Introduction: The Becoming Topological of Culture

Celia Lury, Luciana Parisi and Tiziana Terranova

Theory Culture Society 2012 29: 3
DOI: 10.1177/0263276412454552

Article

Theory, Culture & Society
29(4/5) 3–35

DOI: 10.1177/0263276412454552
tcs.sagepub.com

Introduction: The Becoming Topological of Culture

Celia Lury
University of Warwick, UK

Luciana Parisi
Goldsmiths, University of London, UK

Tiziana Terranova
University of Naples 'L'Orientale', Italy

Abstract

In social and cultural theory, topology has been used to articulate changes in structures and spaces of power. In this introduction, we argue that culture itself is becoming topological. In particular, this 'becoming topological' can be identified in the significance of a new order of spatio-temporal continuity for forms of economic, political and cultural life today. This ordering emerges, sometimes without explicit coordination, in practices of sorting, naming, numbering, comparing, listing, and calculating. We show that the effect of these practices is both to introduce new continuities into a discontinuous world by establishing equivalences or similitudes, and to make and mark discontinuities through repeated contrasts. In this multiplication of relations, topological change is established as being constant, normal and immanent, rather than being an exceptional form, which is externally produced; that is, forms of economic, political and cultural life are identified and made legible in terms of their capacities for continuous change. Outlining the contributions to this Special Issue, the introduction discusses the meaning of topological culture and provides an analytic framework through which to understand its implications.

Keywords

change, comparison, continuity, models, networks, topological culture

Corresponding author:
Celia Lury, Centre for Interdisciplinary Methodologies, University of Warwick, Coventry CV4 7AL, UK
Email: c.lury@warwick.ac.uk
http://www.sagepub.net/tcs/

Introduction

In his studies of the mass culture of the Weimar Republic (1995), Siegfried Kracauer famously identifies a 'turn to the surface'. In developing his description of this turn, Kracauer pays special attention to the objects, media and practices that 'display an elective affinity' with the surface such as the hotel lobby, arcades, and dance troupes as well as newspapers, photography and cinema. So, for example, he describes the dance displays in popular revues where troupes such as the Tiller girls performed, as ornaments made out of bathing suited bodies. The attraction is the display of 'girl clusters whose movements are demonstrations of mathematics'. Kracauer focuses on the penetration of cultural forms by a ratio: 'The ornament, detached from its bearers, must be understood rationally'. He describes the reason at work as having a mathematical logic – a 'Euclidean geometry' – that organizes the masses. Cultural forms obey the logic of a 'linear system', and the 'elementary components' of physics, such as 'waves and spirals', training 'the broadest mass of people to create a pattern of undreamed-of dimensions'. For Kracauer, the mass ornament is the 'aesthetic reflex of the rationality to which the prevailing economic system aspires' (Kracauer, 1995: 79). But, so we will suggest here, a new rationality is emerging: the moving ratio of a topological culture.

This ratio can be identified in the significance of a new order of spatio-temporal continuity for forms of economic, political and cultural life today. This ordering of continuity emerges, sometimes without explicit coordination, in practices of sorting, naming, numbering, comparing, listing, and calculating. The effect of these practices is both to introduce new continuities into a discontinuous world by establishing equivalences or similitudes, and to make and mark discontinuities through repeated contrasts. The topological cultural forms (or constantly changing deformations) of lists, models, networks, clouds, fractals, and flows proliferate. In the movements of these dynamic forms there is a multiplication of relations of equivalence and difference and a radical expansion of the possibilities of establishing comparisons (Heintz, 2010; Riles, 2011). Ordinal rankings or ratings, for example, are increasing in number and importance not only in the economy but also in education, health, and popular culture, as they are used to derive and justify the allocation of resources (Guyer, 2010). More widely, the operationalization of listing has provided powerful tools for sequencing, linking and connecting activities in many contemporary calculative infrastructures, including, for example, credit rating agencies (Leyshon and Thrift, 1999).

In this multiplication of relations, change is established as constant, normal and immanent, rather than as exceptional or externally produced; that is, forms of economic, political and cultural life are identified and made legible in terms of their capacities for change. There is an ongoing expansion of the present (Nowotny, 2002), and a problematization of

events in terms of the potential they offer for change, for what could be and for what might have been. Change is normalized as it becomes a shared condition: everyone is, variously, implicated, even if only as those whose exclusion is required for change to happen. The claim this introduction is making, then, is that culture is increasingly organized in terms of its capacities for change: tendencies for innovation, for inclusion and exclusion, for expression, emerge in culture as a field of connectedness, that is, of ordering by means of continuity, and not as a structure based on essential properties, such as archetypes, values or norms, or regional location.

The influence of topology in social and cultural theory in recent decades is immense. Topological ideas have been a significant source of inspiration across many social science disciplines, including philosophy, sociology, political science, psychology, anthropology, geography and economics. Topological ideas have fed into and transformed multiple specific fields of study. So, for example, as Marres (2012) observes, in the field of social studies of technology, topological ideas have helped dismantle the view that technology and society occupy different domains, contributing instead to the concept of a heterogeneous 'assemblage', which is heterogeneously composed of social, technical and natural entities (Latour, 1987). In economic sociology they have contributed to an understanding of markets as emergent in the activities of firms that continuously and jointly construct a market interface (White, 2002; Stark, 2009). In relation to studies of globalization, topological thinking has fed interest in processes of de- and re-territorialization, networks, flows and assemblages (Castells, 2006; Appadurai, 1990; Ong and Collier, 2005; Lash and Lury, 2007) and is deployed by those geographers and political theorists who seek to describe dynamic relations and mobilities that cannot be contained by scaled spatial entities, such as territory (Balibar, 2009; Elden 2009). In all these approaches it is *relationality* that is important, and topological concepts have enabled social theory to move beyond a reliance on the mechanical and organic to include transductive and transitive modes of relating (Simondon, 1992), and helped turn space and time from 'a priori' into 'a posteriori' categories (Lash, 2009).

But what is proposed in this introduction is not simply the transposition of topological ideas onto the field of culture. Instead we are interested in teasing out an epochal transformation in the intersection between the form and content of cultural expression. In other words, the becoming topological of culture does not simply correspond to how culture imagines topology; instead, our proposal is that topology is now emergent in the practices of ordering, modelling, networking and mapping that co-constitute culture, technology and science. In short, a distributed, dynamic configuration of practices is organizing the forms of social life in ways that supplement and extend those of Euclidean geometry. The latter relies

upon 'lower level' principles of invariance or constancy (rotation, symmetry, scale and translation) and enable movement – or transformation only in relation to external metrics of time and space. In contrast, in a topological society, we no longer live in or experience 'movement' or transformation as the transmission of fixed forms in space and time but rather movement – as the ordering of continuity – composes the forms of social and cultural life themselves. This is not, of course, a matter of one rationality displacing the other, but of their overlapping and mutual implication such that the continuity of movement – or the continuum – becomes fundamental to contemporary culture.

At the same time as making this epochal claim, however, we – and our contributors – do not wish to jettison the conceptual vocabulary afforded by theoretical understandings of topology. The introduction will thus outline both what is involved in the becoming topological of culture, by describing the topological forms of culture that emerge in processes of continuity and ordering, *and* discuss topological thinking insofar as it informs contemporary debates. This approach – the combination of the claim that culture is becoming topological with the use of topology as a way of analysing culture – is, we suggest, not a mere doubling or mirroring, but a slide along a möbius strip, from the outside-in of cultural theory to the inside-out of culture becoming topological. The introduction will thus contribute to what might be called cultural topology (see Shields in this issue for an account of what this might involve) as well as establishing the claim that culture is becoming topological.

In order to illustrate this topological twist, we will focus on the problematic of relationality as it emerges in cultural topology by outlining two key approaches to the problem of the continuum as they are found in mathematics. We organize our account in this way because of the significance we attribute to the mode of ordering based on continuity in contemporary (topological) culture, and because different approaches to the problem of the continuum have been developed in social and cultural theory. In this theory, there is often direct and indirect reference to divergent mathematical understandings of topology, including differential topology and point-set topology, and thus we discuss these approaches later in this introduction. We see this development of topological concepts in cultural theory as part of a dialogue with mathematical (and other) thought that seeks to address the contemporary historical conjunction in which culture is becoming topological.

The structure of the introduction is thus as follows: first we will describe the emergence of topological culture through a discussion of processes of mediation. This involves showing how relations of continuity and discontinuity are being made and unmade by describing the emergence of new kinds of connectivity, ordered-ness and limits, and exploring their role in the creation of the infinity variety of 'Escher-like system[s] of exclusion and inclusion' (Gregory, 2004: 125) that

characterize contemporary culture. The second part of the introduction describes further the developments that have contributed to the coming into being of topological culture, including the expanded role of indices, the formation of meta-models and the proliferation of networks in practices of auto-spatialization. The third part is an exploration of topology in mathematics insofar as it is relevant to social and cultural theory, explicating the significance of the problem of the continuum for understandings of relationality. The fourth part considers issues of control and critique in relation to the operations of method in topological culture, while the final, fifth, part returns to the question of what it means to describe the becoming topological of culture in terms of a moving ratio.

Topological Media-tions

There are many different origins identified in histories of topological thinking (see Shields, 2012) but we choose to start with the work of mathematicians Karl Friedrich Gauss and Bernard Riemann in the second half of the 19th century who developed methods that allowed the study of n-dimensional surfaces without any reference to a supplementary embedding space-time – that is, surfaces that are spaces in themselves (DeLanda, 2005). Put simply, a surface that is a space in itself is not fixed by way of external co-ordinates but is, rather, organized from within itself; it has intrinsic rather than extrinsic dimensions. Mathematicians were not, of course, alone in their explorations of the continuum in this period, and by the turn of the century there were parallel concerns emerging in physics, biology (notably in the work of Jakob von Uexküll),[1] architecture, urban planning, art and literature (among many possible accounts of such developments see Kwinter, 2002, for a discussion with an explicitly topological focus) as well as in social and cultural theory. The notion of the boundary – not only dividing but also joining – was, for example, central to Simmel's conception of sociology: he wrote about the importance of its 'infinitely variable placement' (Simmel, 2007b) in establishing relations between individuals and between individuals and groups. Indeed, he describes the human being as 'the bordering creature' whose situated embodiment shapes and is shaped in every dimension by the spatial and temporal boundaries of existence (Kemple, 2007). In 'The Transcendent Character of Life', one of his last essays, he comments on the double aspect of the human condition both to contain and to surpass itself: 'we are bounded in every direction, and we are bounded in no direction' (1971 [1918]: 355, quoted in Kemple, 2007: 4).

Heidegger, too, can also be seen as a thinker of the continuum. Such an interpretation is proposed by Peter Sloterdijk (2012) through an explication of Heidegger's existential analytic of the 'in' in Being-in (*In-Sein*). Sloterdijk argues that this must be understood in terms *not* of 'being-in

something', with its presumption of a homogeneous container space (as water is 'in' the glass, or the suit is 'in' the wardrobe), but in terms of Heidegger's allusion to the Old German verb *innan*: 'What he calls being-in-the world meaning nothing other than to ''inn'' the world in the verbal-transitive sense: to dwell in the world and to enjoy its openness through an initial attunement (*Einstimmung*) and expansion (A*usgriff*)'. According to Sloterdijk, Heidegger does not present *Da-sein* as 'a sort of a being, which is free from being-in, but which at times is in the mood to take up a ''relation'' to the world'. Rather, 'taking up of relations to the world is possible only because, as being-in-the-world, *Da-sein* is as it is'.

As the exploration of the constitutive role of the continuum begins to emerge across disciplines, the mathematical field of topology develops through the study of the properties of examples of such surfaces, including, notably, the manifold. Riemann himself proposed a general theory of continuous manifolds or open-sets to define the curvature of space. This manifold geometry of continual spatial relations was understood by Riemann in terms of a multiply-extended magnitude capable of different measure relations, independent of the three-dimensional ambient of Euclidean coordinates. It was used to demonstrate that spatial structures may change from point to point on a curve, and thus provided the basis for a mathematical understanding of a continuously changing curvature of n-dimensions. What was of interest to mathematicians was how to define the invariance – that which stays the same – in such spaces of continuous transformation. As we noted above, the operations of invariance in topological geometry – ordering and continuity – are, by contrast with Euclidean geometry, more general. Crucially, they mean that invariance and intrinsic change (understood as deformation) are not incompatible; rather they are rigorously inter-related. Put another way, topology is the setting up of spaces of different kinds of order and continuity in such a way as to enable deformation or change, what Massumi (2002) calls the continuity of transformation. Alternatively, we can describe a topological surface as 'a relational field of emergence' (Parisi, 2012; Manning, 2009).

Our claim in this introduction, however, is not simply that topological thinking develops in the arts, humanities, social and natural science alongside mathematics. Rather, it is that contemporary culture is itself coming to display a proliferation of surfaces that *behave topologically*.[2] To support such a claim we might point to 20th-century developments in the gridding of time and space, the proliferation of registers, filing and listing systems, the making and remaking of categories, the identification of populations, and the invention of logistics, all of which Nigel Thrift (2004) identifies as contributing to what he describes as movement-space. As he and other commentators have also observed, software is now so substantially integrated into the dynamics of contemporary culture and society that it is routinely involved in the reformulation of processes, ideas, institutions

and cultural objects (Fuller, 2003; Galloway and Thacker, 2007). Thrift describes movement-space as a pre-individual, post-social substrate of guaranteed correlations, assured encounters and unconsidered anticipations, which brings new 'awhereness' into the world.[3] In terms of the account we are presenting here, it is this maximization of relations that makes the analysis of the becoming topological of culture a pressing concern; the imperative is to ask: how are capacities for change being rendered legible, how are they being mobilized, and with what effects?

To do this it is helpful to begin to augment this historical account of the emergence of topological culture. Alongside the tendencies listed above, we would want to propose the increasing significance of practices of mediation (Serres, 1995; Latour, 2005). We can start, for example, by considering the changes befalling the various kinds of 'borders' or 'frames' (window, screen, mirror and interface) that mediate social and cultural experience. A basic definition of the frame in media theory is 'a window that opens onto a larger space that is assumed to extend beyond the frame' (Manovich, 2001: 80); alternatively, the frame may be said to connect and separate 'two absolutely different spaces that somehow coexist' (Manovich, 2001: 95). One of the key implications of Deleuze's work on cinema, however, was to consider the frame itself as dynamic, that is, as a constantly changing articulation of the continuum. As Deleuze and Guattari put it: 'Frames or sections are not co-ordinates; they belong to compounds of sensations whose faces, interfaces, they constitute' (1994: 187). In this view, the 'borders' or 'frames' of mirrors, windows, screens and interfaces have become surfaces of sensation themselves by operating the opposition between inside and outside in a dynamic re-making of relations to each other. In this framing there is a loss of the fixity, distance and perspective that went with the classical division between subject and object, as Scott Lash (2012) makes clear.

Let us give some more examples of how the frames of mediation have come to produce topological spaces. In Beatrice Colomina's (1996) discussion of the use of the horizontal window by Le Corbusier, for example, she argues that whereas the vertical window produces an impression of a complete, three-dimensional external space from the inside-out by giving a sense of perspectival depth, the horizontal or landscape window frames a new space, a planar projection 'sticking to the window'. Any building that Le Corbusier might create in relation to the space of such a window could be understood as a mechanism for classification since a building designed to have horizontal windows, as Colomina observes, is a building that 'collects views and, in doing so, classifies them. The house is a system for taking pictures. What determines the nature of the picture is the window' (Colomina, 1996: 311). As she notes, for Le Corbusier, 'to inhabit' the inside-out space of the building produced through the frame of the horizontal window was equivalent to inhabiting a camera.[4] In this way, Colomina places the shift in architecture associated with Le

Corbusier in relation to the ways in which one of the cultural forms identified by Kracauer as having an affinity with the turn to the surface, photography, contributes to a representational and epistemological break with perspective. Photography, Colomina suggests, makes everything contiguous and equivalent (see also Lury, 1996).

Along the same lines, the art critic Rosalind Krauss (1972) describes the pictorial frontality of Le Corbusier's drawings of buildings in terms of the wedging together of objects in a space of pure extension. Rather than edges being used to indicate the depth and discrete separateness of objects, continuity is established between them through what the Purists called a 'marriage de contours'.[5] This 'marriage' – in which one object is brought into relations of contiguity with another in a dynamic framing – is also to be found in television. Mary-Ann Doane (1990), for example, argues that television's 'greatest prowess is its ability to be there', by which she means 'both on the scene and in your living room', and that this '"being-there and here" goes on at the same time, in that quasi-simultaneity to which I have referred'. In this view, the television screen is a 'covering' of the split between here and there, of the outside of the world and the inside of the home; a surface that, nevertheless, does not refer back to a separation between reality and appearance. On the contrary, the television screen is a covering or surface that, as Doane remarks, gives 'shape, contour and figure' to the separation.

Television is conceptualized here as a function, a mapping, or relation of connection, hence a space of topological mediation.[6] If, for William Uricchio (2005), '[t]he idea of the medium, explicitly, invoked in terms like "television" and the German word for television, "Fernsehen", was about the extension of vision in real time', for Samuel Weber (1996) television confounds the points of reference that allow the viewer's determination of what is near and what is far, what is now and what was then, what is connected and what is disconnected. In their place, the television screen is an active surface of coverage or co-ordinatization: television does not extend vision in the sense of capturing the object of sight and then transmitting it (re-presenting it); rather, it is a space in which object-images are animated or brought to life in continuous movement, the continuously changing space of the screen. Indeed, this is only another way of describing television's widely recognized spatio-temporal organization, that is, its articulation of presence, contingency and immediacy, or 'liveness' (Williams, 1974; Marriott, 2007; Auslander, 2008). In this conception, television is a regime of image that is not static but continuously regenerated in cycles of scanning (Parikka, 2011). This allows, as Maurizio Lazzarato puts it, 'sets of elements, affects, organs, flux and functions . . . [to] operate on the same level' in such a way as to cause "subjectivity" . . . [to find] itself simultaneously on the side of the subject and on the side of the object' (Lazzarato, 2006; see also Lury, 2007).

This spatio-temporal configuration of liveness is by no means limited to television, but is, rather, characteristic of contemporary media more generally, contributing to the rise of what Eva Horn has called the *'medial a priori'* (2008: 8). Katherine N. Hayles refers too to 'the movement of computation out of the box and into the environment' (Hayles in Gane et al., 2007: 349), while Parisi writes that 'information is not transmitted between the environment, body and machines, but an entire ecology of information sensing is at play in the movement of transmission between channels' (Parisi, 2009: 188). This increasingly pervasive – ubiquitous – organization of liveness has significant implications for how politics is being reconfigured. Consider, for example, Judith Butler's description of the ways in which the spatio-temporality of politics is being re-constituted in the 'occupy and assemble' movement of 2011. The relation between the 'scene' of action and the media is not only one where the media give visibility to the scene, but one where the media are part of the scene and action, indeed *are* 'the scene or the space in its extended and replicable visual and audible dimensions' (Butler, 2011). For Butler, mediation not only extends the scene visually and audibly but also participates in the 'delimitation and the transposability of the scene' within a new continuum that spans and connects multiple locations, producing a relationship between the local and the global as the recursive unfolding of a surface of connection. In this context, the bodies carrying the camera, audio-recorder or cell-phone become the frame or border between the scene and the media, included and excluded at the same time and because of this vulnerable to the violence of the state.

But our argument does not presume that the emergence of topological culture is confined to media of communication alone. Our proposal is that it is also emergent in the un-co-ordinated or rather, not externally co-ordinated, activities, relationships and mobilities of multiple actors, infrastructural systems, and networks. We acknowledge here the work of political theorist Etienne Balibar (2002), who argues that borders are no longer to be found only at the edges but also in the middle of territories. And this is the argument taken up by Mezzadra and Neilson (2012): they argue not only that borders are in the middle – in and of mediation – but also that borders do not operate only through the binary opposition 'open and closed'. Borders, they say, are 'parameters that enable the channeling of flows and provide coordinates within which flows can be joined or segmented, connected or disconnected'. In describing the operation of such borders, Mezzadra and Neilson further identify the creation of a constituent excess of inclusion over belonging, an excess which, they suggest, contributes to the proliferation of subject positions, including that of the so-called 'irregular' migrant. Neither fully insiders nor fully outsiders, irregular migrants are, they argue, included in the space of labour markets and citizenship but are not able 'to share the ''belonging'' (the legal status) to which a whole set of rights correspond'.

In Penny Harvey's (2012) description of large-scale road construction programmes in Peru, we can similarly see how diverse practices of relationality and connectivity are mobilized in the production of state space, in this case though by way of the infrastructure of roads rather than through the operation of borders. Harvey's analytical framework calls particular attention to the ways in which the differences and discontinuities in the spatio-temporal relations of roads can be considered as 'intervals' that both separate and connect across time and space. What she is able to show with this framework is that 'state-space' and 'territory' are not co-terminous, but, rather, are put in multiple relations with each other. In Harvey's analysis, as in Mezzadra and Neilson's, state space is found to be organized in terms of variable openness, that is, it is simultaneously grounded and mobile, continuous and discontinuous, specific and generic.

In Harvey's contribution, topology is mobilized as a framework of analysis. This is also how Mike Michael and Marsha Rosengarten (2012) begin their contribution to this issue. Identifying three characteristics of topology, they suggest, will help them describe two enactments of HIV – the UN's AIDS clock and clinical trials for an HIV biomedical prevention technology – pre-exposure prophylaxis (PrEP). These topological characteristics are: space and time are not external frameworks but are emergent; points (which might be entities or events) that are distant can also be proximal (categorically as well as spatially and temporally); and transformations of the relations between points are not causal or linear, but open and immanent. As they observe, topology understood in this way affords a number of supplements to the conventional sociological accounting of globalization processes. In the particular case of their examples, a topological conceptual framework enables them to show that while the HIV interventions they describe are enacted in global terms they are met with, and become mediated by, localizing contingencies which themselves draw from globalizing resources. At the same time, however, as their contribution proceeds, they also point to the ways in which a topological sensibility 'allows for a more complex relation to such an analysis – one which reflects upon (or rather inflects with) the enactment of the very categories (of global/local) that the analysis purports to topologize'. Thus, they begin to explore how topology is never simply either the object or the means of study, but is always folded into itself. Indeed, it is this dynamic, recursive onto-epistemological relationship, so we suggest, that is one of the characteristics of the becoming topological of contemporary culture. It provides the basis for the view that topological culture is a form of practical abstraction (Toscano, 2008).

In another exploration of topological dynamics, Evelyn Ruppert (2012) argues that the use of 'joined-up' databases in government policy transforms government logic and the conception of the subject. Thus, in contrast to a national imaginary of state and society informed

by a topographic logic (in which, for example, the census produces the fiction of the nation as a finite, unified, homogeneous whole in terms of the addition of discrete households or individuals: $1 + 1 + \cdots$), Ruppert shows how New Labour's Transformational Government strategy aimed to identify individuals in terms of open-ended categories such as 'poverty plus'.[7] The ambition was to be able to place individuals on a continuum of needs, which in turn was to be mapped onto 'responsive services'. It was held that it was only by connecting and recursively integrating individuals, needs and services in this way that, for example, a child in need or potentially at risk could be made visible. While Ruppert is keen to show the ways in which this transformation was contested, she also argues for the significance of an imagined topological configuration of state and society in which the imagined collective or 'whole' is neither homogeneous nor unified but is, rather, produced as heterogeneous, as internally differentiated and always changing but somehow still finite.

In these and many other cases, we suggest, a topological ratio can be seen to be emerging in processes of mediation. The effect is to produce a continuum that not only enacts the scalar entities of the 'local', the 'national' and the 'global' but also puts them in multiple relations to each other. In the terms introduced by Sloterdijk, the multiplicity of relations does not simply happen *in* the in-between but rather operates a topological continuum *of* the in-between.

Auto-spatialization

To develop further our analysis of the topological forms of contemporary culture, this section seeks to develop a notion of auto-spatialization. This is a term we take from the work of philosopher Gilles Chatêlet (2006), who describes a renewal of the notion of indexation in what he describes as graphic reason.[8] Auto-spatialization refers in Chatêlet's work to a changed relation between indices and that to which indices are supposed to point. In 'classical' mathematical calculation, he argues, a set of indices was neutral: indexation remained external to the development of calculation. Indices were operated as if notation was completely indifferent to that which it noted. In 'contemporary' calculation, he proposes however, notation is becoming concrete: indexation is no longer determined by an external 'set' (of numbers or data) but by a process of deformation in a surface that is itself in motion. Indexation is no longer reduced to the external evaluation of a collection or set, he says, but becomes 'the protagonist of an experiment which secretes its own overflow' (Chatêlet, 2006: 40).

What this suggests to us is that it is important to look at changes in the semiosis of contemporary culture, that is, changes in processes of abstraction and translation, of proportion and participation, ordering

and valuing, sensing and knowing. Our suggestion is that there is currently a transformation in the operation and significance of the indexical in contemporary culture (Lury, forthcoming). So, for example, in relation to the inter-related processes of making of science, state and society, a wide variety of commentators have argued that the use of indices in metrics has historically been supported in various ways, by complex sets of social relations and technologies, often enabling the entities they produce to travel great distances in stable form (to be transmitted as immutable mobiles in Latour's (1987) terms). The movement of such entities – or the transmittability of what was indicated – has historically required the use of indices in ways that enabled them to make references in relation to objects as if they were indifferent to those objects. In contrast, many of today's indices, such as the derivatives of the financial market, the indicators of behaviour employed in the joined-up databases of government, and the algorithmic operations of the software programs that help comprise Facebook and Google, are implicated in transitive relations to an active or dynamic object or environment.

This is a relation in which epistemology and ontology are re-configured. The usefulness of one of the most important capacities of indices – to point, to indicate 'here' and 'now' – a usefulness that has been limited by the grounding, stabilization or territorialization of the fixity of the co-ordinates of the relations they have been used to enact, is now being deliberately animated. This animation, in for example, 'live' data', is a consequence, in large part, of the introduction and operation of dynamic feedback loops, and the extension of their significance by their use in diverse, iterative and automatic information processing systems, supported by multiple sensory memory systems (Thrift, 2008). The transformation of indexation described by Chatêlet thus follows, we suggest, the movement of information and communication technologies into wider circulatory practices of ordering and coding, of representing and regulating difference. Indices in such feedback loops refer to and produce not static or inert space in which fixed, closed objects move or are transported, but a space in movement.

For C.S. Peirce, indices are signs that use some physical or existential continuity with their objects to direct attention to that object. This capacity draws on the two components that are necessarily part of any act of signifying for Peirce: the sign-object relation and the sign-interpretant relation. The indexical act of signifying, he says, consists of a sign that signifies its object by using some physical or existential continuity (sign-object relation), and generates a further sign to signify that object (sign-interpretant relation). That the interpretant need not be a person but can be another sign is obviously significant in relation to the proliferation of the automated recursive systems mentioned above, and to the possibility that the ordering of sequences of indexes afford for the emergence of what might be called epigenetic surfaces (Kwinter, 1992). What is

perhaps most significant here, however, is that, in the dynamic surfaces that are spaces in themselves, indexical continuity need no longer operate only extensively (that is, in terms of extensive distance, of nearness or farness) but may also take place intensively, as they are, for example, put to work in the three topological operations that Michael and Rosengarten describe.[9]

The notion of auto-spatialization as we invoke it here is thus an attempt to point to the new productivity of the storage, transference and relay of metonymic traces in time and space. To explore this further we take inspiration from Steve Brown's (2012) discussion of the importance of understanding memory in terms of mathematical space. Brown discusses the limits of the concept of the virtual in terms of its inability to account for memory in terms of spatio-temporal actualities. To make good these limits he focuses on the potential of Kurt Lewin's use of topological space for a psychological understanding of memory. However, we see this mathematical understanding of memory, defined by thresholds of transition and two-way relations, as also relevant to an understanding of the expansion of the capabilities of the index and the resurgence of the archive in contemporary culture. That is, the topological space of memory outlined by Brown helps describe how the digital archive has become an operative construct whose recursive connections produce a range of experiential spatio-temporal actualities. In such archives, data storage, organized by way of addresses, need no longer be physically located, grounded in a fixed space, but instead is constituted in indexical processes of de- and re-attachment of data, a continuously changing surface of searchability (Parikka, 2011). In relation to archives and other memory spaces organized in this way, the expansion of the actuality of the present described by Helga Nowotny (2002) emerges, variously, as now-ness, anticipation, the predictability of the present, and real-time.

As a second example of auto-spatializing processes, we would point to transformations in the relation between models and physical objects that take place within the calculative background described by Thrift. In this case, there is also a move away from the simulation of existing physical space towards the deployment and exploration of the continuous and changing surface that is space itself. More specifically, the shift towards interactive algorithms, evolving software, responsive and affective computing has opened up the operation of axiomatics – that is, statements that do not derive from or depend upon other statements, which may be mathematical but may also be social and technical, including for example, contracts and protocols. For example, by gathering data from physical space and letting a program run, computational design has shown that space may engender itself through the continuous interaction of variable parts. The axioms of such programs are, as it were, directly responding to the environment.

Far from being projections within the grid of Euclidean coordinates, computational models are instances of the auto-orderings of matter, as the model takes material contingencies to transform its set values and adapt to new ones. In such models, points, as philosopher and designer Bernard Cache (1995) suggests, deflect from linear trajectories and rotate on themselves like a dancer, whose body continuously swerves in order not to fall. Using this kind of modeling process, Cache has designed and built not objects but objectile structures generated through the rotation of lines. In such models, the space of change is a plane of continual variation in which the model is merged with matter. The computation of urban data provides another example of an algorithmic mode of planning defined by 'an extended apparatus of prediction able not only to establish the condition of the present through the retrieval of past data, but also, and significantly, to change these conditions according to data variations immediately retrieved from the environment' (Parisi, 2012).

Indeed, instead of models, it may be more useful to speak of what Felix Guattari (1977) called 'meta-models'. Arguing against the notion of the model as a structure of representation defined by prototypes, inherited patterns or blueprints, Guattari devised the notion of meta-models to acknowledge the auto-gestation of signs and objects of a non-verbal or non-discursive kind. Examples include practices of auto-modeling, appropriating parts of a model to construct new cartographies of invisible connections and diagrammatic conjunctions. Connections here are not only relations between objects that already exist, but also connections between possible (but not yet existing) objects, described by the invisible contacts established between deterritorialized indices. In her contribution to this issue, Parisi suggests that, far from establishing a continuous feedback or irreversible function whereby software takes command over urban behaviour or the latter acts back on the program, the sequential running of algorithms instead exposes an incomputable quantity of rules to an infinite quality of behaviours, leading to un-provable and un-applicable spatio-temporalities. In Parisi's view, the digital design of time and space is not only controlling or pre-empting the emergence of events, but also unleashing random events or unlived worlds into urban design. From this standpoint, the topological surface of contemporary culture does not simply enliven or generate connections, but, rather, is defined by auto-spatializing algorithmic patterns.

For Guattari, meta-models point to the invention of transdisciplinary methods that are able to borrow ideas and things from non-unified fields so as to produce novel concepts that have the capacity to change the understanding of existing problems. In other words, meta-modeling is not only a concept but also a method, able to address the changing conditions of problems without having to refer to subsisting dimensions. For Guattari, meta-models deploy an auto-generating topological surface equipped with its own system of reference and its own variations.

A model is merely the partial image of an auto-productive space that signs and things can create beneath and through the system of representation. Meta-modeling therefore can also be understood through another of Guattari's concepts: the notion of the diagram that he borrows from Peirce, perhaps the fundamental trope in Chatêlet's graphic reason (see also Rotman, 2012).

Diagrammatics stands for the a-signifying or signal-ectic semiotics that describes the processuality of signs and not their position on a structural grid. For Guattari, mathematics, computer encoding, economic functions, art and music are all instances of diagrammatics. They are processes in which ideas, intensities, functions are transmitted without having to pass through a structure of (symbolic) signification. Diagrammatics indeed establish a direct connection between form and matter, signs and objects (Guattari, 1977: 281): an immanence of relations that creates curves in the surface of spaces in themselves. The reciprocal relation between material fluxes and the semiotic machine (Guattari, 1977: 281) therefore corresponds to an auto-modelling surface. This is precisely a topological space in that it is a space defined by relations or the infinitesimal points running between objects. This relational space is not, however, constituted by voids or gaps but is rather a constantly changing space whose movement is described by infinitely small particles occupying what looks like an empty interval, but is in reality a threshold of change, at which one geometrical surface is knotted into another and another: a möbius strip of invariants transforming lines and points into curves and joints linking one plane to another.

A third example of auto-spatializing processes is networking. In this case, the links with topology are obvious. Networks typically deploy a branch of topology that draws graphs composed of two elements: nodes and connections between nodes, or edges. In such graphs, linking is a recursive and nonlinear process that produces emergent patterns or forms of organization. When applied in computing, network topology is essentially concerned with classifying patterns of interconnections between computers, but it is by no means so restricted: it has found rich potential for application not only in informatics, but also in biology, warfare and the social sciences (Wuchty et al., 2006; Arquilla and Ronfeldt, 2001; Christakis and Fowler, 2009). In other words, the space in itself that is constituted in network topology is the space that increasingly defines the cultural dynamics of hyper-connected societies.

In this regard, networks may perhaps be considered as a special case in the becoming topological of culture. While social and political theory first singled out network topology as the defining form of the complex organizational changes affecting the composition of capital and labour at the turn of the 21st century (Castells, 1996; Hardt and Negri, 2000), it soon became clear that it did not only mark a re-organization of economic production. As a result of the exponential socialization of personal

computing, diagrammatically governed by internet protocols (Terranova, 2004; Galloway, 2004; Galloway and Thacker, 2007) and, more recently, by means of the extension of internet connectivity to a wide range of devices endowed with micro-processing and communication capabilities such as internet TV and radio, tablets, and smart phones (Raychaudhuri and Gerla, 2011), digital social networks are increasingly coming to determine the formation of what Bernard Stiegler (2008) calls 'new relational circuits of transindividuation'. These circuits comprise one of the most glaring examples of topological space in contemporary culture.

In his contribution to this issue, Richard Rogers (2012) identifies four distinctive spatializations, or what he terms political geometries, produced in the mapping practices of the web over the last 20 years. In the 1990s, or as he calls it, the 'web as hyperspace' period, 'links on websites propel so-called cybernauts into other dimensions'. The mapping of hyperlinks highlighted the importance of the politics of association within network topologies and demonstrated that they could no longer simply be assumed to correspond to the early typology of centralized, decentralized and distributed networks. On the contrary, selective link-making 'creates space . . . as demarcated and shaped by limited acts of association'. During the second period, the 'public-sphere or neo-pluralistic period', the web is conceived as a 'great conversation' to be mapped thematically. Websphere analysis, however, had to face new auto-spatializing processes emerging from the increasing centrality of search engines in organizing the political geometries of the web – and their limits in mapping alternate spaces such as those generated by practices of commenting, tagging and so on. In these practices, spheres were increasingly co-constructed by engine algorithms and site owner behaviour, enacting the web as a series of sub-spaces such as, for example, the websphere, the blogosphere, the newssphere or even the tagosphere (folksonomic spaces). As Rogers put it, the study of the politics of web space became cross-spherical. In the third period, the web is mapped as a set of social networks or as a space 'that could show a social network'; 'clusters of actors' are linked with 'issue spaces', revealing their co-constitution, while in the fourth and current period, we are witnessing a mutation in web topology introduced by the diffusion of locative technologies. This is not the 'grounding' of users in physical space, but the construction of network actors as always only temporarily based, 'travelling physically from event to event' (Rogers, 2012; see also Mackenzie, 2010).

Across all these periods, net-mapping practices construct a range of possible topologies in which form (the pattern of relations between points) enables function (the speed by which certain elements flow from point to point, the kinds of actions that networks find easier to perform, including evaluations of how different networks can be 'punctured' or cut) and function dynamically defines the qualities of relations

in terms of, for example, density and direction of connections within a centre/periphery polarity (Christakis and Fowler, 2009). Digital social networks, then, are topological actualities in which culture is increasingly defined and produced out of the in-betweens of digital databases that are themselves continuously being remade within the multiple relational circuits of technical-geographical milieus. From this point of view, digital social network topologies exceed the common representation of networks as two-dimensional graphs composed of nodes and edges and instead are continually taking shape in a variety of topological forms, such as the globes, spheres and foam described by Sloterdijk in his account of the processes of techno-social trans-individuation. The dynamic recursiveness of processes of sharing, linking and modifying of internet objects (text, video, sound and software), the circulation of the social quanta of beliefs and desires (Tarde, 1903), and their implication in processes of subjectivation constitute the multiple spatio-temporalities of contemporary culture through their ordering in topological continua.

Network topology further confounds the distinction between inside and outside by folding into the subjective techno-bubble which human subjectivity (or the anthropological stratum of the human) keeps drawing around itself. From the folded interiority of the hyper-connected, multiply-screened homes of US suburbs described by Nicholas Mirzoeff (2005) to the mobile, tethered, psychological bubbles drawn by cell phone and digital social networks enveloping the affluent US teenagers described by Sherry Turkle (2011), network subjectivities emerge as split between the discrete and the continuous. On the one hand, the social appears to be constituted by individuated, infolded envelopes, enclosing the world of social relations from a specific point of view, and relating to each other only through the mediation of (internet) objects. On the other hand, there is the production of foam-like forms of sociality, a cavernous social world of interconnected, open monads, trans-individuated by diffuse, differential processes of imitation and invention. *More geometrico*, then, the web maps charted by Rogers open onto a new kind of hyper-Spinozist topological ethics of affective composition, which is at the same time a neo-monadology of trans-individuation. If the 'common', as Hardt and Negri have recently argued, is the framework through which to break the 'epistemological impasse between the universal and the particular', then we could argue that it will be 'common notions' emerging out of this networked topological ethics of composition that will determine the trans-individuation of the 'revolutionary assemblages' opposing neoliberal capital today (Hardt and Negri, 2009: 120, 340–4).

Mathematics, Relations and the Problem of the Continuum

What understanding of mathematics is at issue in the account we have been giving in this introduction? For some, most notably for Alain

Badiou (2005), mathematics is itself ontological, or better it is the purest form of ontology to the point where he can claim that mathematics is ontology and ontology is mathematics. In contrast, in this introduction, we are suggesting that rather than being equivalent to ontology, topology is a socio-technical field of practical abstraction in which the possibility of new relations between ontology and epistemology are emerging. And such relations – to be found in, for example, the changing role of indices or movement of models into the social world – are what is producing a topological culture: surfaces that are spaces in themselves are not only self-organizing and emergent, but their self-organization brings being and knowing, ontology and epistemology, into new kinds of relations. Indeed, this is the transitivity described by Sloterdijk in his discussion of Heidegger above. For this reason – to acknowledge some of the problem-spaces of this transitivity, but also to indicate the variety of approaches to topology within mathematics – what follows now is a brief overview of some of the developments in mathematical history that have been significant for both social and cultural theory *and* the practices in which the continuum emerges.

This short overview is thus not intended as a summary, but is, rather, a sketch, a pathway, organized – initially at least – by reference to the problem of the continuum. We believe this problem is a useful focus here since, as we note above, it is a locus for the question of how to think – and do – relations. Indeed, we would suggest both that the theorem of the continuum is at the core of topological thinking, and that the becoming topological of culture provides the terrain for some of the most interesting thinking about the problem of the continuum today. This theorem can be presented in terms of the question: what does it mean to think the space between two points as a continual surface of relations? Then, should we think of the continuum as the space of relations either as a differential that exceeds the entities it relates in the direction of the infinitesimal (that is, the smallest points between terms) or as being decomposed into set-points? The first approaches the problem of the continuum in terms of relations of differentiation and integration, while the second deploys an understanding in terms of the relationality associated with discrete point-set topology. The former explores the possibilities of relations of transformation, continuity or continuousness in terms of continual variation. The latter develops a notion of the continuum through the explication of 'pure' discreteness as expressed, for example, by the concept of the whole number. In this second approach, it is the very distinct-ness or discrete-ness of objects (of points, numbers or entities) that is what allows for general relations of invariance to be established. In this section, we chart a way through the complex mathematical field of topology by mapping these two tendencies, since they are of special relevance to the understandings of topology in social and cultural theory.[10]

As previously mentioned, a topological surface can be seen as an instance of Riemann's manifold, a non-standard geometrical figure that he defined in terms of spatial relations and not by reference to points in space (see Boyer, 1989: 545–7). More precisely, Riemann's continuous manifold explained how space was a kind of patchwork of local spaces. He thus provided a framework by which to map the locally Euclidean structure of neighborhoods without an a priori global Euclidean map. On the contrary, each point in a surface has a small neighbourhood, which can correspond to a Euclidean space, but the manifold of which the point-neighbourhood is part, does not. The Riemannian manifold thus describes the multidimensionality of a curved – or constantly curving – space specified by way of its relationship to other spaces. Importantly, for our argument, the Riemannian manifold is the mathematical description of the dimensions of a space that is not reducible to the physical arrangement of points according to fixed coordinates. Alternatively put, in this understanding, space is described in terms of differential continuity, the specification of which results in the mathematics of a variety of continuous or discrete manifolds. Indeed, so conceived, the space of the manifold anticipated the field of algebraic topology which approaches the continuum theorem by way of a concern to describe all possible continuous relations between sets.

If this tendency within the mathematical history of topology approached the theorem of the continuum by emphasizing the infinite and differential character of the relation, the other tendency we discuss here explains the problem of the continuum in terms of empty sets. For instance, Cantor's *Contribution to the Theory of Manifold* (1878) sought to establish a formalization of the mathematical invariance of dimensions (Crilly and Johnson, 1999: 8). Cantor rejected Riemann's infinite-dimensional topology, according to which a function could possess an infinite number of points of discontinuity that could nonetheless be integrated, starting from the general level of differential relations. Instead he worked with the hypothesis that a different type of infinite sets could exist in a higher dimensional space or plane (Crilly and Johnson, 1999: 5). Cantor was looking for topological invariance determined by infinite sets as opposed to the general continual variations of manifolds as spatial curvatures.

Of particular interest to the cultural and social theoretical articulation of the continuum is Cantor's notion of the 'limit point'. Cantor defined every infinite set of points in a bounded region of n-dimensional space as possessing at least one limit point. According to Cantor, the limit point (or accumulation point) is internal to the set but is not the same as the set: it is a point that can never be reached but nevertheless can be mathematically described as being internal to the set. A limit point so defined can thus for example correspond to a variable that, despite being indeterminable in an absolute sense, can be determined as existing within a set

of given values. It is thus central to how the border or boundary is to be understood (in terms of inclusion and belonging, and also in terms of internal and external relations) in mathematical terms. For example, Sha (2012) describes the limit of the open set as being undefined and yet a margin. In his account, the restriction of access to a movie theatre for people aged between 13 and 17 becomes a flexible edge, which nonetheless can establish that people almost 13 can be included as 13.

In other words, for what has come to be known as point-set topology, the continual relation between points does not depend on the differential ratio of the relation, but is instead conceived as another set of points. Against all forms of experiential intuition, point-set topology, derived from Cantor's actual infinities, defines curvatures – or manifolds – as sets of ordered n-tuples of numbers.[11] Cantor's set theory therefore defined a way in which operations on discrete entities (discrete sets of numbers) could be used to explain continuousness. More specifically, continuity is granted by the empty set – a discrete void – that is divorced from any specific instances of the set. From this standpoint, as Badiou has made clear, there can be no over-arching one, totality or whole that can explain or contain all. For Badiou (2005), within this empty one, there is, however, multiplicity to the extent that a proper name can never exhaust the infinity of the set. In this way of thinking, defining, for example, a group of people as multiplicity (in terms of, for example, inclusion and exclusion) cannot be done by categorization or reference to the specific characteristics of its members, but must be achieved by the operation of the group as an empty set.

But this is to jump ahead. At the turn of the 20th century Henri Poincaré, who famously claimed that set theory was the disease of the 19th century, put set-topology or the problem of the mathematical formalization of the continuum, into question.[12] His study of combinatorial topology focused on the intrinsic qualitative aspects of spatial configurations that remained invariant under continuous one-to-one transformations. So, for example, a circle is said to be topologically equivalent to an ellipse insofar as the dimensionality of their space is a topological invariant. Alternatively put, Poincaré was able to show how a function of continual deformation from a spherical into an oval form could be described without the need for puncturing or tearing, that is, without the necessity of making a cut or establishing a finite point or the operation of discrete entities. According to Poincaré, topology could and should thus be concerned with the qualitative rather than quantitative aspects of mathematics: the qualitative integration of differential equations, he argued, would define a topological continuum more effectively than discrete set-topology.[13] Indeed this is the position outlined by Rotman (2012), who argues, in implicit contradistinction to Badiou, that point-set topology remains restricted within its own ontological premises in mathematics. For Poincaré, the uniform continuity of 4-D manifolds

was to be explained in terms of qualitative transformation and infinitesimal connectedness of the sets or states of experience rather than by discrete spatio-temporal sets isolated from one another.

Poincaré's topology re-introduced the study of qualitative properties and continuity into the theory of discrete or finite groups. In this way of thinking, the relation is not defined by finite points of determination or integration (nodes, dips, focal points and centres), but is, rather, determined at another level, where these points are part of a field of vectors (continual tendencies of a line) that encompass them all. Among other contemporary writers, Manuel DeLanda (1991) has used this notion of a vectorial field of forces to describe the quasi-historical relations that led to the birth of capitalism as well as to explain how the military machine embraced the calculation of the movements of a target on the battleground in terms of vectors. More recently, DeLanda (2006) has adopted this topological understanding to discuss 'the social' in terms of assemblages of differential relations.

Yet, as already suggested, the necessity of discrete entities to the explanation of the relation and the mathematical theorem of the continuum remains contested in contemporary mathematics. Indeed, the articles included here adopt different positions in relation to the mathematical problem of the continuum. For Xin Wei Sha (2012), for example, topology is not a tool for measuring social relations but a poietic articulation of cultural dynamics, a materially situated articulation of culture. He proposes that topology itself needs to be understood as a mathematical index of lived experience, of a mathematics unwilling and unable to dissociate liveness from culture. This is a mathematics 'even more primordial than counting' (Sha, 2012).

Through a close reading of point-set topology, Sha argues that behind the notion of the open set is the concept of openness. A topological space defined in relation to the notion of openness is, he suggests, able to articulate changes of states by way of vector spaces or spaces of transformation, without reference to metric numbers and dimensionality. One of the examples Sha uses to demonstrate this is the flow of people through the US Bureau of Immigration Center at Ellis Island, New York. In his terms, this flow is an infinite set of life courses clustered around a limit, in this case, the event of passing through Ellis Island. The topological concept of openness, he suggests, can be used to colour 'the life courses that run before and extend beyond this event according to some particular grouping'. For Sha, it is connectedness that explains how transformation can occur from one set or group of people into another, and it is connectedness that underpins the notion of topology, which he deploys to account for the felt experience of continuity. For Sha, topology is simultaneously both a concept of continuity corresponding to a quality of lived experience and a (mathematical) description of this experience. It is a method of cultural analysis that exposes mathematics

to a non-metric and non-discrete articulation of experience: a poiesis of matter.

Brian Rotman (2012) also shares Poincaré's view of topology, but for different reasons than does Sha. Against the discontinuity inherent to digital models, Rotman argues for a mathematical view of topological space based on analog transformations. He rejects point-set topology and instead suggests another mode of conceiving the mathematics of topology. Through a close investigation of categorical thinking, Rotman appeals to the diagrammatic language of arrows and configurations of arrows. For Rotman and others, diagrammatic thinking is diametrically opposed to the purification of formal language carried out by the 1930s Bourbaki group. With the intention of cleaning mathematical language from paradoxes, this group purged notation, definition, construction, diagram and ultimately any processual thinking from mathematics. Against this Puritanism of mathematical thought, Rotman asks: how does language understand mathematics? In other words, what are the categories that subtend formalism? Far from being defined in terms of discrete objects, Rotman conceives of categories in terms of objects and arrows, or composition and equality between arrows.

As is Sha, Rotman is thus critical of the static structuralism of set theory, but he puts forward a contrasting alternative. Sha rearticulates the notion of openness in the open set to maintain a rigorous yet anexact mathematical method: a poieis that articulates cultural dynamics and experience. In other words, Sha reinvigorates mathematics from the point of view of the openness of open sets. Rotman instead does not seek to rescue set theory but rather takes arrows to be the primitive terms of schemes or dynamic structures, clearly defined by external relationality. In this way of thinking, it is the outside that *produces* the inside and thus there is no recognition of any sense of belonging to a primordial set, even an open one. Rotman's categorical thinking aims here to expose the limits of mathematical thought as an autonomous enterprise. Instead he suggests that mathematical objects 'are never isolated individuals' because they 'are structurally akin' to other 'species or families of related objects' (Rotman, 2012). Ultimately Rotman is proposing a diagrammatic thought of things in movement. Whilst sharing with Sha the desire for topology to be understood in terms of dynamics, Rotman more explicitly argues for a structuralism of becoming that is a step away from mathematical definitions. His antipathy to mathematical formalism leads him to argue that (mathematical) topology is but a mode of thought in which multiple interconnected levels are being deployed in the service of an analytic physics of culture.

As these examples suggest, despite our identification of two tendencies in mathematical topology, any simple opposition between a topology of continuity and a set-topology of discontinuity or between discrete and continuum, digital and analog, can only be misleading. Indeed, the

opposition is put forward here, not as a fixed contrast, but as a way of pursuing the problematic of the continuum, with the aim of understanding what is at stake in modalities of relations, of inclusion and belonging, and the constitution of entities. For us, what the internally divided mathematical field of topology offers for social and cultural theory is the possibility of describing a double condition in which the maximization of relations constituting topological culture may be at once experienced and not experienced. This is also the argument of Lash (2012), who discusses topology in terms of set topology, the infinity of infinity, or the openness of the open set. More specifically, Lash (like Brown, 2012) suggests that unlike Deleuze's notion of the virtual, which is beyond experience, topology can be understood in terms of figures, which enable the analysis of the deformation of one actual entity into another in terms of particular topological properties. Topology is thus at the twisted intersection of the mathematical and the empirical realms for Lash. With topology, he suggests, it is possible to explain how the lived experience is able to go beyond itself: a lived deformation.

Lash, like Rotman, embraces the critique of formalism, but, in contrast to Rotman, suggests that both set-topology and Poincaré's manifold continuum offer a defense of the figure. However, whilst Badiou's appeal to set theory and indirectly to set-topology ends up proposing an infinite temporality, a trans-infinity beyond experience, Lash instead insists that topological figuration deals with experience or empirical surfaces (Lash and Lury, 2007; Adkins and Lury, 2009). From this standpoint, Lash complicates our reading of topology by arguing for a transcendental-empirical double, which at once includes mathematics and experience, a form of practical abstraction, constructing its own space-time. And while Rotman insists upon the importance of the diagram, so the notion of the imaginary is important to Lash, who uses it in contrast to both the symbolic and the real. The imaginary describes 'something invented' (Castoriadis, 1997: 127), whether this refers to a 'sheer' invention ('a story entirely dreamed up'), or a slippage, a shift in meaning in which available symbols are invested with other significations than their 'normal' or canonical significations. Above all, the imaginary is 'the capacity to see in a thing what it is not, to see it other than it is' (Castoriadis, 1997: 127).[14]

Deformations of Control and Critique

In relation to the becoming of such a topological imaginary, the issue of what a number of contributors to this issue understand as method becomes important. Importantly, attention to this issue does not fail to address what Allen calls 'topologies of power', that is, the ways in which the abstract materiality of topological rationality is itself 'imbued with

power', since, as Allen says, 'proximity, distance and reach are inseparable from the practices of power which define them' (Allen, 2011).[15]

In their advocacy of the border as method, for example, Mezzadra and Neilson (2012) explicitly challenge the view that method is 'a set of pregiven, neutral techniques that can be applied to diverse objects without fundamentally altering the ways in which they are constructed and understood'. They assert that border as method is more than methodological, and argue that it is a matter of politics: 'To put this differently we could say that method for us is as much about acting on the world as it is about knowing it. More accurately it is about the relation of action to knowledge where many different knowledge regimes and practices come into conflict'. Noortje Marres also provides a discussion of topological method, what she calls the topological expansion of the frame as method. She too is interested not only in how it is that topology may be used to perform the epistemic work of rendering legible relations among entities and the ontological work of actually bringing about such relevant relations but also, like Mezzadra and Neilson, with the politics of how both these kinds of work – epistemological and ontological – may be brought together in method. Thus she is concerned to explicate how it may be that the frame as method may be developed – or topologically expanded – as an *empirical* mode of critique. In her case, this mode needs to be 'invested in capturing and dramatizing the contingent, dynamic and non-coherent unfolding of the times and spaces of issues'.

To develop this approach she takes two contrasting examples of the use of frame as a topological method in relation to an instance of environmental politics: the use of smart meters in green homes. In the first expansion of the frame Marres describes, there is an invocation of both the dynamic nature of technical and social arrangements, and the interrelatedness of different levels of orders, namely technology, society and the environment. However, in this first expansion of the frame, the invocation is, she says, only half-heartedly topological: the topological imagination is not extended either to the social itself, which continues to be framed in scalar terms, or to the relation between technological and social change, which she says continues to be defined as a causal one, however minimally speaking. The second way of expanding of the frame Marres describes is more radical. It involves not only the inclusion of more actors in a space of debate or controversy, but also the recognition of the necessity of changes in the shape of the space itself brought about by the inclusion of more – and more heterogeneous – actors. For Marres, this second use of the frame as topological method recognizes the capacity of controversy to produce variations in the spaces and times of issues: 'rather than defining controversy in terms of actors taking positions, it here entails the articulation of heterogeneous – social, technological, environmental, political, economic – concerns. A particular object is thus seen, by way of this topological expansion of the frame

as method, to be constituted in particular 'states of issuefication' (see Rogers, 2012).

In their exploration of contemporary processes of mediation, Fuller and Goffey (2012) explore the forms of life that are brought into relation with each other in the continuum of 'Don't/Be Evil'. In relation to one of the examples of the 'machines' that produce this continuum, the relational data-base, they observe what we might call the use of 'the normal' or normalization as method. As they point out, normalization is technically understood as part of the 'optimization' of the design of a database: it involves the stripping away of unnecessary hierarchies or other structures within data, resulting in the treatment of each piece of data and each relation as a separate entity. This means that as data is updated, deleted or inserted, it does not carry with it any dependencies on other data or structures, but is characterized only by its discreteness. Normalization is thus described by Fuller and Goffey as a method that has the capacity to produce neutrality as to the relative importance of one datum compared to another. So how is this neutrality to be understood politically?

On the one hand, we can be critical, as are Fuller and Goffey, of the ways that entry into a network is sometimes constrained so as to obviate the neutrality of normalization; on the other, we can also be a little apprehensive (as are they too) as to what, if anything, could *not* be encompassed in this mode of reasoning and its operational imaginary of the 'infinite comprehension of a concept'? In the face of this expansion of reason, some of our contributors, such as Harvey, call attention to what she believes to be the inevitability of 'invisible trouble' within complex relational spaces. Fuller and Goffey themselves propose the adoption of a strategematic approach to 'expand' this trouble, an approach which they explain by reference to the micro-politics developed by Félix Guattari. This politics operates on the basis that the development of the analysis of experience is one with the process of its production. The proliferating concepts that result in this process may become, they suggest, practical elements in ongoing and diverse processes of experimentation, a kind of onto-epistemological reverse engineering.

The Limits of Reason

We started this essay by suggesting that the turn to the surface identified by Kracauer is entering a new phase. Kracauer argues that the ratio he describes negates human reason in the promotion of an abstractness that is not attached to the exercise of human self-understanding: abstractness, he says, is 'the expression of rationality grown obdurate'. Capitalism does not rationalize too much for Kracauer, but rather too little: it does not encompass 'man'. On the one hand, this view might be taken to imply that the limits of rationality can and should be overcome by its

extension, but on the other, it also suggests that the nature of the reason or ratio he describes is at issue in any attempt by humanity to exercise self-understanding.

The topological culture that we have described in this introduction goes beyond that which Kracauer observes in relation to both these understandings; that is, it involves both an immense extension of the reach of rationality and an intensive transformation in reason itself. On the one hand, in today's topological forms of culture rationalism is no longer a limited form of language, but is rather an implementation of an infinity of reason that precludes any contagion with sensuality, the visceral or feeling. There is a new formalism, which is beyond direct sensation; this reason is not challenged by either the semiosis of language or a feeling body but, rather, is extended beyond any category or specific body. On the other hand, the rise of topological culture is not only about more and more efficacious abstraction, more calculation and control: insofar as the indices, meta-models, networks and experiments of topology are not detached from the material, from the body, language or the senses, but rather work in and through them, topological rationality participates in and renews the specificity of the material and the sensuous. Topological rationality is thus not obdurate, in contrast to that described by Kracauer, but rather is dynamic, soft and tractable, both precise and vague, able to operate the physical and sensual horizon of experience beyond and beneath the law-like symbolic system of signification. As such, the radical incompatibilities at the heart of topological culture do not simply encompass 'man' but rather actively engages the limit modes of the human in forms of practical abstraction that produce humanity both with-in and with-out the self-understanding of experience. Just as the rationality of culture is becoming co-extensive with the globe, the globe itself is simultaneously being brought into existence as a topological space.

Notes

1. Sloterdijk is only one of a number of topological philosophers who have drawn on the work of von Uexküll, whose work drew attention to the significance of border maintenance for organisms, especially in relation to immunity. Others influenced by von Uexküll's thinking include Heidegger, Merleau-Ponty, Agamben, Cassirer, Deleuze and Guattari as well as contemporary biologists including, notably, Herbert Maturana.
2. Indeed, we would further suggest that one of the characteristics of a topological culture is that subjectivity is being rendered intelligible as behaviour through the ways in which change is organized at both sub- and supra-individual levels.
3. Sloterdijk's sphereology can be seen as an attempt to answer the question of 'where' in new ways (Borch, 2008: 548–9). Borch quotes Sloterdijk's claim that Tarde's monadology suggests that societies or associations are 'scales calling for space' that can be adequately described only 'thanks to an analysis

of expansion, a topology, a dimension theory and a ''network'' analysis' (in Borch, 2008: 557).

4. Sloterdijk too is interested in Le Corbusier and in particular in the idea that the house is a machine to live in. He argues that this notion of the house-machine prepared the way for new flexible architectures that dissolved the connection between a house and its stationary place-specificity (Borch, 2008: 558). In this regard, Sloterdijk also discusses the architect Buckminster Fuller who developed mobile buildings that were adaptable to various air conditions.
5. She writes, 'First, the object is registered as pure extension, as flat shape which never breaks rank with the picture's frontality to suggest a turning of one of its facets into depth. Second, the constellation of objects wedge together in that insistent continuity of edges which the Purists called marriage de contours. Third, colour and texture are handled in a manner that calls attention to the inherent superficiality of these ''secondary qualities'' – so that distance or depth in the painting becomes no longer a matter of representing the space separating one object from another in the real world. Instead distance is transformed into a representation of the caesura between the appearance of the object and the object itself' (Krauss, 1972: 52–3).
6. The school of German media archeologists has drawn particular attention to the ways in which 'technical media is defined by its capacities to make continuous signals in discrete series, through, for instance, the Fourier transformation' (Parikka, 2011: 59).
7. Commercial '1 + ' devices which have the capacity to go beyond addition include Google Plus and Nike Plus.
8. Brian Massumi speaks to some of the same issues in his description of a vector space that is not containable in metric space, a qualitative space of variation referenced only to its own movement, what he calls a space 'running on autopilot'. For him, this is 'an intensive movement, occurring in place (as at a work-station, or with rolled-up eyes) – or more accurately outplaced, in the event. This is an abstract movement on an abstract surface' (Massumi, 2002: 187).
9. In an intriguing account of Peirce's thinking, Pape (2008) claims that the index is fundamental to the achievement of continuousness. Thus he quotes Peirce: 'A tap on the door is an index. Anything which startles us is an index, in so far as it marks the junction between two portions of an experience' (CP 2.285, 1893, quoted in Helmut, 2008: 7). This interpretation of Peirce's thinking suggest that, for Peirce, the two-place relations of indices are always parts of other two-place or n-place relations.
10. We recognize that it is only one possible mapping.
11. On set-topology see Boyer (1968: 621–2).
12. One of the most basic problems in topology is to determine when two topological spaces are the same, that is, when they can be identified with one another in a continuous way. This has been called the 'Poincaré Conjecture', marking the beginning of algebraic topology (Eynde, 1999: 82–87, and Rotman, 2012).
13. Poincaré, inspired by the theory of continuous groups, re-articulated the problem of the continuum in terms of Julius Plucker's equivalence principle. The latter stated that it is possible to construct an infinity of different but

equivalent spaces by choosing different primary elements, such as lines, planes, conics, so as to develop a ''relativistic'' view of dimensions in spatial geometry (Crilly and Johnson, 1999: 7–14; Bell, 1986: 538–40, 604).

14. For Castoriadis, the imaginary stems from the 'originary faculty of positing or presenting oneself with things and relations that do not exist. . . . This is, finally, the elementary and irreducible capacity of evoking images' (2005: 127).
15. In this respect, it is interesting to note that Michel Foucault approached the notion of neoliberalism in his last courses at the Collège de France by paying attention, as Stephen Collier (2009) observes, to the topological dimensions of technologies of power. For Collier, 'the identification of advanced liberalism as a diagram of power or a form of govern-mentality' makes visible what is most general and abstract about 'a new class of governmental forms across a range of cases', thus constructing neoliberalism as a kind of topological invariant unfolding through a series of deformations. Indeed, Collier suggests that a 'topological analysis is now required to show how styles of analysis, techniques or forms of reasoning associated with ''advanced liberal'' government are being recombined with other forms, and to diagnose the governmental ensembles that emerge from these recombinations' (Collier, 2009: 99).

References

Adkins L. and C. Lury (2009) 'What is the Empirical?', *The European Journal of Social Theory* 12(1): 5–20.

Agnew, J. (1994) 'The Territorial Trap: The Geographical Assumptions of International Relations Theory', *Review of International Political Economy* 1: 53–80.

Allen, J. (2011) 'Topological Twists: Power's Shifting Geographies', *Dialogues in Human Geography* 1: 283–298.

Appadurai, A. (1990) 'Disjuncture and Difference in the Global Economy', *Theory, Culture & Society* 7: 295–310.

Arquilla, J. and D. Ronfeldt (2001) *Networks and Netwars: The Future of Terror, Crime, and Militancy*. Los Angeles: Rand Corporation.

Auslander, P. (2008) *Liveness: Performance in a Mediatized Culture*. New York: Routledge.

Badiou, A. (2005) *Being and Event*. London: Continuum.

Balibar, E. (2007) *Politics and the Other Scene*. London: Verso.

Balibar, E. (2009) 'Europe as Borderland', *Environment and Planning D: Society and Space* 27(2).

Bell, E.T. (1986) *Men of Mathematics*. New York: Touchstone.

Borch, C. (2008) 'Foam Architecture: Managing Co-isolated Associations', *Economy and Society* 37(4): 548–71.

Boyer, C.B. (1989) *A History of Mathematics, 2nd edn*. New York: John Wiley & Sons.

Brenner, N. (2001) 'The Limits of Scale: Methodological Reflections on Scalar Structuration', *Progress in Human Geography* 25(4): 591–614.

Brenner, N. (2004) *New State Spaces: Urban Governance and the Rescaling of Statehood*. Oxford: Oxford University Press.

Brown, S.D. (2012) 'Memory and Mathesis: For a Topological Approach to Psychology', *Theory, Culture & Society* 29(4/5).
Butler, J. (2011) 'Bodies in Alliance and the Politics of the Street', *Transversal: A Multilingual Web Journal*. Available at: http://eipcp.net/transversal/1011/butler/en (accessed 1 November 2011).
Cache, B. (1995) *Earth Moves: The Furnishing of Furniture*. Cambridge, MA: MIT Press.
Callon M. and J. Law (2005) 'On Qualculation, Agency, and Otherness', *Environment and Planning D: Society and Space* 23(5) 717–733.
Castells, M. (1996) *The Rise of the Network Society*. Oxford: Blackwell.
Castells, M. (2006) *The Theory of the Network Society*. Cambridge: Polity.
Castoriadis, C. (1997) *The Imaginary Institution of Society: Creativity and Autonomy in the Social-historical World*. Cambridge: Polity.
Chatêlet, G. (2006) 'Interlacing the Singularity: The Diagram and the Metaphor', pp. 31–45 in S. Duffy (ed.) *Virtual Mathematics: The Logic of Difference*. Manchester: Clinamen Press.
Christakis, N.A. and J.H. Fowler (2009) *Connected: The Surprising Power of Our Social Networks and How They Shape Our Lives*. New York: Little, Brown & Co.
Collier, S.J. (2009) 'Topologies of Power: Foucault's Analysis of Political Government beyond "Governmentality"', in C. Venn and T. Terranova (eds) *Theory, Culture & Society (Special Issue on Michel Foucault)* 26(6): 78–108.
Colomina, B. (1996) *Privacy and Publicity: Modern Architecture as Mass Media*. Cambridge, MA: MIT Press.
Crilly, T. and D. Johnson (1999) 'The Emergence of the Topological Dimension Theory', in J.I. Mackenzie (ed.) *History of Topology*. Amsterdam: Elsevier B.V.
DeLanda, M. (1991) *War in the Age of Intelligent Machines*. New York: Zone Books.
DeLanda, M. (2005) *Intensive Science and Virtual Philosophy*. London: Continuum.
DeLanda, M. (2006) *A New Philosophy of Society: Assemblage Theory and Social Complexity*. London: Continuum.
Deleuze, G. (1993) *The Fold: Leibniz and the Baroque*. London: Athlone Press.
Deleuze, G. (2004) *Difference and Repetition*, trans. P. Patton: New York: Continuum.
Deleuze, G and F. Guattari (1994) *What is Philosophy?,* trans. H. Tomlinson and G. Burchell. New York: Columbia University Press.
Desrosieres, A. (1998) *The Politics of Large Numbers: A History of Statistical Reasoning*, trans. C. Naish. Cambridge, MA: Harvard University Press.
Doane, M.A. (1990) 'Information, Crisis, Catastrophe', in P. Mellencamp (ed.) *Logics of Television*. Bloomington: Indiana University Press.
Elden, S. (2009) *Terror and Territory: The Spatial Extent of Sovereignty*. Minneapolis: University of Minnesota Press.
Ernst, W. (2006) 'Dis/continuities: Does the Archive Become Metaphorical in New Media Space?', pp. 105–123 in W. Chun and T. Keenan (eds) *New Media, Old Media: A History and Theory Reader*. New York: Routledge.

Fuller, M. (2003) *Behind the Blip: Essays on the Culture of Software*. New York: Autonomedia.
Fuller, M. and A. Goffey (2012) 'Digital Infrastructures and the Machinery of Topological Abstraction', *Theory, Culture & Society* 29(4/5).
Galloway, A.R. (2004) *Protocol: How Control Exists after Decentralization*. Cambridge, MA: MIT Press.
Galloway, A.R. and E. Thacker (2007) *The Exploit: A Theory of Networks*. Minneapolis: University of Minnesota Press.
Gane, N., C. Venn and M. Hand (2007) 'Interview with Katherine Hayles: Ubiquitous Surveillance', *Theory, Culture & Society* 24 (7–8): 349–358.
Genosko, G. (ed.) (1996) *The Guattari Reader*. Oxford: Blackwell.
Gregory, D. (2004) *The Colonial Present*. Oxford: Blackwell.
Guattari, F. (1977) *La révolution moléculaire*. Fontenay-sous-Bois: Recherches (*Molecular Revolution: Psychiatry and Politics*, 1984, trans. R. Sheed. Harmondsworth: Penguin, 1984).
Guyer, J. (2010) 'The Eruption of Tradition: On Ordinality and Calculation', *Anthropological Theory* 10(1): 1–9.
Hardt, M. and A. Negri (2000) *Empire*. Cambridge, MA: Harvard University Press.
Hardt, M. and A. Negri (2009) *Commonwealth*. Cambridge, MA: The Belknap Press of Harvard University Press.
Harvey, P. (2012) 'The Topological Quality of Infrastructural Relations: An Ethnographic Approach', *Theory, Culture & Society* 29(4/5).
Heintz, B. (2010) 'Numerische Differenz. Überlegungen zu einer Soziologie des (quantitativen) Vergleichs', *Zeitschrift für Soziologie* 39(3): S162–181.
Kemple, T.M. (2007) 'Introduction – Allosociality: Bridges and Doors to Simmel's Social Theory of the Limit', *Theory, Culture & Society* 24(7–8): 1–19.
Kracauer, S. (1995) *The Mass Ornament: Weimar Essays*, trans. and ed. T.Y. Levin. Cambridge, MA: Harvard University Press.
Krauss, R. (1972) 'Léger, Le Corbusier and Purism', *Artforum* 10(8): 50–53.
Kwinter, S. (1992) 'Landscapes of Change: Boccioni's *Stati d'animo* as a General Theory of Models', *Assemblage* 19: 50–65.
Kwinter, S. (2002) *Architectures of Time: Toward a Theory of the Event in Modernist Culture*. Cambridge, MA: MIT Press.
Lash, S. (2009) 'Afterword: In Praise of the *A Posteriori*: Sociology and the Empirical', *European Journal of Social Theory* (Special Issue, ed. L. Adkins and C. Lury) 12(1): 175–187.
Lash, S. (2012) 'Topology and the Social Imaginary', *Theory, Culture & Society* 29(4/5).
Lash, S. and C. Lury (2007) *Global Culture Industry: The Mediation of Things*. Cambridge: Polity.
Lash, S. and J. Urry (1994) *Economies of Signs and Space*. London: SAGE.
Latour, B. (1987) *Science in Action*. Cambridge, MA: Harvard University Press.
Latour, B. (2005) *Reassembling the Social*. Oxford: Oxford University Press.
Lazzarato, M. (2002) *Puissances de l'invention. La psychologie économique de Gabriel Tarde contre l'économie politique*. Paris: Les Empecheurs de penser en ronde.

Lazzarato, M. (2006) 'The Machine', *Transversal: A Multilingual Web Journal*. Available at: http://eipcp.net/transversal/1106/lazzarato/en (accessed 18 November 2011).
Leach, E.R. (1961) *Rethinking Anthropology*. London: The Athlone Press.
Leyshon, A. and N. Thrift (1999) 'Lists Come Alive: Electronic Systems of Knowledge and the Rise of Credit-scoring in Retail Banking', *Economy and Society* 28(3): 434–466.
Lury, C. (1996) *Prosthetic Culture*. London: Routledge.
Lury, C. (2004) *Brands: The Logos of the Global Economy*. London: Routledge.
Lury, C. (forthcoming) 'Going Live: Towards an Amphibious Sociology', *Sociological Review*.
Lury, K. (2007) 'A Response to John Corner', *Screen* 48(3): 371–376.
Mackenzie, A. (2010) *Wirelessness: Radical Empiricism in Network Culture*. Cambridge, MA: MIT Press.
Manning, E. (2009) *Relationscapes: Movement, Art, Philosophy*. Cambridge, MA: MIT Press.
Manovich, L. (2001) *The Language of New Media*. Cambridge, MA: MIT Press.
Marres, N. (2012) 'On Some Uses of Topology in the Social Analysis of Technology (Or the Problem with Smart Meters)', *Theory, Culture & Society* 29(4/5).
Marriott, S. (2007) *Live Television: Time, Space, and the Broadcast Event*. London: SAGE.
Massumi, B. (2002) *Parables for the Virtual: Movement, Affect, Sensation*. Durham: Duke University Press.
Mezzadra, S. and B. Neilson (2012) 'Between Inclusion and Exclusion: On the Topology of Global Space and Borders', *Theory, Culture & Society* 29(4/5).
Michael, M. and M. Rosengarten (2012) 'HIV, Globalization and Topology: Of Prepositions and Propositions', *Theory, Culture & Society* 29(4/5).
Mirzoeff, N. (2005) *Watching Babylon: The War in Iraq and Global Visual Culture*. New York/London: Routledge.
Nowotny, H. (2002) 'Vergangene Zukunft: Ein Blick zurück auf die ''Grenzen des Wachstums'' ', pp. 655–694 in *Impulse geben – Wissen stiften. 40 Jahre VolkswagenStiftung*. Göttingen: VolkswagenStiftung.
Ong, A. and S. Collier (eds) (2005) *Global Assemblages*. Oxford: Blackwell.
Paasi, A. (2009) 'Bounded Spaces in a ''Borderless'' World: Border Studies, Power and the Anatomy of Territory', *Journal of Power* 2(2): 213–234.
Pape, H. (2008) 'Searching for Traces: How to Connect the Sciences and the Humanities by a Peircean Theory of Indexicality', *Transactions of the Charles S. Peirce Society: A Quarterly Journal in American Philosophy* 44(1): 1–25.
Parikka, J. (2011) 'Operative Media Archaeology: Wolfgang Ernst's Materialist Media Diagrammatics', *Theory, Culture & Society* 28(5): 52–74.
Parisi, L. (2009) 'Technoecologies of Sensation and Control', pp. 182–200 in B. Herzogenrath (ed.) *Deleuze and Guattari and Ecology*. London: Palgrave Macmillan.
Parisi, L. (2012) 'Digital Design and Topological Control', *Theory, Culture & Society* 29(4/5).
Peirce, C.S. (1978) *The Philosophy of Peirce: Selected Writings*, ed. J. Buchler. London: Routledge.

Raychaudhuri, D. and M. Gerla (eds) (2011) *Emerging Wireless Technologies and the Future Mobile Internet*. Cambridge: Cambridge University Press.
Riles, A. (2011) *Collateral Knowledge: Legal Reasoning in the Global Financial Markets*. Chicago: University of Chicago Press.
Rogers, R. (2012) 'Mapping and the Politics of Web Space', *Theory, Culture & Society* 29(4/5).
Rotman, B. (2009) 'Gesture, or the Body without Organs of Speech.' Available at: http://www.semioticon.com/semiotix/semiotix15/sem-15-02.html (accessed 15 November 2011).
Rotman, B. (2012) 'Topology, Algebra, Diagrams', *Theory, Culture & Society* 29(4/5).
Ruppert, E. (2012) 'The Governmental Topologies of Database Devices', *Theory, Culture & Society* 29(4/5).
Sassen, S. (2006) *Territory, Authority, Rights: From Medieval to Global Assemblages*. Princeton: Princeton University Press.
Serres, M. with B. Latour (1995) *Conversations on Science, Culture and Time*. Ann Arbor: University of Michigan Press.
Sha, X.W. (2012) 'Topology and Morphogenesis', *Theory, Culture & Society* 29(4/5).
Shields, R. (2012) 'The Topological Turn, or The Seven Bridges of Königsburg 1736', *Theory, Culture & Society* 29(4/5).
Simmel, G. (2007a) 'The Metaphysics of Death', *Theory, Culture & Society* 24(7–8): 72–77.
Simmel, G. (2007b) 'The Social Boundary', *Theory, Culture & Society* 24(7–8): 53–56.
Simondon, G. (1992) 'The Genesis of the Individual', pp. 297–319 in J. Crary and S. Kwinter (eds) *Incorporations*. New York: Zone Books.
Sloterdijk, P. (2011) *Bubbles: Spheres, Volume I: Microspherology*. New York: Semiotext(e).
Sloterdijk, P. (2012) 'Nearness and *Da-sein*: The Spatiality of Being and Time', *Theory, Culture & Society* 29(4/5).
Stark, D. (2009) *The Sense of Dissonance: Accounts of Worth in Economic Life*. Princeton: Princeton University Press.
Stiegler, B. (2008) 'Within the Limits of Capitalism, Economizing Means Taking Care', in *Ars Industrialis*. Available at: http://arsindustrialis.org/node/2922 (accessed 23 October 2011).
Tarde, G. (1903) *The Laws of Imitation*. New York: Henry Holt & Co.
Terranova, T. (2004) *Network Culture: Politics for the Information Age*. London: Pluto Press.
Thrift, N. (2004) 'Movement-space: The Changing Domain of Thinking Resulting from the Development of New Kinds of Spatial Awareness', *Economy and Society* 33(4): 582–604.
Thrift, N. (2005) *Knowing Capitalism*. London: SAGE.
Thrift, N. (2008) *Non-representational Theory*. London: Routledge.
Turkle, S. (2011) *Alone Together: Why We Expect More from Technology and Less from Each Other*. New York: Basic Books.
Uricchio, W. (2005) 'Television's Next Generation: Technology / Interface Culture / Flow', in L. Spiegel and J. Olsson (eds) *Television After TV: Essays on a Medium in Transition*. Durham: Duke University Press.

Vanden Eynde, R. (1999) 'Development of the Concept of Homotopy', in J.I. Mackenzie (ed.) *History of Topology*. Amsterdam: Elsevier B.V.
Weber, S. (1996) *Mass Mediauras: Form, Technics, Media*. Stanford: Stanford University Press.
White, H. (2002) *Markets from Networks: Socioeconomic Models of Production*. Princeton: Princeton University Press.
Whitehead, A.N. (1978) *Process and Reality*. New York: The Free Press.
Williams, R. (1974) *Television: Technology as Cultural Form*. London: Fontana.
Wuchty, S., E. Ravasz and A.-L. Barabási (2006) 'The Architecture of Biological Networks'. Available at: http://www.springerlink.com/content/pt750761mp147516/ (accessed 2 July 2012).

Celia Lury is Director of the Centre for Interdisciplinary Methodologies, University of Warwick. She was co-ordinator of the research network A Topological Approach to Cultural Dynamics (www.atacd.net). Her recent publications include *Inventive Methods* (co-edited with Nina Wakeford; Routledge) and *Global Culture Industry: The Mediation of Things* (with Scott Lash; Polity).

Luciana Parisi convenes the MA Interactive Media: Critical Theory and Practice at the Centre for Cultural Studies, Goldsmiths, University of London. In 2004 she published *Abstract Sex. Philosophy, Biotechnology and the Mutations of Desire* (Continuum Press). She has recently completed a monograph, *Contagious Architecture. For an Aesthetic Computation of Space* (MIT Press, March 2013).

Tiziana Terranova is Associate Professor of Sociology of Communications and New Media at the University of Naples 'L'Orientale', where she is also the director of the PhD programme in cultural and postcolonial studies. A TCS associate editor, she is the author of *Network Culture: Politics for the Information Age* (Pluto Press, 2004) and numerous essays on the cultural politics of new media.