of shared corporeality elaborated in previous work is used to comprehend the relational materiality of

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ecologies and bodies that characterizes agro-food networks (FitzSimmons and Goodman 1998). Corporeality is understood as metabolism and metaphor to signify organic, eco-social processes that are intrinsic to agriculture, to food, to agro-food networks, and to the hybrid constitution of these practices in the social world.

The central purpose here is to renounce the methodological erasure of nature and expose its foundations in the reductionist ontology of modernity. That is, the nature/society dichotomy, and the division between classes of phenomena “that drive and those that are driven” (Law 1994, p. 12), which lie at the heart of agro-food studies and their ‘parent’ disciplines in orthodox social science. Against these dualistic oppositions, relational concepts are used to bring nature and its materiality explicitly into the analysis by focusing attention on shared corporealities: second nature, agricultural nature, produced in interaction with social labour, and the corporeal metabolism that describes the nexus of food and human bodies, of production and reproduction. The theoretical framework of agro-food studies, fettered by modernist ontology and epistemology, cannot respond fully to the new ethical and relational issues raised by environmentalist groups and urban food movements, understand their social resonance, nor grasp the bio-politics they engender. For these reasons, this paper identifies with the rising tide of scholarship that is challenging the abstraction of nature and advancing the greening of social theory.² Agro-food studies, positioned at the primary metabolic loci between humans and nature, rightfully belongs in the vanguard of this intellectual project.

With this wider agenda as the *leitmotif* throughout, formulations that engage with the materiality of nature mainly by positing the organic exceptionalism of agriculture and food networks are examined briefly in the following section. The discussion then considers the severe limitations arising from the abstraction of nature evident in several recent perspectives in agro-food studies – the consumption ‘turn’ in the work of Ben Fine, Terry Marsden and their respective colleagues, and Wageningen actor-oriented rural sociology. Subsequent sections explore actor-network theory as a means of resolving these ontological difficulties using case-studies of food scares, agri-biotechnologies, and the regulation of organic agriculture and food in the United States.

Exceptionalism and its discontents

Several currents can be identified in agrarian political economy and related fields that do challenge the modernist nature/society dichotomy, albeit inadequately, and so contribute to the reconstructive project noted above. This is the case of formulations, much against mainstream theorizing in agrarian political economy, that defend the exceptionalism of agro-food networks and agrarian social formations on analytical grounds (Mann and Dickenson 1978; Goodman, Sorj and Wilkinson 1987; Mann 1990; Goodman and Redclift 1991;

Benton 1993). Although these contributions do not posit the active relational materiality of agricultural nature explicitly, the biophysical processes of agricultural production and food consumption are represented as natural, though relative and historically contingent, constraints to industrialization, placing these organic processes at the forefront of the analysis. The response at different conjunctures of industrial capitals to the properties of agricultural nature (biological time, climate, land, photosynthesis) and human physiology describes the formative and contemporary dynamics of individual agro-food networks, and notably their discontinuous, fragmented, and incomplete industrialization (Goodman, Sorj and Wilkinson 1987).

These characteristics concomitantly have provided scope for the persistence of exceptionally heterogeneous and diverse practices, encompassing labour processes, social relations, farming styles, craft skills, institutional forms, and a preponderance of non-corporate family units in agricultural production (Whatmore et al. 1987a,b; van der Ploeg 1990; Moran et al. 1993). Significantly, this *living* historical legacy of heterogeneous practices and organizational forms provides a material base from which to interrogate hegemonic industrialized metabolic relations and to construct alternative political and institutional futures. Heterogeneity creates the capacity for *polyvalent* responses and, to use the lexicon of neo-Schumpeterian innovation theory, for paradigm shifts. This *open-endedness* of social, agro-ecological, and institutional alternatives, originating in organic, though historically contingent, properties and cultural norms, is the foundation of claims for the organizational exceptionalism of agro-food networks.

A related perspective is discernible in environmental history and its efforts to break the analytical silence on the material foundations of social life and social reproduction. In the words of one of its leading exponents, environmental historians are seeking to establish "an ecological perspective on history" (Worster 1984, p. 2), which recognizes that nature is "an agent and presence in history" (Worster 1988, p. 6).³ This epistemological claim is formulated largely in terms of physical limits, dialectical reciprocity, and mutual determination (Cronon 1983; White 1985). Here, we might join with Worster (1990) in his general appeal that "the *reorganization of nature*, not merely of society, is what we must uncover" (Worster 1990, p. 1100, original emphasis) in the transition between historical epochs. Agro-ecological processes and their distinctive materiality play a prominent role in elaborations of this analytical perspective (Fitz-Simmons and Goodman 1998). Agricultural or 'eco-regulatory' labour processes also are central to the deployment of natural limits arguments in Benton's ecological revision of Marxist political economy (Benton 1989, 1993).⁴

This brief account of historically contingent theorizations of natural limits and organic exceptionalism reveals these specificities as the fulcrum of distinctive past and contemporary patterns of capital accumulation and labour process organization. However, in mainstream agrarian political economy, these ap-

proaches typically are rejected for their alleged ecological and technological determinism or on the grounds that biophysical specificities lack analytical significance. Following the modernist ontology of agricultural economics and rural sociology, agricultural nature appears simply as an external, inorganic medium, acted upon and manipulated by human artifice. In this view, agro-food networks essentially are treated for analytical purposes as standard industrial sectors or branches of activity.

However, as this discussion suggests, agro-food networks conform awkwardly to the organizational model of manufacturing industry. In these networks, *pre-industrial* production processes and agricultural products remain as enduring sources of competition, benchmarks of quality, and as culturally potent alternatives to the industrial paradigm (Goodman and Wilkinson 1993). These considerations argue strongly against reductionist efforts to situate agro-food networks within generic models of industrial organization and innovation.⁵ At root, this reductionism reflects the myopic productionist ‘gaze,’ with its instrumental rationality and Promethean assumptions, which erases agricultural nature and its constituent metabolic relations. These perspectives replicate the nature/culture dichotomy of modern economics and sociology and consequently share their inability to engage with ecological questions. However, as noted below, formulations framed in terms of agrarian exceptionalism also fail to overcome these limitations; at best, they reveal analytical awareness of the need to bring nature ‘back in.’

The consumption ‘turn’ and actor-oriented perspectives: nature denied

These same limitations, though to varying degrees, are encountered in new theoretical currents that recently have gained some prominence in agro-food studies. Here, we comment briefly on several contributions to two lines of analysis: the so-called consumption ‘turn,’ a move that parallels related developments elsewhere in the social sciences (Miller 1995; Edgell, Hetherington and Warde 1996), and actor-oriented approaches. Coincidentally, these recent contributions reveal the continuing epistemological rift, evident more generally in agro-food studies, around the conceptualization of structure and agency. In theorizing consumption, for example, Ben Fine and his colleagues (Fine et al. 1996) defend the materialist concerns of political economy against the challenge of post-modernist perspectives (Fine et al. 1996, pp. 60–61), whereas Arce and Marsden (1993) seek to escape the perceived rigidities of structuralist political economy and its inadequate treatment of human agency.

Systems of provision

The materialist orientation of Fine and Leopold (1993), Fine (1994), and Fine, Heasman and Wright (1996) is immediately apparent as their analysis of con-

sumption generally, and of the distinctiveness of food consumption in particular, builds upon the notion of vertically integrated 'systems of provision. This notion has strong lineal affinities, although these go unremarked, with a long tradition of political-economic, supply-side concepts that includes agro-food chains or *filières*, commodity systems, and agro-food complexes.

In this analysis, the distinctiveness of agro-food systems of provision is attributed to the organic content of food production and consumption. But, while "acknowledging the necessity of (the) physiological or biological content of food systems," Fine and his colleagues reject implications of biological determinism with the assertion that this content is not "an unmediated, asocial or ahistorical determinant" (Fine et al. 1996, p. 37). Thus, although "food systems incorporate an organic content both systematically and pervasively," these systems "are themselves open to restructuring and transformation" (p. 37). Elsewhere, it is suggested that "the imperatives of food systems' profitability have subjected the food system to forces that continuously shift its relationship to the organic – through the industrialization of processes and products" (p. 8).

So far, so good, yet this schema clearly rests on an unacknowledged and unwelcome premise that introduces a crippling ambivalence into the analysis. That is, despite assertions to the contrary, there is an *a priori* content or irreducible core 'essence' of the organic in agro-food systems of provision, irrespective of historically contingent mediation by tendencies and structures. Thus "the defining characteristic of the food, as opposed to other, systems of provision is the crucial significance of organic factors at both of the extreme ends of the system . . ." (Fine et al. 1996, p. 36). Or, again, "Food systems . . . are distinguished by a particular feature . . . food has a physiological character . . ." (and) "we would extend this understanding of the organic content of food as having influence along the whole SOP" (p. 37).

It is salutary, of course, to draw attention to the organic content of agro-food systems of provision but Fine et al. (1996) contribute little to the theorization of nature in these systems. Their analysis fails to clarify either the reciprocal or, for that matter, the unilateral, relations between organic content and the historical development of systems of provision. More pointedly, as observed earlier, Fine et al. (1996) recognize the shifting relation between food systems and the organic, but the dynamics of these transformative processes, and whether and how they are consequential theoretically, are inadequately explored. If organic content distinguishes agro-food systems of provision, then, to pose Michael Watts' question, "what difference does the difference make?"; that is, is it analytically significant? (Watts 1994, p. 567). Is it anything more than an empirical taxonomic criterion?

The silence of Fine and his colleagues on the theoretical and material implications of the organicism of agro-food systems is revealing. Anxious to avoid charges of biological or natural determinism, they take refuge in the modernist ontology, a vantage point that disables analysis of the materiality of nature in

interaction with social forces. In seeking to deny causal *priority* to the organic, a worthy enterprise, it is deprived of all analytical standing and becomes simply a descriptive category. The ‘organic content’ of agro-food systems of provision is viewed exclusively from one pole of the nature-society dichotomy. This move erases the organic analytically, whether as autonomous agent, co-actor, constitutive presence with social labour in the historical construction of food provisioning systems, or even as a contingent constraint on capitalist imperatives.⁶ In the hands of Fine et al. (1996), the organic as nature or biology is a sterile concept, analytically moribund and indeterminate.

Contextualizing human agency

Nor does the organic fare much better with Arce and Marsden (1993), whose main methodological concern is to abandon the “reductionist notion of ‘system’” (p. 296) that allegedly pervades agrarian political economy. Indeed, the organicism of agro-food networks is largely taken for granted, and it is consumption and social agency that are regarded as the neglected categories. Consumption is represented as a key site in food commodity chains, where (surplus) value increasingly is constructed and extracted, notably through the power relations embedded in quality standards and regulation (Arce and Marsden 1993; Marsden and Wrigley 1995; Marsden 1997). In consequence, social contestation over quality and value assumes central importance in “setting the parameters for the specific labour and environmental conditions” in different regional, often distant, production spaces (Marsden 1997, p. 174). In these differentiated, unevenly developed, “mosaics of regional production and consumption spaces” (Marsden 1997, pp. 170–71) that define transnational food networks, “the environmental problems and intensive labour conditions associated with land-based production are distanced” (Arce and Marsden 1993, p. 294).

However, the *interplay* between spatialized agricultural natures, or ‘environment’ in this account, and the social world of labour, commodity circulation, and exchange is very much of secondary importance in this line of inquiry. Rather, the theoretical project, heavily inflected by actor-oriented perspectives, is to reclaim “the significance of contextualized human agency” that “the (food) system approach suppresses” (Arce and Marsden 1993, p. 296). In their view, this task involves “reconceptualizing value in everyday situations (social practices)” in order to “disclose social differentiation in the value construction of food” (pp. 296–7).

Critical of ‘structuralist political economy,’ Arce and Marsden (1993) appeal for a theoretical framework that will create room for “the importance of actors’ cultural and knowledge negotiations in defining the meaning of food” (p. 296). With this purpose, they venture on to the now familiar terrain of rising consumer interests in diet and health, the emergence of new social and ethical values concerning the “natural (both physical and biological) environment,”

and their expression in changing consumption practices. This is useful as a descriptive account of the contested arenas of food bio-politics. However, as a theoretical treatment of “*contextualized* human agency,” it is squarely in the tradition of mainstream sociology, and correspondingly flawed by the embedded ontological separation of nature and society. Thus, although ‘mad cow disease’ may have persuaded people to eat more fresh produce, a change that is represented analytically as “an expression of how people are internalizing *their meaning of nature*” (Arce and Marsden 1993, p. 303, emphasis added), the ontological reality of non-human nature and its material and relational role in the unfolding of these events go unrecognized here.

In Arce and Marsden’s treatment of social agency, there is no room for active or collective negotiation between nature and the social world. Nature is merely a cipher for human intentionality and practice, and there is no engagement with recent approaches that conceptualize non-human nature as a relational entity with active properties (Callon and Law 1995). Consequently, when Arce and Marsden (1993) discuss the contested processes whereby the ‘value relations’ of food commodities are reformulated, nature appears as an unexplored category that is marshaled by the different social actors – consumers, supermarkets, farmers – as a *discursive* resource. In short, in this discursive domain, only one voice is heard. The organicism of agro-food networks thus remains a shadowy presence in this analysis, a reflection of the larger and unacknowledged reductionism embodied in the nature-society dualism.

Wageningen actor-oriented approaches

This reductionism is again very much in evidence in the rural sociology of actor-oriented perspectives, which is strongly associated with Wageningen University. Oddly enough, certain concepts found under this rubric would support a symmetrical treatment of human and non-human agency but, despite references to the work of Callon, Latour and Law in more recent writing (Long and van der Ploeg 1995), this path is not taken. The approach is presented as an alternative to determinist, unilinear theorizations of agrarian structural change encountered in the commoditization debates of the 1970s and 1980s. Against such formulations, the empirical diversity and heterogeneity of farm organizational patterns or ‘styles of farming’ are seen not as anomalies *vis-à-vis* some structurally driven, teleological outcome but as the result of interaction between different ‘actors’ projects’ based on informed strategic decisions (Long 1986).

Van der Ploeg’s formulation of the actor-oriented perspective is founded on the specificity of the farm labour process; namely, that the ‘objects of labour’ and the ‘instruments’ can be secured as use-values *via* on-farm or internal production and reproduction (van der Ploeg 1986, 1990). With this “unity of production and reproduction,” the division between use-values and exchange-

values in the farm labour process is open to manipulation, which gives farmer-actors 'room for manoeuvre' to decide on the pace and process of commoditization. This 'mastership' over the elements of the labour process, derived from farmers' control over reproduction, creates the theoretical possibility of a continuum of styles of reproduction representing differential relationships farmers can establish "*vis-à-vis* the markets and dominant technological models" (van der Ploeg 1994, p. 75). Within the 'room for manoeuvre,' the strategic choices made by farmers in relation to these 'structuring principles' give rise to different 'styles of farming' (van der Ploeg 1993, pp. 248–52).

Polyvalence thus re-emerges, with the specificity of the farm labour process once again viewed as the source of agriculture's organizational and technical diversity. However, the Wageningen group, in Long's words, takes an explicitly "constructivist approach (to) . . . the differentiated nature of styles of farming, agrarian enterprise, and agricultural work." That is, one that treats agrarian development as a "socially constructed and continuously renegotiated" process (Long 1996, p. 11). There is no place for agricultural nature nor other non-human actors in this (re)negotiation. Thus van der Ploeg (1993, p. 241) regards agricultural production "as a specific form of social practice," where "local ecosystems" enter merely as a descriptive category or dimension of the morphology of farming styles.

With its emphasis on use-values and their role in production-reproduction, van der Ploeg's conceptualization of the farm labour process in certain respects resembles Benton's 'eco-regulatory' labour processes. But here this insight is used to re-affirm the all-pervasive domain of human action – 'agency as singularity' as Callon and Law (1995, p. 503) have it – and not to theorize the materiality of nature in its relations with social labour. Thus 'the living organisms' that make up the 'objects of labour' in the farm labour process create a gamut of possibilities for direct producers to retain effective control over production and the development of the productive forces (van der Ploeg 1986, p. 27).⁷ However, this specificity has analytical importance only insofar as it extends the field of human agency. Against this social construction of nature, the 'cultural repertoire' of farming 'styles' could readily be re-conceptualized as different relational co-productions of 'natures-cultures' (Latour 1993). This course is not followed, however, and nature, here 'ecosystem,' is simply the *mise en scène* for the human theatre where 'projects' are autonomously planned and contested. With its exclusive preoccupation with social categories, the rural sociology of actor-oriented perspectives is deeply entrenched in the ontological separation of nature and society.

Escaping impalement

So far, we have identified several accounts of agro-food networks and their constitutive relations that are impaled on the 'social' pole of the problematic dual-

ism between 'nature' and 'society.' These approaches seek no analytical engagement with nature, and thus silently re-affirm its objectification in accordance with the ontology of orthodox social science. The danger of impalement is also present but at the opposite pole with formulations that attempt to overcome the eclipse of nature by bringing biophysical processes explicitly into the analysis, focusing variously on exceptionalism, mediation, organicism, and ecological 'limits.' Broadly, these perspectives represent agro-food networks as constituted through interactive processes between the world of produced or social nature and the world of social labour. Nevertheless, these approaches pay residual homage to the idea that some capacity or power is 'held back' by an ultimately unknowable, impenetrable nature, an immutable dimension of the 'natural order' that is beyond the reach of humans and their artefacts. In these dialectical interactions, agriculture or agro-ecosystems are being reified and take on the attributes of external nature – paradoxically, agricultural nature, 'second nature' is theorized as being of the social world and yet, in some measure, apart from it. Thus in natural or ecological 'limits' arguments, where biophysical processes mediate human action, these processes represent a collective proxy for the nature 'beyond' the reach of social agency, and so outside the social world.

Although these dialectical analyses of nature-society formations mark a significant advance on anthropocentric, objectified accounts, the issue of how to theorize the relational materiality of these entities, at once mutually determined yet separate, is not resolved. That is, the appeal, however qualified, to an external, essential nature, historically and analytically prior to social nature, simply recreates the ontological division of nature and society (FitzSimmons 1989a).

A possible way forward from this *impasse* of ontological polarities is offered by actor-network theory, which rejects categorical notions of 'nature' and 'society' and proposes instead a framework in which their interaction is conceptualized in terms of heterogeneous *collective* associations "of elements of Nature and elements of the social world" (Latour 1993, p. 107). The entities produced by these interactions are hybrids of nature and culture or "quasi-objects, quasi-subjects," which are assembled into actor-networks, the central analytical metaphor. Networks differ in size, scope, and power, but all obey the common principle of symmetry, that is, of being co-productions of nature and society. Secondly, agency is collective and relational, conceptualized as the collective capacity of humans and non-humans to act. It is an *effect* of these heterogeneous networks, or hybrid *collectifs* (Callon and Law 1995), in which non-humans are endowed with active capacities. Thus 'singular' notions of agency situated at either pole of the 'Great Divide' are rejected by actor-network theory, which "insists that social agency is never located in bodies and bodies alone, but rather that an actor is a patterned network of heterogeneous relations . . . Hence the term actor-network – an actor is also, always, a network" (Law 1992, p. 384).

Despite its promise in dissolving the ontological separation of nature and so-

ciety by theorizing the ‘natural’ and the ‘social’ not as *a priori* categories but as co-produced, performative identities that emerge in the process of network building (Callon and Latour 1992), actor-network theory has been slow to find its way into agro-food studies. Moreover, while authors recognize that actor-network theory provides new analytical and ethical perspectives on nature–society interactions, so far it has been used mainly to address the more narrowly social scientific questions of ‘structure’ and ‘agency.’

Thus Murdoch has outlined the epistemology of actor-network theory at some length, but his critical attention has focused particularly on issues of power and the ‘radical symmetry’ of extending the concept of agency to include non-human entities (Murdoch 1994, 1997). Themes and topics examined in empirical applications of actor-network theory include agricultural and environmental policy (Clark and Lowe 1992), British rural land development (Marsden et al. 1993), farm pollution regulation (Lowe and Ward 1997), alternative trade organizations (Whatmore and Thorne 1997), and food scares and dietary fads (FitzSimmons and Goodman 1998). Finally, Busch and his colleagues have drawn persuasively on actor-network theory to examine the construction of quality, knowledge/commodity transformations, and agricultural globalization in the case of rapeseed (Busch and Tanaka 1996; Juska and Busch 1994; Busch and Juska 1997). In the following section, these metaphorical tools, combined with the notions of metabolic relations and corporeality, are used to analyse recent food scares, agri-biotechnologies, and contemporary debates surrounding the proposed federal regulation of organic agriculture in the United States.

Exploring the middle kingdom

Actor network theory and its location of agency in the hybridity of relational nature-culture collectives provides a conceptual repertoire rich in possibility for addressing the intrinsically hybrid metabolic and corporeal questions of agro-food networks. This metaphor can be extended to regard agency as an emergent property of networks, of collectives that express the ontological unity of humans and non-human entities in the principle of their co-production. While all collectives mix together human and non-human actants, the dimensions of hybrid agency depend upon the complexity of the network. That is, on the enrolments of quasi-objects – wheat fields, pedigree livestock, fermentation vats, cold chains, futures markets, menus, and cookbooks, for example – whose trajectories “trace . . . both forms of nature and forms of society” (Latour 1993, p. 108). It is here, in the extension of the complexity and scope of collectives, and the related potential to dominate others, that science and technology assume importance. Innovation multiplies the ‘sociotechnical hybrids’ or quasi-objects enrolled in the building of collectives, making “the community that we form with these beings a more intimate one,” and giving “new impetus

to the redefinition of the social body, of subjects and objects alike" (Latour 1993, pp. 108–109). With these general principles of actor-network theory, several key concepts – translation, network reversibility, and black boxing – require brief elaboration as they are helpful in deciphering the contested transformations and innovations in agro-food networks.

Networks are the expression of translation processes, a generic term for the various formative steps taken to align and bind human and non-human entities into alliances (Callon 1991). These processes include enrolment, whereby inter-related roles and functions are stabilized and attributed consensually to actors, and mobilization, the culminating phase of translation, when enrolment is "transformed into active support." This signifies that "a constraining network of relationships has been built," although "this consensus and the alliances which it implies can be contested at any moment" (Callon 1986, pp. 218–19). Role, function, and identity are thus relational attributes, negotiated during the various 'moments' of translation, rather than predetermined. Correspondingly, hybridity is a protean, multifaceted property of both the entities enrolled and the composite actor-network.

Actor-networks are variable not only in their geometry, but also in the degree of stability and irreversibility (Callon 1991). If networks are to persist, they must foil efforts by competing collectives to translate and enrol their constituent entities. Resistance to overtures for 'retranslation' depends on the 'durability' and 'robustness' of the network, qualities which are conceptualized, like irreversibility, as relational properties (Latour 1991; Callon 1991). These qualities, as Callon (1991) notes, may follow a gradient ranging from informal discursive practices, for example, to conventions codified in regulatory norms and standards, which represent forms of network co-ordination or 'translation regimes.' Even so, "... translations, however apparently secure, are in principle reversible" (p. 150).

Actor-network theorists have devoted considerable attention to the dynamic processes that confer stability on networks such that they appear to be irreversible and are treated as black boxes. In the case of stable, strongly co-ordinated networks, typically 'heavy with norms,' the translation operation is taken for granted and "tends to shed its history" since "it can be assimilated to a black box whose behavior is known" (Callon 1991, p. 152). When such networks link with other actor-networks and exchange intermediaries, Callon (1991) refers to their 'punctualization.' In this process, an entire network, such as markets, technologies, or scientific disciplines, are translated "into a single point or node in another network" (pp. 152–53). Law (1992, p. 385) refers to black boxing as a form of simplification in that "if a network acts as a single block, then it disappears, to be replaced by the action itself and the seemingly simple author of that action."

Translation operations or network patterns that are black boxed thus are 'reduced' to routines, standardized practices, that other networks can draw

upon as resources. However, “punctualization is always precarious, it faces resistance, and may degenerate into a failing network” (Law 1992, p. 385). Callon (1991, pp. 141–2) takes the example of a nuclear power station that remains a black boxed actor-network converting “known inputs into programmed outputs” until, as in the case of Chernobyl, the punctualized intermediary emerges as an author as the heterogeneous contents of the black box are revealed. This concept of black boxing can readily be extended to the everyday metabolic relations of agro-food networks, particularly in the analysis of incidents, such as food scares, and social struggles that expose punctualized, routine corporeal practices to scrutiny.

Food scares

The jaws gape open, tongueless, and each circular set of teeth is smeared with a little blood, as though the drama had begun with an animal, which was not carnivorous, eating flesh.

Through the cut hide, the son axes the breast bone . . . From that moment onwards, the cow, no longer an animal, is transformed into meat . . . (John Berger: *Pig earth*, 1979, pp. 2–3).

Food scares are episodic events when the hybrid co-productions of natures-cultures that make up human food practices are revealed and re-negotiated. In these moments of acute politicization, human and non-human intermediaries reconsider their roles and identities in the actor-network, and the social worlds built around these relational ties collapse in disarray. Thus with confirmation of the outbreak of bovine spongiform encephalopathy (BSE) in a Kent dairy herd in November 1986, the resulting implosion of the beef-dairy cattle collective was felt initially in Britain, then the European Union, and recently reached into a court room in Amarillo, Texas. As this actor-network, previously taken for granted or punctualized, imploded in dissension, the actants inscribed in the translation were identified and their punctualized roles became ambivalent and uncertain. Unscrupulous farmers, cost-cutting rendering firms, contaminated animal protein in ruminant feed, slipshod abattoir practices, over-worked meat inspectors, and neo-liberal deregulation policies have all been implicated in the occurrence of spongiform encephalopathies that cross species barriers and cause a new variant of Creutzfeldt-Jakob Disease (nvCJD) in humans eating BSE-infected meat products. These hybrid actants are mediated, it is now believed, by newly apprehended ‘abnormal’ or ‘rogue’ protein molecules called prions, which apparently can withstand the high temperatures reached in rendering plants. These proteins are identified, at least in the scientific mind, as the proximate ‘causal’ factor of BSE and nvCJD, although organophosphates are now regarded as another possible ‘cause.’

This network of hybrid intermediaries also is exposed to scrutiny by the periodic incidents of food poisoning, in some cases fatal, associated with Escher-

ichia coli (E. coli), usually a harmless bacterium found in animal and human intestines. Actants here include a pandemic of Shigella dysentery in Central America, feedlot cattle, abattoirs, and US fast food restaurants.⁸ The scientific 'smoking gun' again is isolated from the collective agency of the network, and in this case it is a new strain of bacteria, known as E. coli O157:H7, that carries a gene producing the Shigella toxin (*New York Times*, 6 January 1998, pp. A1–14).

These episodes disrupt the co-ordination and 'robustness' of agro-food networks on all registers – material, political-economic, social, discursive, and semiotic – as enrolment becomes precarious and punctualized relationships are called into question. The fetishized, punctualized, and 'naturalized' co-productions of everyday foodways are suddenly scrutinized by enrolled intermediaries, not least the meat-eating public. Routine metabolic relations are abruptly superseded by the instinctive interrogations of the omnivore's paradox, metabolism becomes strategic, a matter of personal corporeal consent. Food scares open black boxed agro-food networks to reveal the hybrid collectives in which daily food habits and practices are enrolled. That is, the translation of bodies into co-productions which, taking the examples above, connect the metabolism of the four guts of cattle to human digestive tracts and the sense of well-being.

Like the King's horses, the King's men, and Humpty Dumpty, the collective can only be put back together again by renegotiating the relationships mediated through the network. The content and geometry of the collective is reconfigured to enlist new quasi-objects, new hybrid intermediaries to secure the safety of non-human and human metabolisms. In this work of (re-)translation, and the articulation of new codified forms of co-ordination or 'translation regimes,' there are close affinities with convention theory (Callon 1991; Wilkinson 1997). In the case of BSE, this re-ordering of hybrid actants – animate, politico-institutional, sociotechnical, and textual – comprehends cattle certification schemes, computerized cattle tracking programs, 'specified risk materials,' cattle export bans, myriad scientific advisory committees, new food safety agencies, and public inquiries.

In terms of actor-network theory, food scares expose the hybrid mediations inscribed on 'food,' and invite us to 'follow the actors' in the translation process as hybrid collectives are reconstituted. Such glimpses into the black boxes of agro-food networks are the stuff of bio-politics, giving leverage to groups seeking to transform the punctualized institutions and practices which mediate relationships between non-human and human actors. For faithful allies of the collective, the political challenge is to recover their cohesion by re-aligning their interests and re-defining their roles in a new translation regime, which avoids displacement into more radical, competing 'programs of action.' So far, the beef collective in the United States, Oprah Winfrey notwithstanding, has been more adept in the arts of 'boundary' co-ordination than its European counterparts.

Agri-biotechnologies

Tell me what you eat: I will tell you what you are.

(J.-A. Brillat-Savarin: *The physiology of taste*, 1825; 1994, p. 13).

Power is about *whose* metaphor brings worlds together, and holds them there.

(Susan Leigh Star, 1991, p. 52)

Agri-biotechnological innovation can readily be framed in terms of actor-network theory as practices to modify and thereby ‘retranslate’ the constitutive elements of agro-food networks. That is, to enrol new hybrid co-productions of nature-culture – genetically modified organisms and genetically modified foods – into stable, strongly co-ordinated networks. Notions of translation, heterogeneous associations of humans and non-humans, and the networked agency of hybridity resonate strongly when exploring the bio-political struggles provoked by reconfigured agro-food networks, multinational ‘life science’ corporations, and the mobilization of the new intermediaries, the new quasi-objects of biotechnological engineering.

These new enlistments, weaving together the natural and social realms in Latour’s (1993, p. 42) ‘seamless fabric,’ epitomize the accelerating ‘socialization of non-humans,’ what Rabinow (1992, p. 246) calls “the improvement, the enculturation of nature” in the service of “biopolitical specifications like ‘nutrition.’” Corporations such as Monsanto, Novartis, and Zeneca are working to establish new translation regimes aligned to support the routine introduction of genetically modified organisms into plants and animals. These hybrid entities, as food, mediate the dual metabolisms connecting agricultural nature and human reproduction. “Simultaneously real, discursive, and social,” as Latour (1993, p. 64) has it, agri-biotechnologies introduce new mediators into the intimate corporeal relations of agro-food networks, promising new corporealities and, quite literally, new bodies.

In contesting these intimate, novel co-productions, attention has focused precisely on these dual metabolisms and shared corporealities. Oppositional groups have raised material and ethical concerns in campaigning against the release of genetically modified organisms into the metabolism of agricultural nature (and ‘wild’ nature), and the incorporation of genetically modified organism-derived foods into human bodies. Currently, the struggle is joined around genetically engineered herbicide (glyphosphate)-resistant soybeans (‘Roundup-Ready’) and genetically modified maize, two extraordinarily ubiquitous corporeal mediators of agro-food networks as animal feedstuffs and human processed foods. The general public has been reluctant to accept the validity of the industrial and scientific establishment’s problematization of agri-biotechnologies (*intéressement* in Callon’s (1986) lexicon), whether framed as a solution to world hunger, a low risk method of ‘improving’ on nature, or as inevitable technoscientific progress. These bio-politics reveal a clash of divergent ontologies. The industrial perspective is grounded in the modernist dualism of an external, ma-

nipulable nature that is to be dominated and worked 'on' as an arena of technoscientific innovation and human progress. Against this instrumental rationalism, oppositional groups, particularly green NGOs, while not devoid of anthropocentrism, invoke a relational ethics, often articulated in terms of shared community and stewardship.

Significantly, public concerns about agro-food technoscience and its problematization are not met simply by implementing regulatory norms, standards, and conventions. The controversy in Western Europe surrounding the labelling of genetically modified grains and processed foods reveals these limitations. As we have suggested, opposition is rooted fundamentally in ethical considerations, and these are not easily addressed by regulatory bodies supportive of industrial technoscience and accumulation. This capacity to arouse ethical concern, and particularly when 'naturalized' metabolic relations are at stake, describes another dimension of the awkward distinctiveness of agro-food networks. It is hard to imagine ethical principles as the inspiration of public opposition against the next generation of microprocessors. Not so with 'Roundup-Ready' soybeans.

*Hijacking the organic*⁹

Ethical considerations also assume strategic significance in the contested regulatory bio-politics of organic agriculture and food in the United States. In 1990, Congress passed the Organic Foods Production Act, which mandated the establishment of the National Organic Standards Board (NOSB), administered by the US Department of Agriculture (USDA), in order to develop a comprehensive set of regulations governing the production and handling of certified organic foods nation-wide. The NOSB convened in 1992, and in 1994 it presented its initial recommendations to the Secretary of Agriculture, followed by some thirty addenda. These recommendations were largely ignored by the USDA in drafting the new National Organic Program Proposed Rule, which was released to the public in December 1997. The proposed rule evoked a storm of protest, galvanized by the organic farming movement, which reached unprecedented levels, with the USDA receiving over 200 thousand communications before the public comment period closed on 30 April 1998.

The debate has centred on the meaning of the term 'organic,' and its use in labelling, a discursive controversy with real material and ecological ramifications. The proposed rule departed dramatically from NOSB recommendations, ignoring well-established and widely accepted standards of organic practice. The USDA proposal presented a restrictive, highly technocentric vision, focusing on permitted inputs rather than agro-ecological processes or the socio-economic dimensions of sustainable agriculture (Buck et al. 1997; Guthman 1998). In what appeared to be a calculated move to destabilize the organic agro-food network, the proposed rule sanctioned the enrolment of new hybrid entities,

notably irradiation, municipal sewage, and genetically modified organisms, in the definition of what constitutes organic food. These three highly controversial intermediaries are antithetical to the material practices and ethical values of the organic movement and, not surprisingly, their inclusion provoked vociferous dissent. As Callon (1991, p. 135) observes, “actors define one another in interaction – in the intermediaries that they put into circulation,” adding that “intermediaries *describe* their networks in the literary sense of the term.” The Secretary of Agriculture recently bowed to public protest and gave assurances that the three offending intermediaries would be excluded from the revised regulations to be issued later in 1998 (*The New York Times*, 9 May 1998). Nevertheless, this extraordinary episode merits brief analysis.¹⁰

In actor-network terms, the USDA proposal formally initiated a process of retranslation to displace and enrol the organic agro-food network into the punctualized conventional agro-food networks of corporate agribusiness capitals and the state apparatus. The struggle of the organic farming movement has been to resist the power of translation or redefinition of its interests by these actors. The new rule, in short, threatened the distinctive practices, material and discursive, of this alternative ‘mode of ordering’ of metabolic relations (Law 1994). If this ‘detour’ had been taken, the organizational logics of *connectivity*, based on the ‘telling and performing’ of shared relational ethics between those who produce and those who consume organic food, would have been undermined, perhaps irredeemably (Whatmore and Thorne 1997). In this event, to use Callon’s lexicon, the organic agro-food network would have undergone *normalization*, foreclosing a return to previous translations, and enhancing the irreversibility of conventional agro-food networks (Callon 1991, pp. 146–152).

In organic agriculture the fetishized abstraction of food is intentionally unveiled, bringing the complex filaments of food provisioning explicitly into focus. That is, the organic agro-food network invites scrutiny of its constituent metabolic relations, an interrogation that follows from its organizational and ethical premises of connectivity, in contrast to the punctualization or black boxing characteristic of industrial agro-food networks. The multiple human and non-human actants involved at every step are explicitly foregrounded, giving transparency to the complex material, eco-social, and discursive practices that bring food from the land to the table in the routine context of everyday life. In these alternative actor-networks outside the established hegemony of conventional agro-food networks, food becomes a signifier for political, social, and ecological struggles that are otherwise easily ignored. Personal choices have political ramifications, and decisions about food can give voice to political commitments (Miller 1995).

The bio-politics of food, as expressed in the organic farming movement, is an oppositional politics of praxis that contests the industrial orderings of eco-social relations based on instrumentalist utilitarian rationality. Such an alternative world view directly subverts the modernist dichotomy of nature/society.

Instead, it engenders an oppositional and parallel actor-network, a collective that enacts different relational rules of the game, emphasizing the metabolic unity between the cultivation and consumption of food, and encompassing a moral community that transcends the instrumentalist division between people and nature. The relational nature-culture *collectifs* and hybrid agency of actor-network theory are mirrored in the labour processes and discourses of organic farming. In this view, the body and the earth are analogous, and food as co-production is the central unifying material and symbolic linkage that bridges and binds the social and natural together. Here the metaphor of health and the practices of good husbandry find expression in a relational ethics (Whatmore 1997) that, in turn, informs the bio-politics of the organic farming movement.

These bio-politics, materially and discursively, express the ontological unity of humans and non-humans espoused by actor-network theory, and hint at the political opportunities latent in the recent turn in the philosophy and sociology of knowledge and the 'Age of ecology' (Worster 1977). In this respect, actor-network theory has the significant merit of proposing a new language of nature-society relations. For all its omissions and imprecision, this new lexicon is a significant step towards conceptualizing the metabolic reciprocities, and their hybrid offspring, that define everyday existence, and which have been erased by the objectifying dualisms of modernity. Agro-food networks, as the primary metabolic loci on this terrain of hybridity, represent privileged sites for this theoretical engagement.

Conclusion

The bio-politics of green social movements and environmental NGOs are articulated from ethical principles whose ontological foundations are diametrically opposed to those underlying mainstream social science disciplines. This dissonance has encouraged belated, but still isolated, reconstructive efforts to overcome the abstraction of nature – the contemporary 'greening' of social theory. This paper argues that several leading recent perspectives in agro-food studies are vulnerable to this indictment. Further, this erasure is embedded in an a-historical and asymmetric reading of the co-evolutionary processes forming 'agri-cultural' communities, their staple 'heirloom' varieties, and accompanying metabolic relations and corporeal intimacies. As Latour (1994, p. 60) remarks about this extraordinary socialization of non-humans, "domestication cannot be described as a sudden access to an objective realm that exists beyond the social. In order to enrol animals, plants, proteins in the emerging collective, one must first endow them with the social characteristics necessary for their integration."

The modernist dichotomy of nature and society, so deeply ingrained in agro-food studies and orthodox social theory, is disabling – analytically, politically, and ethically. The externalized, mechanistic conceptualization of the non-

human realm militates against conversations with environmental activists and collaborations to formulate a radical politics of nature-society interaction. In effect, by failing to recognize and repudiate the abstraction of nature, the contemporary social sciences silently collude in the objectification of nature, and hence its de-politicization. Tacit consent in this ontological collusion, as eco-feminists, eco-Marxists, and other 'green' oppositional currents have vigorously argued, shackles comprehensive critique of capitalist political economy.

Actor-network theory offers conceptual and metaphorical tools that expose and address the erasures 'naturalized' by the modernist ontology. We have used this theoretical vocabulary to reveal the shortcomings of some recent agro-food perspectives and mainstream social science more generally. A next step would be to take actor-network approaches to nature-society co-productions, the hybridity of agency, and power, for example, and explore their closer integration with other reconstructive social-theoretic projects, which give greater prominence to interrelationships between nature, social justice, and the construction of alternative socio-ecological futures.

Notes

1. I am grateful to Margaret FitzSimmons and Timothy Vos for their comments. The usual disclaimers apply. An earlier extended version of this paper was presented at the Workshop on Systems and Trajectories of Agricultural Innovation, Institute of International Studies, University of California, Berkeley, on 23–25 April 1998.
2. Following Schmidt (1971), Grundmann (1991) observes that Marx uses the conceptual framework of 'metabolism' or 'interchange with nature' (*Stoffwechsel*) to describe the transformation of nature for human purposes through the mediation of technology. Thus "technology discloses man's mode of dealing with nature" (Marx, *Capital*, 'Vol. I, cited by Grundmann 1991, p. 107). Davis (1997) indicates that Marx, in his critique of political economy, was attacking simultaneously theories of value that reified capital by ignoring the organic or natural foundations of production, and theories that postulated that the organic as land presented absolute natural limits to accumulation. "Nature in Marx is thus a co-equal source, with concrete labour, of use-value, but a relative (that is to say, manipulable) constraint on the expansion of exchange value" (Davis 1997, p. 24). See also Benton (1989).
3. Reconstructive efforts have focused on ways to transcend the dualistic opposition between nature and society that resides at the foundational core of the intellectual traditions of modern social science disciplines. Contributors have traced the consequent erasure of nature, its material reality and active presence, in the academic disciplines of economics (Martinez-Alier 1987; Norgaard 1994), sociology (Benton 1991, 1995), human geography (FitzSimmons 1987a,b; Demerit 1994), Marxist political economy (Benton 1989; Harvey 1996) and Marxist geography, notably the 'production of nature' perspective (Schmidt 1971; Smith 1984; Redclift 1987; Castree 1995).
4. Nature as an active material presence emerges in Worster's (1979) account of the US Dust Bowl in the 1930s and, more generally, in the contrast he draws between 'traditional' husbandry and industrial agriculture in terms of their observance of "the natural ecological order" (Worster 1990, p. 1101).

5. In agricultural labour processes, Benton suggests, labour is "primarily deployed to sustain or regulate the environmental conditions under which seed or stock animals grow and develop" (1989, p. 67). This dependence of eco-regulatory labour processes on "nature-given conditions" means that "For any specific technical organization of agriculture, these elements in the process are relatively impervious to intentional manipulation, and in some respects they are absolutely non-manipulable" (p. 68).
6. For example, neo-Schumpeterian analyses of technical innovation and economic change are premised on notions of path-dependency and technological irreversibility (Dosi 1988). Once a technological paradigm has been established, alternative 'ways of doing things,' by assumption, have already been eliminated by the search process, competition, and the cumulative characteristics of technical change.
7. While claiming to privilege the organic, Fine et al. (1996) palpably fail to get to grips with this concept and explicitly work through its analytical implications in 'tempering' relations between agro-food networks and industry. For discussion of this and related issues, see *Review of International Political Economy* 1(3) 1994, pp. 519–586.
8. Van der Ploeg's (1986) concept of the farm labour process thus has close parallels with the exceptionalist position, here present in the production-reproduction of non-human and human use-values in mutually constitutive processes. Interestingly, he recognizes that these possibilities to structure labour processes and develop the productive forces are "essentially different from the typical industrial situation" (p. 47).
9. The world's most serious outbreak of *E. coli* O157 occurred in late 1996 when twenty people died in Lanarkshire, Scotland.
10. This case-study has benefited from discussions with Timothy Vos and draws on his long experience of the organic farming movement as practitioner and activist.
11. The politics and institutional dynamics behind the USDA's radical departure from the original NOSB recommendations are a matter of speculation at this point.

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