

Actor-network theory and methodology: social research in a more-than-human world

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Abstract

This article explores the methodological implications of actor-network theory for social research. Pointing to an increasing awareness of ANT in sociological discourse, but assuming that it is more widely known than well understood, the article outlines some of the key features of ANT as an approach to social life, before addressing the tricky question of how these ideas translate into methodological practice. The possibilities of the approach are illustrated by reference to the author's own ANT-inspired historical research on the socio-material history of dairy milk in the UK, which is used as a point of reference and an example throughout. Particular attention is given to the practical method deployed in the milk study, namely documentary historiography, leading to a critical exploration of the use of ANT in the analysis of historical texts. This involves considering the nature of the relationship between texts and lived practices, and drawing out how ANT offers a distinctive way of seeing texts which challenges the standard ethnographic view of texts and fundamentally transforms the issue. Given that documentary historiography is not a method strongly associated with actor-network theory because it raises considerable methodological dilemmas, this provides one particular account of how such dilemmas can be managed or overcome. Social researchers interested in the potential of actor-network theory should be able to draw upon this in exploring the possibilities of the approach for their own work.

Keywords: Actor-network theory; Methodology; Hybrids; Heterogeneity; Nonhuman Agency; Relational Ontology; Texts; Practices; Historiography.

'There are no humans in the world. Or rather, humans are fabricated – in language, through discursive formations, in their various liaisons with technological or natural actors, across networks that are heterogeneously comprised of humans and nonhumans who are themselves so comprised. Instead of humans and nonhumans we are beginning to think of flows, movements, arrangements, relations. It is through such dynamics that the human (and the nonhuman) emerges.' (Mike Michael, 2000: 1).

Introduction

In recent years something called 'actor network theory' has come to attract wider attention within the social sciences. This intellectual tendency born of Science and Technology Studies has increasingly come to be seen as an important reference point for anyone who wants to take seriously the role of 'nonhumans' in social life. Against this background, this article discusses how ANT can be mobilised in social scientific and especially sociological research, notably in terms of what kinds of knowledge-practices it enables and what sorts of

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methodological possibilities it opens up. In order to do so without excessive abstraction, I use my own recent ANT-influenced research to ground the discussion, as it provides a useful example of ANT in practice. This was a study of the history of dairy milk in the UK, which combined what could be thought of as a historical sociology of the emergence of the modern dairy industry with a socio-material history of milk (Nimmo, 2010). Although the study was not simply an ‘application’ of ANT, and though it was informed by several intersecting traditions, including Foucauldian genealogy, human-animal studies and post-humanism, the theoretical core of the approach was quite distinctly ANT, so it provides a useful way to explore what it might mean in practice to carry out ANT-influenced research.

The question of how ANT is ‘done’ in research practice is a pertinent one, because it is often – I believe wrongly – regarded as an essentially theoretical approach which does not have a methodological repertoire as such. The discussion of my research on milk addresses this directly by exploring the relationship between ANT and a specific methodological practice, documentary historiography, as this was the method deployed in my study. Though this is a specific method and some of the issues it raises will of course be quite particular to it, it also illustrates more general issues around the methodological implications of ANT which are relevant for a range of methods. It should be noted that ANT is a complex theoretical formation with many variations, and whilst my use of ANT inevitably represents a particular ‘version’, it is not my intention here to assert this as the ‘correct’ one. That would be a rather sterile – not to mention very un-ANT-ish – sort of exercise. The aim is simply to explore in a non-partisan way some of the methodological implications and possibilities of ANT in general.

ANT stories: more-than-human ontologies

As several of its key architects and proponents have stressed, ANT was never supposed to be a programmatic theory, but a loose intellectual ‘toolkit’ or ‘sensitivity’ (Law, 2004, 157), something that could help to sensitise researchers to complex and multiple realities which might otherwise have remained obscure. Hence the canonisation represented by the coining of the term ‘Actor-Network Theory’ can be problematic in implying a theoretical unity which is not necessarily there.¹ ANT really is what ANT-influenced theorists and researchers do in their research. Yet it would be wrong to suggest that this work does not have a set of ‘family resemblances’ in common. At the most general level, ANT provides a corrective to the usual social scientific focus upon human beings and the ‘social’ domain of human ‘subjects’, by directing attention to the significance of nonhumans in social life. It suggests that social relations should not be seen in isolation, but as always existing in relations with all kinds of extra-social networks between humans and nonhumans, which need to be recognized and made visible (Latour, 1993; Michael, 2000). For ANT there is no ‘society’ as such, in the sense of a domain consisting exclusively of relations between human subjects, as these relations are always mediated and transformed and even enabled by nonhumans of diverse kinds, whether objects, materials, technologies, animals or eco-systems. Instead of a dualist conception of ‘society’ and ‘nature’, or ‘subjects’ and ‘objects’, ANT posits *hybrids* of ‘societies-natures’, heterogeneous assemblages in which humans and nonhumans are inextricably mixed up together. ANT studies therefore trace the complex interrelations between what we tend to think of as the autonomous ‘social’ and ‘natural’ domains. This ‘more than social’ or ‘more than human’ approach (Whatmore, 2006; Lorimer, 2010) is envisaged as a broadening out of the social scientific gaze so that it acknowledges the profound and multiple significances of non-humans in social life.

These ideas not only influenced the way in which I studied milk, they also inspired my initial interest in it. Milk is at first glance a highly banal substance, consumed unreflexively by millions of people every day as a part of highly routinised consumption practices; it could not be more ordinary. Yet beneath this mundane appearance milk is also deeply hybrid: On the one hand the milk consumed by humans on a daily basis is very much a product of modernity, inseparable from modern forms of social organisation, production and distribution, as well as modern techno-social arrangements, from mechanical milking technologies and pasteurization plants to transport and retail infrastructures. But milk is also a substance produced by cows to feed their calves, and remains in that sense deeply ‘natural’; the milk we consume is not just a manufactured article and a commodity but is also a product of particular sorts of inter-species relations. This nonhuman side

of milk is both visible and invisible. The ‘naturalness’ of milk has long been emphasised in milk advertising, and yet the ‘nature’ presented in these discourses is little more than a commercial spectacle, a romantic idea of purity which has more to do with the logic of commodities and consumerism than with the real materiality and corporeality of inter-species relations of production. I argue that the real nonhumanity of milk is something which is problematic for modernity and which has therefore been carefully managed, repressed, and as far as possible made invisible, in order that milk can be consumed without it signifying anything of our problematic relations with nonhumans and the environment.

This is similar to what Carol Adams (1990) calls ‘the structure of the absent referent’ in the practice of meat-eating, wherein the death of the animal that precedes the act of consumption, though known abstractly, is somehow made to *not* signify, or is made absent, through a range of material and semiotic techniques. In the case of milk, which is the product of a still-living animal, what is made absent is the inter-constitution of the human and nonhuman worlds that is embodied in the hybridity of milk. My wider argument, connecting with Foucauldian and post-humanist critiques as well as ANT, is that this ongoing work of making hybridity absent is an ontological condition for the reproduction of modern notions of what it is to be human (Nimmo, 2010). It can also be regarded as a special case of a process that critical theorists have identified as central to capitalism, namely the effacement of the traces of production in a commodity once it passes into the sphere of consumption, so that consumption can take place untroubled by the lived relations of production which are its condition of possibility. Thus, despite its deeply hybrid nature, milk as we encounter it on the supermarket shelf appears to us merely as a commodity and as thoroughly ‘social’; it has been systematically ‘purified’, in an ontological as well as a material sense, the traces of its nonhumanity having been carefully effaced.

For these reasons milk provides an especially fruitful and interesting object of analysis for ANT, which is centrally concerned with rendering visible the multiple interrelations of humans and nonhumans that make up the ‘messy’ assemblages characteristic of the modern world, and with challenging the purification of these imbroglis into distinct ‘social’ and ‘natural’ elements which are treated as incommensurable. In the case of milk this meant digging beneath the commodified everyday appearance by tracing how milk became modern and ‘social’ by being purified of its hybridity. This was necessarily a historical analysis, as the purification of milk began as a highly visible project in the late nineteenth century with the struggle against tuberculosis transmitted through milk and the gradual emergence of milk regulation, sanitation and inspection; but this hybridity became progressively less visible through the course of the twentieth century as milk was carefully reinvented as a ‘pure’ and ‘healthy’ product.² A historical analysis was therefore indispensable in order to grasp the real messiness and complexity of milk, which is now all but invisible. This was not however a ‘social’ history as such, but was rather a ‘more than social’ history, which meant taking seriously the role of diverse objects, technologies and organisms, not just as a context of social action but as intrinsic elements of that action, and indeed as actors in their own right.

The potential radicalism of this can be appreciated when one considers the persistence of subject/object dualism in structuring social scientific discourse. This has been manifested in many forms, from the structure/agency question to the ongoing bifurcation of ‘interpretivist’ and ‘realist’, as well as ‘qualitative’ and ‘quantitative’ approaches to understanding social life. There have been manifold attempts to overcome this divide, by proposing some kind of dialectical relationship between its two poles (Berger and Luckmann, 1966), by theorising the subsumption of one side under the structural totality of the other (Althusser, 1965), or by conceiving ‘practice’ as a mechanism of intermediation between the subjective and objective dimensions of social life (Giddens, 1986; Bourdieu, 1977). It can be argued that each of these in its own way has re-inscribed the subject/object divide by virtue of the attempt to overcome it on its own terms.³ ANT in contrast makes no such attempt, but instead argues that things have simply never been divided into subjects and objects, except insofar as modern knowledge-practices have laboured to so divide them. For ANT, subjects and objects are in fact *inventions* of modernity.

Yet it would be a mistake to assume that we separate subjects from objects merely because of a contingent error in our thinking, an instance of what Gilbert Ryle called a ‘category mistake’ (2009: 8), because actually this separation is embedded in the very organisation of our knowledge and our social-material life. In Bruno

Latour's (1993) terms, the division is integral to the cosmology of 'the modern constitution', an epoch-defining structure of knowledge which depends for its coherence upon a perpetual separation of the human 'social' domain of subjects from the nonhuman 'natural' world of objects (1993: 13, 29). Our modern knowledge-practices constantly inscribe these dualist categories upon phenomena in an ongoing 'work of purification', which meticulously disentangles the social from the natural so that each seems 'pure' and uncontaminated by the other. In effect modern knowledge presents us with a distorted vision of the world by virtue of the very way it makes sense of it; by compartmentalising everything into subjects and objects which are held to be ontologically distinct, it obscures the heterogeneous and hybrid networks which are so central to understanding the complexities of the modern world. The strategy of ANT is to challenge this logic of 'purification' by treating subjects and objects in radically similar terms, and by tracing and problematising the very processes of purification which inscribe them as separate and incommensurable. This has been referred to variously as 'the sociology of translation' (Callon, 1986), 'ontological politics' (Mol, 1998; Law, 2004), or more recently 'cosmopolitics' (Stengers, 2010); but perhaps the most helpful term is 'generalised symmetry' (Latour, 1993: 94), as this best expresses the core commitment to analysing relations which cross-cut the modern 'great divide' between humans and nonhumans, subjects and objects, society and nature, in such a way that the various kinds of entities involved on both sides are treated in the same terms, which is to say, symmetrically.

To illustrate what this might mean in practice I return to the example of milk. One of the most well known and controversial formulations arising from generalised symmetry is its postulation of 'material agency' (Knappett and Malafouris, 2008). Agency is not an exclusive property of human beings, it suggests, but on the contrary, 'objects too have agency' (Latour, 2005, 63). This is designed to destabilise modern society/nature dualism by positing the existence of something which is supposed to be an exclusive and defining property of social subjects – the capacity for agency – on the object side of the ontological divide. Designed to highlight the work of ontological purification that underpins notions of agency as the exclusive property of human beings, this way of thinking proved highly suggestive in studying the modernisation of the modern milk industry. Whereas a conventional 'social' approach would have gone to great lengths to carefully distinguish which elements in all of the complex and heterogeneous factors involved in the modernisation of milk were truly 'human' and 'social' and could therefore be properly regarded as 'agents' of historical change, I was able to dispense with making such distinctions, which in turn enabled me to perceive the remarkable entanglements of humans and nonhumans which I soon found at the heart of every significant historical transformation of the milk industry.

Freed from the conventional requirement to restrict the attribution of agency to human and social entities, it became apparent that the commodification of milk and the modernisation of the dairy industry were underpinned by networks which were striking in their heterogeneity. My starting point was the critical year of 1865, when a severe outbreak of rinderpest wiped out most of the cows kept in the urban cowsheds that had previously supplied the town populations with most of their milk, precipitating the rapid expansion of the railway transportation of milk into the towns and dramatically changing the entire economic geography of the milk trade. The appropriate end-point for my study was more difficult to determine, but I finally settled on 1940, by which time most of the major changes which would shape the modernised milk industry through much of the twentieth century were well underway, and certainly clear in their logic and trajectory. During this seventy five year period the milk trade was transformed from a highly localised cottage industry, where people consumed only small quantities of milk produced by small herds no more than a few miles away, to a fully commercialised national industry dependent upon multiple technologies, subject to an exacting regime of sanitary inspection and with significant elements of centralised economic organisation, in which milk from large rural herds was routinely cooled and refrigerated before being sent hundreds of miles by rail to distant consumers in towns and cities. The per capita consumption of milk also increased exponentially as part of this process of modernisation, especially through the early decades of the twentieth century. Previously, consumption had been more or less stable at what by today's standards was a very low level per person for several centuries, and in the 1860s it was widely regarded as a risky and potentially disease-laden substance, associated with high levels of infant mortality and with practices of adulteration and watering down by unscrupulous town milk sellers; there were even tales of fish swimming around in milk that was waiting to be

sold (Jenkins, 1970: 38). But the gradual establishment of sanitary regulation of the milk trade alongside the emergence of organised milk publicity and mass advertising transformed the public perception of milk from a dirty, impure and disease-carrying substance to a vital and uniquely nutritious staple food.

Studying the multiple agents involved in these dramatic changes, it quickly became apparent that any attempt to separate the 'social' factors from the 'non-social' or 'natural' factors would have been an irrelevant and misleading exercise, since the processes themselves exhibited no such separation. In fact the 'agents' of these shifts turned out to encompass not just the things one might normally think of as broadly social or socio-economic, such as farmers, dairy companies, milk consumers, advertisers, railway companies, sanitary officials and government bodies; but also included multiple nonhumans, such as diseases, bacteria, microscopes, soil phosphates, the steam engine, refrigeration technologies, systems of measurement, the biological properties of milk, and indeed cows themselves, each of which could be seen as enacting a certain 'agency' of historical change. It was equally clear that any effort to differentiate between the agency of human social actors as 'primary' and that of nonhumans as in some way 'circumstantial' or 'contextual' could not be grounded in the historical analysis but would simply be an a-priori ontological distinction. Viewed in terms of the historical processes themselves, the agency of humans and that of nonhumans was not different in kind – each could be equally efficacious in making a difference to a given situation. Moreover the agency of humans in many cases could not be comprehended in isolation from the agency of various nonhumans, and indeed vice-versa. Thus it transpired that agency was not a property of certain kinds of entities at all, but was in fact an emergent property of the networks and inter-relationships between heterogeneous actants – it was a relational effect. Furthermore, the more actants enrolled in these networks and the more heterogeneous these actants were, the more potent the resultant agency. Bruno Latour (1993) identifies this 'hybridization' – the construction of increasingly complex networks between diverse entities – as a defining characteristic of modernity and the key to its peculiar dynamism.

ANT therefore provided a highly useful set of theoretical resources with which to undertake a historical analysis of the modernisation of the milk industry. The approach actually enabled me in certain respects to be *more* empirical than a conventional social or sociological history, because it allowed me to approach the sources without preconceptions about what sorts of historical roles different kinds of entities could legitimately be ascribed. The analytical advantages of this were clear, but it also created a methodological dilemma, since like most historical researchers I was obliged to rely for my historical analysis upon documentary archive sources. These comprised the Journal of the Royal Agricultural Society, the Journal of the British Dairy Farmers' Association, the Journal of the Ministry of Agriculture, the reports of the Medical Officers of Health for Manchester and Salford, the pamphlets of various sanitary societies, as well as assorted national and local official documents and secondary sources. The question therefore became how to avoid a human-centred approach when relying on these written sources produced by human beings. This also raised the broader question of how to construct a coherent account of complex historical developments without separating the natural from the social, economic and political, in other words without making the very distinctions which normally constitute the structure of a social scientific explanation. All of the normal challenges of historiography were still present, such as the selection of appropriate sources, the challenges of source-criticism and interpretation, as well as issues of triangulation, reliability and validity, but these were all now magnified by the commitment to generalised symmetry – how to read the sources 'symmetrically' whilst avoiding the projection of theoretical preconceptions onto the historical material. Thus the overarching methodological and epistemological problem which presented itself was that of how to trace the agency of nonhumans and material entities through the layers of human symbolic and social mediation represented by documents.

A heterogeneous ethnography of historical texts

ANT has only rarely been associated with historical research, no doubt in large part due to the methodological problem outlined above. But in discussing how this may be overcome I want to begin by briefly looking at the relationship between ANT and a different methodological tradition, namely ethnography, because in contrast with documentary historiography, ethnography has often been the 'natural' method of choice for ANT-

influenced researchers, and for good reason. Ethnography is a deliberately ‘messy’ methodology, putting its faith in the interpretative competence of the researcher when immersed in a social milieu in all its complexity. Rather than seeking the security of pre-conceived analytic categories, ethnographers typically steer a far more inductive course by cultivating an openness to the multiple and overlapping phenomenological worlds of their subjects. Indeed the history of ethnographic thinking manifests a marked attentiveness to something very much akin to what the ANT theorist John Law calls ‘non-coherent realities’ (2004: 92, 98, 100, 112), and to the interweaving of heterogeneous elements in the constitution of life-worlds – something implied by the ethnographic method of ‘thick description’ (Geertz, 1973).

Central to the commonalities between ANT and ethnography is a shared emphasis upon practices – people’s everyday actions, activities and behaviours. A methodological orientation to practices is a defining characteristic of ethnography and underpins its sensitivity to heterogeneity and multiplicity, not least because practices are themselves heterogeneous and multi-layered. Studying social life via the method of closely tracing practices involves acknowledging the disparate elements that routinely enter into the complex and active processes by which people give meaning to the world, their activities and their lives (McNaghten and Urry, 1998, 2). These disparate elements encompass objects and environments, materials and techniques, taxonomies, categories and symbolic systems, which are inextricably intertwined within practices so that any absolute distinction between subjective and objective or social and natural dimensions is rendered nonsensical (Mol, 1998: 31). Practices are by their nature an imbroglio or ‘mangle’ (Pickering, 1995), so that a methodology which takes practices as its object effectively side-steps purification processes in the construction of knowledge, instead generating a kind of ‘thick ontology’ – multiple, overlapping and messy. There are also some differences between the ethnographic view of practices and that which is implied by ANT’s generalised symmetry, which tends to give significantly more emphasis to the agency of nonhuman actors within assemblages of practice. But the commonalities are sufficient to render the take-up and use of ANT by ethnographers a relatively straightforward task, and to render the use of ethnography by ANT researchers a coherent strategy. Both eschew neat analytic categories in favour of a sensitivity to messiness, contingency and non-coherence; both acknowledge the heterogeneity of practices and their interweaving of the social and the material; both are broadly inductive and place an emphasis on the detailed description of what takes place ‘on the ground’.

Historical research however does not have the luxury of direct access to practices, but must rely instead upon texts. If practices are messy, multiple and materially heterogeneous, then texts in comparison appear relatively neat and one-dimensional, offering at best a heavily filtered distillation of lived reality, shorn of its vital textures and centred upon the subjectivity of the human author. Hence John Law’s comment that -

‘[T]he coherences of textuality make powerful realities, but they also lose something: the non-coherent, the non-textual. Realities enacted in other ways. And if we simply stick with the textual then we stop ourselves from ‘reading’, from knowing, from appreciating, those realities.’ (Law, 2004: 97)

This renders the straightforward solution of treating texts as windows on practices – thereby enabling an ANT ‘ethnography of the text’ (Woolgar, 1988: 14) – unworkable, since texts are at once too ‘flat’, too ‘mute’ (Hodder, 2000: 703), too inert and ‘non-reactive’ (Bryman, 2004: 370). With texts it seems the heterogeneous practice is always already absent, and we are left only with traces distilled into symbols and abstracted from the rich and multiple worlds in which they emerged, leaving little scope for ethnography as such. If this perception of the limitations of texts is not often spelled out that is probably because it is largely taken for granted, with social researchers widely regarding the analysis of ‘mute’ texts as a poor substitute for interaction with reflexive subjects and ‘proper’ ethnographic observation of lived practices. The ANT philosopher Annemarie Mol makes this point in explaining her ‘praxiographic’ methodology:

‘I investigate the knowledge incorporated in daily events and activities rather than knowledge articulated in words and images and printed on paper.’ (Mol, 2002)

From a historian’s point of view this is highly problematic, insofar as it militates against the possibility of *historical* ethnographic studies. But I want to argue that the customary relegation of texts as sources of

knowledge about the world is not only a slightly lazy convention in the ethnographic tradition, but is actually inconsistent with the principles of ANT. Indeed a more ANT-ish way of understanding texts is to see them as *inscriptions*, which is to say, not just as ‘representations’ of a complex reality that always eludes them, nor just as ‘sedimentations’ of practices (May, 1997: 157-8), but as technologies of translation and mediation, or ‘mobilizations of the world’ (Latour, 1999b: 99-100). This means grasping texts not as reflections of reality or reports on reality but as *enactments* of reality; they are means by which some things are made present and others absent, so that specific ontologies are performed into being and others made invisible. As Latour and Woolgar put it, ‘writing is not so much a method of transferring information as a material operation of creating order’ (1986: 245).⁴ Thus, far from being two-dimensional or ontologically ‘flat’, texts are themselves hybrid; material things by definition, and therefore ‘objects’ on a strictly modern view, texts as inscriptions also mediate the relations between subjects. Seen in this light, texts are not dislocated from practice but are intrinsic to practices – indeed there is scarcely a practice in the modern world which does not have its accompanying texts, often a panoply of texts, without which the practice would be deprived of the oxygen of its networks.⁵ Thus texts as mobile and material inscriptions are active agents which assemble, shape and connect practices, and in doing so enact objects, constitute subjects, and inscribe relations, ontological boundaries and domains.

Returning again to the milk study in order to illustrate what this might mean in terms of methodology, it essentially meant combining the techniques of historiography and source criticism with a critical discourse analysis informed by the principle of generalised symmetry. In practical terms this involved reading the documents on two ‘levels’ at once, on the one hand for their empirical content, but also more genealogically, that is to say, with an attentiveness to the historical agency of the documents themselves in defining – and thereby helping to constitute – subjects, objects and domains. Thus the documents were treated both as reports on real events and developments, which could be more or less accurate, and at the same time as inscriptions with a social and ontological efficacy of their own. I found that this latter dimension of documents could potentially tell me more about the historical assemblages from whence they had emerged than could their ‘content’ as such.

Lindsay Prior (2008) has made a similar methodological argument in pointing out that social scientific approaches to documents have tended to be concerned only with their content, as produced by human beings, as distinct from their function, or what they *do*, within relational networks.⁶ This way of seeing texts transforms the problem fundamentally. No longer centrally a hermeneutic question of how to access lived practices via the compromised medium of texts, instead it becomes a question of tracing the work of inscription, translation and mediation performed by texts. In this way something like a symmetrical ethnography of the text becomes conceivable, and the subjectivity of the human author looks less like an anchor from which the researcher can stray only so far, and more like a mere nodal moment in complex sets of human-nonhuman relations. Thus reading such relations into texts need not be a case of theoretical ‘projection’, but can instead be a symmetrical re-articulation of the tried and tested critical-historiographic practice of reading sources ‘against the grain’, ‘weaving together many layers of information to reveal complexities’ (Chaudhuri et al, 2010, xiii), thereby reconstructing subordinated knowledges, subaltern voices, and traces of relations which the authors of the documents may not even have been aware that they were setting down. Only in this case, crucially, not all of those ‘voices’ will be human, and those relations will not simply be social relations between human beings, but the multiple networks and mediations of a more heterogeneous collective.

In *The Pasteurization of France* – one of the few well-known historical ANT studies – Bruno Latour (1988) relies upon historical texts pertaining to the emergence of modern bacteriology or ‘Pasteurism’. These are used in order to show that the historical transformations involved were simultaneously socio-political, scientific and material in character, having as much to do with the agency of microbes and the contingencies of politics as with the individual scientific ‘genius’ of Louis Pasteur. Drawing the metaphor of battle and warfare from standard accounts of this period in scientific history, Latour explains his method:

'[I]nstead of clearly dividing science from the rest of society, reason from force, I make no a-priori distinction between the various allies that are summoned in times of war. Recognising the similarity among allies, I offer no a-priori definition of what is strong and what is weak. I start with the assumption that everything is involved in the relation of forces but that I have no idea at all of what a force is.' (1988: 7)

This agnosticism is deployed in a close reading of three scientific journals from the relevant period in such a way that human and nonhuman agents are treated symmetrically, and analysed only in terms of their inter-relations, mediations and translations:

'For each of the relevant articles, I sketched the interdefinition of the actors and the translation chains, without trying to define a-priori how the actors were made up and ranked.' (1988: 11)

In both of these passages the emphasis is upon the researcher's ontological forbearance. Thus it is not so much a case of theoretically inserting nonhuman actants into an otherwise human-centred story, but of refraining from imposing ontological categorisations *a-priori*, thereby allowing the heterogeneous relations and intermediations which are already present to emerge. This closely parallels the methodological approach I used in my own historical analysis of milk, to which I now return in order to illustrate the kind of more-than-human historical narrative that this strategy made possible.

Prior to the 1870s it was impossible to think of milk separately from cows and calves. Milk was part of the cow, a product of its body and inseparable from its species life and its fleshy bovine being. This perception of milk was linked to the social conditions of production of milk in this period, as well as the material properties of the substance itself. Milk provided an ideal medium for bacterial growth and therefore could not be transported any significant distance from udder to consumer whilst remaining fresh. The perishability of milk rendered time and distance impassable barriers to its commodification on anything but a local scale. Together with the prevalence of watering down of milk by struggling milk sellers, this led to widespread popular demand for milk which was 'warm from the cow'. This warmth was widely perceived as an indicator of freshness, authenticity, and the apparent absence of human intervention between cow and consumer, which was regarded as 'meddling' and associated with adulteration. Thus the material trace of the animal within the milk was the key signifier of purity, and the vital warmth transferred from the circulation of blood within the animal's body to the milk in its udder – from the corporeal flow of one vital fluid to another – was valued positively. Indeed so much so that some unscrupulous milk sellers even took to artificially warming their watered down milk before sale (Nimmo, 2010).

Reading the documents symmetrically, with an eye to the role of material and nonhuman agencies in historical transformation, it becomes apparent that this situation began to change from the 1870's onwards as milk began to be sent hundreds of miles by train, introducing a far greater degree of intermediation between cows and consumers. Materially of course milk remained quintessentially an animal substance, but the human-bovine encounter embodied in milk was increasingly rendered an abstract and absent presence, rather than something tangible and immediate. As well as the dramatic growth of the railway transportation of milk, there were other socio-technical factors involved in this shift. Developments in microbiology associated with the work of Louis Pasteur and Robert Koch were revealing the previously invisible 'agency' of bacteria within milk. Whilst statistics compiled by Medical Officers of Health were showing significant rises in urban infant mortality associated with the new rural-urban milk trade. Thus the early suspicion of milk that had been 'tampered with' began to be replaced by a suspicion of milk in its pure state. Partly in response to these anxieties, refrigeration technology first utilised in the brewing of beer began to be adapted to milk production and used to cool milk before transportation, allowing it to be sent much further whilst remaining fresh. As a result of these combined developments, the demand for milk 'warm from the cow' did not merely disappear but was actually inverted. Far from signifying the comforting proximity of the animal, warmth became associated with bacterial growth, infant mortality and risk to health, and it was coldness that came to be the guarantor of freshness and purity. This coldness also signified distance from the animal, paralleling the wider transition towards a dislocation of milk from its nonhuman origins. Though more than ever dependent upon

hybrid networks, milk as perceived by the consumer had become a pure commodity, its nonhumanity effaced and its hybridity rendered absent.

Contrary to what is often suggested then, documentary historiography can be a perfectly viable methodology for ANT studies, although this does involve thinking of historical texts in a somewhat unusual and counter-intuitive way. It is partly a matter of performing a discourse analysis informed by generalised symmetry, which can make an important contribution to unpacking the human-centred discourses and purifications which may be embedded in the texts. But the texts themselves can also be seen as circulating inscription devices, simultaneously material and discursive. They are not only emergent from and embedded within multiple ensembles of human-nonhuman relations and practices, but are themselves actants within these relations, which mediate and enable the construction of particular networks. ANT can help to sensitise the historiographical researcher to these relational dimensions of texts, what one might call their non-realist *materialities* (Law, 2004: 153, 161). This does not of course obviate the need for empirical historiography, but it does shift the problematic away from the unhelpful notion of myopically groping towards richly textured heterogeneous practices armed only with 'flat' subject-centred representations.

Conclusion

This article has explored some of the methodological implications of the use of actor-network theory in social research. Some of the characteristic features of ANT as an approach have been outlined, including its emphasis upon the inseparability of humans and nonhumans or the 'social' and the 'natural' in hybrid networks, the tendency of modern knowledge to 'purify' or separate these assemblages into discrete domains, and the key idea of 'generalised symmetry' as a strategy for un-thinking this purification. The emblematic ANT argument concerning material- or object-agency has also been explained in this context. The possibilities of the approach have been illustrated by reference to my own ANT-inspired historical research on the socio-material history of dairy milk in the UK, showing how it enabled me to combine an analysis of the social, economic and political dimensions of modernisation with an acknowledgement of the roles played by diverse nonhumans, such as microbes, microscopes, refrigeration technologies and diseases. The article then turned to the practical method deployed in that study, documentary historiography, in order to explore the use of ANT in the analysis of historical texts. Outlining the common distinction between the multi-dimensionality of practices and the relative one-dimensionality of texts, it considered the question of how it is possible to generate a symmetrical account of historical assemblages from texts produced by human subjects. It was argued that ANT offers a distinctive way of seeing texts which fundamentally transforms the issue. For ANT texts are not inadequate representations of lived practices which are always already absent in the text, but are relational inscriptions embedded in hybrid networks which they help to assemble. It was argued that it is not therefore a question of trying to fathom what is 'outside of the text', but of tracing what kinds of relations the texts are performing into being, what sorts of actants they are enrolling and what purifications they are inscribing. In this view historical texts are not mere traces of far removed complex realities but are vital conduits for the very processes of network assemblage and mediation taking place in a given historical moment. The task for the ANT researcher then is to be the 'ethnographer of the text' who follows those processes in all their heterogeneity.

¹ Bruno Latour famously criticised the term 'actor-network theory' as poorly designed, faulty and, like a malfunctioning product, badly in need of recall (1999a, 15). By 2005 he was more sanguine, accepting the acronym 'ANT' and musing that it was 'perfectly fit for a blind, myopic, workaholic, trail-sniffing and collective traveller' (2005: 9).

² The geographer Peter Atkins has also written about this, in his *Liquid Materialities: A History of Milk, Science and the Law*, Ashgate, 2010.

³ For an interesting account of how ‘the structure-agency’ debate has been framed by ‘the structure lobby’ on their own terms, as well as a critique of Giddens’s ‘structuration’ theory from a Symbolic Interactionist and Ethnomethodological perspective, see Wes Sharrock (2010) ‘The Production and Reproduction of Social Order: Is Structuration a Solution?’, in Peter Martin and Alex Dennis (eds) *Human Agents and Social Structures*, Manchester University Press, Manchester and New York, 100-116.

⁴ Although Latour is emphatic that ANT is something very different from deconstruction, this ANT conception of texts as performative inscriptions bears some resemblance to Derrida’s (1974) *Grammatology* in rejecting the metaphysics of presence which underpins the assumption that texts are a mere ‘supplement’ to an originary meaning located elsewhere.

⁵ This is how Latour and Woolgar vividly describe the laboratory setting for example: “By recording all events and keeping traces from all the inscription devices, the laboratory overflows with computer listings, data sheets, protocol books, diagrams, and so on... the noise of accumulated data.” (1986, 246)

⁶ See also Michel Callon (2002) ‘Writing and (Re)writing Devices as Tools for Managing Complexity’, in J. Law and Mol, A. (eds) *Complexities: Social Studies of Knowledge-Practices*, Duke University Press: Durham and London.

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Biography

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