Digital Infrastructures and the Machinery of Topological Abstraction

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Abstract

Drawing on contemporary pragmatic philosophy and grounded in a reading of techniques associated with digital media as sophist practices of influence and manipulation, this paper proposes an 'experimental' reading of key aspects of the topological qualities of the infrastructure of the knowledge economy, with its obsessive attempts at measuring, recording and monitoring, or 'qualculation'. Taking seriously, albeit with humour, early criticisms of actor-network for its ostensibly Machiavellian proclivities, it offers a series of playful stratagems for the exploration and analysis of power as an emergent property of socio-technical relations. Topology, in this account, becomes relevant to cultural analysis because of the way that it allows us to think together processes constructive of the intensive continua of 'desiring production' with the sociotechnical operations of digital media infrastructures. Different elements operative within digital media (the super-hub, the power of small numbers, recursion and relational databases) are read stratagematically – as figures of a praxis (the material practice of immaterial labour), that reveals different facets of the operations of power, while also allowing for counter-tactics to be deployed. Rather than proposing a theoretical account or an empirical analysis, the paper develops what Stengers (2011) calls 'operative constructs', which become ingredients for further active exploration of and thinking about the topological qualities of mediatic infrastructure. The paper addresses four different and overlapping areas of digital media from a point of view that considers the plural, compositional quality of media/power relations.

Keywords

abstraction, affect, databases, immateriality, Machiavelli, manipulation, micropolitics, pragmatics

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Introduction

In this paper, some aspects of contemporary power and the topological qualities of its operations are examined by means of a consideration of the agency of technique and technical practice. This is something of a shift from the predominant Foucauldian emphasis on the way that configurations of knowledge shape the historical conditions, the historical 'a priori' of practices. The focus on technique here takes its inspiration instead from the exploration in science and technology studies of the socio-technically constructed qualities of social order. More specifically, it takes seriously both the early invocations of Machiavelli in STS (Latour, 1987) as well as later references to sophistry (Latour, 1999; Stengers, 2010), proposing in turn a 'stratagematic' reading of some of the operations of power.

The place of technique in Western knowledge practices and the desirability of considering it independently of the tacit privileging of the epistemic to which it is normally subject has been made most forcefully in the recent work of Isabelle Stengers (2010, 2012). In this paper we draw some of the consequences of that attempt at dissociation and the fruitful conception of techniques of influence deriving from it, in relationship to formal and informal, intentional and unintentional practices of manipulation and control. Understandings of computation and the processes and practices associated with it are habitually framed in epistemic terms – as the recurrent emphasis on ideas about modelling within computing science suggests. However, this tendency to focus on issues of knowledge can detract from a more material consideration of the way that digital artefacts give shape to fields of experience and the opportunities for action they embody. It is the pragmatic efficacy of 'grey' media forms that we are most interested in exploring here.[1] Following Machiavelli, we seek to adopt the point of view of power and the uncertainties and ambiguities attendant on its exercise.[2] Unstable alliances of actors are considered here in terms of the opportunities for manipulation and the experimental seeking of (uncertain) outcomes they present.

Of particular interest in this paper, then, are techniques operative within the field of software engineering and the configurations of digital artefacts that are constructed by it. This is an area of research that has suffered from the restrictively dichotomous nature of the conceptual frameworks typically used to analyse it. However, exploring digital artefacts from a point of view in which the technical and the social are treated on equal terms is indispensable. It has been further argued (Berg, 1997) that understanding the role of formal systems equally requires attention to what happens in the 'gap' between the formal and empirical, or what we think of here as the technical and the social: information technology has a habit of generating strange dynamics and new shapes in and of experience – forms of interruption (Wajcman and Rose, 2011) or

precipitous anticipations or frustrated waiting (Mackenzie, 2010), that are inexplicable otherwise. The spatio-temporal configurations, or code/spaces (Kitchin and Dodge, 2011), that are generated around this gap have an increasingly significant role to play in the organization of everyday life, and they generate peculiar topological dynamics of their own, which require imaginative tools to be made visible. What we are interested in here are the un- or under-explored, anomalous or aberrant aspects of the 'abstract' materiality of the infrastructures of contemporary experience and the ways in which such aberrations can be or are being exploited.

Our approach may be characterized as 'stratagematic'. The term 'stratagem' here is borrowed from Arthur Schopenhauer, whose over-looked text *The Art of Always Being Right* (2004) develops a quasi-Machiavellian approach to the way in which aberrations of language may be used to win arguments. Schopenhauer's text is a dark and rather cynical re-visiting of the project, first started by Aristotle, of learning how to spot and then refute sophisms, because it brackets out any consideration of the ultimate truth or validity of arguments. For Schopenhauer, a stratagem points to a specific, pragmatically efficacious way of exploiting the sophistic materiality of discourse. Contemporary theory would in all likelihood consider Schopenhauer an advocate of the performativity of language, and there are some interesting points of contrast with contemporary invocations of the performative or virtuoso powers of language to be made in this regard (Virno, 2004; Callon, 2006). In this context, a stratagem may be considered as a performative, socio-technical operation that constructs the forms of topological continuity on which it appears to act.[3]

Presenting stratagems rather than searching for causes might seem odd. Not least because there is a good argument that all the sophisms that Aristotle sought to sniff out could be traced back to one root cause – homonymy as the 'radical evil' in language (Cassin, 1995). But exploring the phenomenological complexity of the ways in which the imperfections of a media form (such as language) can be and are exploited has a pragmatic goal: that of generating a certain kind of sensibility to the organization of power within a field of experience. In conformity with the origins of sophistry in the art or artfulness of 'tekhne', the discussion proposed here considers techniques and technologies in slightly different terms than the evidently instrumental qualities of their use might suggest is relevant. There is a need to consider the broader 'artfulness' of technologies and techniques as itself having effects in its own right, as something that can – and should – be evaluated on its own terms.

The register of 'artfulness' and the broader history of sophistic manipulation links the semiotico-material qualities of digital media to the field of affect or desiring production, pointing to a link that is often occulted or only considered in terms of the formal abstraction of the

'signifier', although the issue of topology has a long history in relationship to psychoanalysis. The stratagems here are situated in relationship to concerns about topology partly because they deal with what others have referred to in terms of the 'automatic production of space' (Thrift and French, 2002) and the 'technological unconscious' (Thrift, 2004a), with its own under-explored and labile constellation of topoi. Much of the material that we are concerned with here is also situated at points in which mathematically conceived forms are taken up in or indeed derived from social and cultural contexts. The computational (or quasi-computational) techniques with which we are concerned are addressed in terms of the way in which topological aspects of spatial (and temporal) relations – continuities, deformations, breaks and proximities – form the stakes of an ongoing productive construction. Power in the social sense here develops in proximity to the mathematico-technical 'power of the continuum' – a presumed mathematical characteristic of non-denumerable sets, operating in the transfinite, something which might best be understood here as a power of *continuation*.[4] When it comes to the role of the socio-technical in matters infrastructural, continuity and the capacities and properties that can be ascribed to it are themselves the object of myriad processes of not entirely seamless, somewhat glitchy construction. Topology is thus to be considered not – as one might be tempted – as a given of structure but as part of the stakes of a strange kind of socio-technical praxis that operates through both humans and non-humans. It gives us a way to characterize pertinent aspects of the stratagematic operations of power.

In the following four stratagems, then, we offer a series of advisory notes on the state and operation of contemporary forms of power and the means by which it may be handled. Each stratagem tackles a specific aspect of the abstract materiality of digital media: the frenetic sensations of love in the age of the telephone; an intense investment in the abstracted space of small numbers; the formal-material continuities of recursion; and the proliferating relata of databases. In the tense, accelerated, environment of the knowledge economy, establishing continuity of flow – work, data, libido – is paramount.[5] These stratagems disclose the delicate operations by which such continuity might be and sometimes is, obtained, and the risks incurred.

Be Everything but Available

In his text of 1923, *Zoo, or Letters not about Love* (2001), the formalist writer Viktor Shklovsky fills pages and pages with a diastolic correspondence, which, while rarely echoed by the other side of the epistolary heartbeat, is drenched in the immolating rapture of love. His letters to Alya provide traces of a hunger that consumes him, eating up all of the mental currency of attention that he has in his pockets. However, this is a love

for a woman who, besides stipulating that he must not write to her about love, will not pick up the phone. Living in an era before the automated answer, Shklovsky feels the world reorganized. One of the many ways it is so is through the conjunctions of different spaces, but also of different emotional and linguistic intensities, squeezed down a copper wire. One of those spaces is absence. The story has numerous registers, devices and ruses by which love is figured, but one dimension that is rarely noticed is its mathematical content. Five times over the course of this short book, Shklovsky makes an allusion to non-Euclidian geometry as exemplifying the world turned upside down magnificence of love. Although he does not name it, the figure he uses is one that is core to Lobachevski's (1955) hyperbolic geometry, with its possibility of an infinity of parallel lines arrayed around and surging through a single point. Every experience of the world, every waking state, turns into an anticipation of and hunger for the beloved. The sensation of his adoration of her is compared to the moment in which a fine woollen scarf is drawn through a gold ring: every aspect of the fabric of the universe converges on this one wondrous point, and passes out through the other side, recomposed. Shklovsky's problem is that the loved one may not feel reducible to this point of convergence or may feel it slightly to her side, missing the point, and his text offers a precursory mapping of the topology of love, the plastic field of intensities out of which it is constituted and the operations that are required to refigure its particular constellation of relations. But, in its condensation of two figures – of the loved one, the one who will not answer the ringing mechanism, who will not become a node, and the one who connects to everything, who recomposes the universe by simply being in it – Shklovksy equally stages and prefigures network analysis through a geometry of affect: the loved one is the super-hub of reality.

One of the conditions of love is the warping of time, the speed at which an endless embrace seems to pass, and the slow monotony of time spent unwillingly apart. However, there is another – spatial – effect of passion that provides a rescension of the evolution of networks and which must also be used. That is the capacity for abundance, of being everything. Elsa Triolet, who plays the role of Alya in the novel, inadvertently took on and trumped the role of the Emperor, as described in Dean and Massumi's *First and Last Emperors* (1992), to rule by being everywhere – to be everything, to saturate the lover's universe – and to be nowhere, unreachable, detained in the bath, in dalliances with fancy cars or in dances with men decorated with ear rings or a repulsive Englishness, with a million other things. The pain of the lover lies in the fact that the loved one is everything, but yet is absent, following a different trajectory.

Writing on evolution, Henri Bergson compares the trajectory of a single life, the process of speciation, the development of a genera, with the trajectory of fragments from an exploding shell. The blast recapitulates

its branching through a hierarchy of entities. Each species – one cluster. Each organism – only ever capable of being one fragment. Each mutation – one spin from true. Nature, however, has the capacity to encompass all: shell, explosion and shrapnel, and is in nowise bound to make the sacrifice of differentiation (Bergson, 1998 [1911]: 100). The special madness of love is an encounter with the condensation of all of nature in one being and a recognition of all of one's pre-personal power unfolding in that universe, recognizing it not as a totality but something that is also mutually unfolding. The figure of the fully graphed centralized network, the summa of all possible events, or of connections, is also that of the loved one, the universe. This is the tragedy of the single life, of mortality, when it is brought into contact with reality of rejection, or of the apparent impossibility of not living an infinite number of lives simultaneously.

For just as 'the probability of a global epidemic depends on the number and configuration of initial infectives' (Ball et al., 1997: 61), so the problem of the lover, as faced by Shklovsky, is to saturate the imaginary of the recipient of the letters, which are not about love, with burning, enticing or subtle reminders of the lover and the rapture the loved one might share in. Each ruse in the letters becomes a means of bending flat inattentiveness or bemused dismissal, of opening up a gateway to the universe of love, to the full force of its explosion. Each simple point swells in anticipation that it might be the one to draw the loved one in. What is to be hoped is that there is an absence of symmetry between the point of attraction, which is small – an observation, a joke, a copula of wordings – and the massively expanding universe in which the lover anticipates being joined. Rather than the writer's work being to manipulate language to induce the reader into shedding perceptual habits, setting the elements of the world free from their mundane associations, it is to suffuse the world with the inevitability of the reciprocation of love.

But more trivial passions can also be turned to account. We are told that in the interval between the saturation of connection of the super-hub and the happiness of the isolate (the one who stays in the bath and refuses to pick up the telephone) there is a growing capacity for new opportunities for the harnessing of value to emerge (Anderson, 2006; Brynjolfsson et al., 2007). In a market made smoother by the ease of connections between nodes, what was once detritus finds its buyer, a meager supply finds its true users, and amateurs of all sorts find their devoted fans. Every needle finds its necessary haystack. To put it another way, there is less excess that cannot be leveraged to a point of consumption. A difficulty presents itself, however. In making themselves available, the agents of these minor passions are compelled to compete with the proliferation of ruses, cons, games, lines, seductions, choices of trajectory, of all of those others who are also operating in this modality of space. The abundance of pretenders to super-hub status can tend to

obliterate the possibility of choosing, rather than submitting to, the spatiality of absence. A great roiling abundance of minor gateways, slight triggers into patches of the universe get their hustle on under every stone and each mouse-click. After all, one does not want to be reduced to a dot.

In matters of networked connectivity, then, the issue is not just that the saturation of affective possibilities explored by the lover presages the simple techniques of attention management adopted in the information economy. It is that the affinities of familiar network topology with intimate emotional state are such that social production and desiring production (a distinction due to Deleuze and Guattari, 1987) are linked here so intimately that they may be considered two descriptors for the same scale-free movement. In literary form, Shklovksy's *Letters* offer us the means for exploring the topological map of movements that this production sketches out and the traps attendant on it.

Stir Faith in Small Numbers

In the complex topologies of networked infrastructure, small numbers are taken to be decisive. One is reminded of the power of the few sufficiently many times to make such an assertion suspicious. Look at how many members the Bolshevik Party had in 1917, how many Al Qaeda operatives it took to bring down the World Trade Center, and how few people it takes to run the basic technical operations of Wikipedia. Parables and commonplaces abound with the power of tiny increments yielding a radical difference. Guerrilla warfare relies upon the disproportionate effects that may be gained by the war of the flea and on the combination of precision, imperceptibility and unpredictability of small forces accurately deployed (Rogers, 1757; Taber, 2002). The function of sainthood, as an exemplary state of being, relies upon the rarity – yet presumable attainability – of the ascetic holy life in a world of temptation. The effects of small numbers are pressed upon us as exemplars of the instability of global systems and of the power of the individual to effect real social change. In a world of molar aggregates and the probabilistic function of the law of large numbers, the appeal to small numbers and their improbable consequences offers something of the order of amelioration or palliative.[6] Fantastic effects are yielded in such accounts through minimal, but well-chosen or accidental, acts that ripple through volatile systems. So, the exercise of virtù under conditions of digital infrastructure dictates that one should seek out the simple . . . and then distrust it.

An important critical response to such accounts is to look for the background mechanisms, the popular support, subsidiary operators and alliances, technical pre-conditions and the conceptual structuration of entities that make a certain result more likely: material infrastructural devices and associated practices that are generative of the abstracted spaces, the peculiar topological continua in which small numbers are

invested in with such alacrity. The spring-time of blossoming events has its own nameless natural history, but one which has only a very loose relation to a proper phylogeny or to the principles of identity by which it might be named or called to order. But equally, if it seems a miracle from nowhere is required, these are the elements that must remain cloaked, established so as to appear tangential, or which simply recede from the foreground of perception in the greyness of attenuated contrasts. The stability of a system can then no longer confidently be said to be reliant upon its nesting within larger systems that guarantee it. Another response might be to turn to Poisson distributions (modelling the probability of events whose averages are known) and their own kind of articulations of the true nature of randomness, mathematical models of the ability of microscopically slight differences to effect significant results (Tasic, n.d.; Guy, 1988).

The experience of living in conditions determined by large numbers, of homogeneous populations of probability (which is, effectively, the condition of the contemporary), involves focusing one's attention on the opportunity provided by small numbers – whether that be the opportunity of winning the lottery or of being immediately and inexplicably recognized for one's innate and unique talent in a televisual extravaganza. It is not an experience that has been predominant over the course of human history, even if it suggests parallels with folk wisdom about chance or good fortune. In the modern world, it is an experience that media, cultural imaginaries and the economic ideologies of self-affirmation and opportunity seem particularly proficient at generating as a state of ever-extensible, statistically grounded, hope, as a correlate of unrestricted, exponential growth in the production of data.

But, given the emphasis on the power of small numbers in the contemporary imaginary, the question of whether the topology of media systems that arise during periods in which there is such effervescent affective investment in them are configured in such a manner as to accentuate the effectiveness of the small is one that is yet to be answered. The fantastic yields of computer viruses, worms and bugs are often proffered as a state to aspire to, in which the smallest of operators reaches a magnificent climax for millions within days of being launched – witness in parallel the corporate adoption of viral marketing, network production of the soundbite or seeking of promotional effects through video-clips on YouTube, as only the most obvious of instances (Alt, 2005; Parikka, 2007). The yearning to be the bearer of such a difference, of being able to sense participation in such a moment, in turn drives the sales of sugary, parascientific narratives that seek only to confirm it as a possibility (Gladwell, 2001). Redemption by an encounter with the non-linear sublime replaces the need for strategy in many minds, but as such it is also something from which stratagems can be derived in turn.

Small numbers work because the topological spaces out of which statistics are extracted are not friction-free environments. Whether such topological continua are, at least rhetorically, said to exist as markets, the noiseless environment of information theory, or a technology that implements it, homogeneity is in reality a difficult condition to identify. Hence the micropolitical event is able to make use of small differentiations in opportunity, event-texture, speed and the conjunction of forces and chances, differentiations the heterogeneity of which become occluded in the statistics. Machiavelli uses the metaphor of a wildly flooding river to describe the propensities of such fortune, and advises preparation and adaptation as a way both to modify and cope with the behaviour of an aleatory world and audacity as a means of bringing a mythically feminized luck to the point of subdual and consummation (Machiavelli, 1964: 130–3). Somehow though, in the present day, coupling preparation with audacity seems to translate into the expectation that minuscule variation – the righteous gesture, the personal disaggregation from the norm, the presence of a video or a document in a database – might just be all it takes for something to change for the better. Connectedness across abstracted, statistically homogenized spaces generates the hope of exceptionality, the data point that tips and inflects against the grain.

The yearning for the significance of small gestures comes in part from dismay at the effects of the large or monolithic. A citizen may hope to do something utterly innocuous, seemingly trivial, but, in so doing, incidentally render the world perfect. Such expansive hopes are shared by those who buy lottery tickets, stir viral froths online, or determine that it is best to think positively. In the case of micropolitics, the idea of the small gesture that proliferates may be its own Straussian 'noble lie' (Strauss, 1978). It is, however, a mode of belief that is – as is suggested shortly – deeply suited to the naturally quantitative topologies of networked and computational digital media and the forms of calculus – or even 'qualculus' – to which they give rise, but which also tends to flatten out what used to be seen as different scales. Indeed it may even be the slippage *between* scales of reality – the blurring of the differences between, say, the autonomous circulation of the soundbite, the small circuits of local issue politics, and global movements of capital – which accounts for the nostalgia for individual agency associated with the cultural investment into the power of small numbers. Statistics here generates a space of topological continuity where in most other respects there are tectonic cracks, disconnected circuits, poorly meshing practices and disaggregating assemblages of broken agents.

Micropolitical gestures predicated on the validity of the small numbers model implies the possibility – even the necessity – of continuity of scales, the transversality of shifts across orders of reality that disappear in the notionally homogeneous space of statistics. But it also implies an important inverse. An action at the macro-scale – that of states,

intergovernmental bodies, standards setting organizations, corporations, armies, or other molar entities – may ultimately dwindle to nothing, the full force of its signal decaying in the endless circuits it traverses and in the minor modifications and impossibilities it may succumb to as it tangles with the complications of the micro-scale, with what engineers call 'implementation details'. Policy decisions predicated on the influencing of motives – as in the current appeal to behaviour and its economic ramifications (everything is confidence) – amount to nothing without the appropriate taking into account of the different operations of different scales of reality. The folds of particular topological fields don't necessarily mesh, with the result that a suave and debonair politician who cringes under studio lights may scale up as badly as the verbal pyrotechnics of the habitué of the studio interview scale down to the level of the 'little people' when engaging in walkabout small talk.

In a further inversion, the reverse of this aspect of the micro-political imaginary is to be found in the developing field of risk management in public and corporate governance. First order risks, such as malfunctions, direct failures of task, or loss of property or revenue, blur in relation to second order risks such as loss of reputation and brand-damage (Power, 2007). The maintenance of good practice at every stage and scale of a work-cycle is a means of minimizing the ability of things to migrate from being minor problems to those of massive scale without any intervening passage-points of escalation. The mythical yield that marks the transition from nowhere to everywhere; from mundane normalcy to utter collapse; from the pain of conformity to revolution; from unknown to stardom; from a sluggardly to an inspired economy, appears now to some to be as reliable as a train timetable, given the right throw of the dice.

The propensity to develop intensive forms of affective investment in extremely small numbers derives in part from the power to process many numbers which computation provides. The relatively recent ability to work with the massively scaled computation of phenomena in complex topological geometries, to simulate nonlinear dynamic systems and to engage in advanced forms of modelling renders such phenomena visible, apparently tractable and open to interpretation and use. The ability to find hitherto unnoticeable, or unproduceable, disproportionate effects through being able to sort through an exponentially larger number of possible combinations inspires the possibility that any slight modification of behaviour may yield spectacular results. In turn, the ability of programs to interpret, interact with and actively inhabit such topological spaces of proximity brings them closer to the surface of daily awareness. The computational re-instantiation and acceleration of the power of small numbers resonates with their often promulgated relation to networks and their elaboration of a form that is topological, that is at once continuous yet composed of discrete parts, with no limit of scale. The eagerness to find in networks – those of computers in particular – a form

with ubiquitous explanatory powers, despite their limited topological qualities, in turn reasserts the power of small numbers and the ability to traverse scales. At the same time though, it seeks to find a means of explaining the function that such network relations play, a means of turning such a function into something recognizable within historically more traditional infrastructures of communication and action.

The growing resonance of the power of small things comes about most potently because of the recognition that within certain configurations of relations, they can indeed make the most crucial difference: the possession of a visa, word of a loophole, access to food, conditions which can be difficult, if not impossible, to arrange. These are trivial things, the matters of everyday life, and their absence may yield death, or its double, attrition. But the finality of the everyday event is such that it tends to stay in its own place in the hierarchy of abstraction layers. Unless accidentally taken up elsewhere, or benefiting from the propitious generosity of an error, it stays within its own proper domain, ending the process. In such cases, there is no real interplay between audacity and preparation, as they speak different languages and cannot refer to each other.

Conceptualized in terms of a logic of representation, statistical invocations of small numbers sometimes make it difficult to see what such invocations *do*. Conversely, abstractions, such as those produced by statistics, even those which are most often criticized for reifying or occluding a relationship to the real can, by such means, induce the emergence of a topological continuum and hence traverse scales of reality, introducing probabilistic, determining or contingent effects. Rather than a representational function, faith in small numbers is bolstered because number provides a relation of dimensionality capable of jumping and uniting scales (the enumeration of asylum seekers, atoms, jars of jam, states, available registers, the fewness of fish left in the sea, the repetitious form of short multifarious lists of things that aim to trigger a sense of wonder at the manyness and variability of things), acquiring proximities that in turn provide a relationship between abstraction and the mechanics of narrative traction, a technics of relation.[7]

Invoke Recursion

Recursion is one of the special pleasures of programmers, the use of a procedure that involves a series of discrete steps, one of which entails the relaunch of the procedure. An algorithmically specifiable technique for generating continua, it is a constant relaunching that aids both programmatic concision and economy, and which doesn't have to be simply stacked inside itself, as is often thought the case. Recursion may involve the launch of another procedure which in turn relaunches the first one – such as a piece of software working its way through websites by following

one link then another, at each point splitting into a copy of itself carrying out the same behaviour, deleting itself once an end point in the chain of links has been reached. In this respect, recursion exemplifies a process of automatic production, of time, over time.

If topology involves a means of recognizing the invariance of forms in space, recursion offers a means of establishing temporal invariance. Here the characteristic problems of topology, of homotopy and continuous functions manifest in relational terms are articulated through the arrangement of staging sequences and processes. Calculus itself, originally invented to track 'the motions of the planets, the comets, the moon and the sea' (Newton, in Koyré and Cohen, 1972), is a tool for tracing recursions across time, but it is also thus a means for describing the cyclical movements of a world, one that it is wise to be able to step out from as well as being able to bend oneself and others towards. As a stratagem, recursion is immediately distinguishable from one that aims all too simply at domination, and it highlights the importance of establishing a continuum through processual iteration. But it is a stratagem the very formal, algorithmic qualities of which also compel its use in a moderate manner, with due attention to the conditions under which termination is achieved.

As a technique, recursion is typically handled by a loop, a sequence of instructions in which a program performs a set of operations, looping back to repeat them again until a specific condition is satisfied. But recursion may also be something far more systematic and pleasing – a characteristic feature of some entity or other definable in terms of the kind of recursive mathematical function that programmers are taught to exploit. First of all, recursion is not inevitably a re-instantiation of the same (Deleuze, 1994). It may consist of a derivable pattern of activity, of self-similarity, but in a condition in which each recursive event is different, in terms of its scale, location in time, in the complications it may entail, and in terms of its place in relation to its nesting within other recursions or to those in which it is in turn nested. As such, recursion may be used to organize heterogeneous material into a continuous, self-consistent pattern.

Control requires recursion, and this is its innovative answer to the ancient question put to Socrates in Plato's *The Republic*, and then repeated by Juvenal: *quis custodiet ipsos custodes*? Who watches the watchmen? To which the answer was: their own deluded sense of duty – checks and balances. The recursiveness of control mechanisms in the operations of digital media infrastructures creates a situation in which no upper layer, required to draw on its merely moral strength to fight the seductions of corruption, is required, since another cycle of recursion can always be called upon to top it out. That recursion has this potential requires that it be handled meticulously in order for it not to spill out in unrecuperable ways, generating patterns in excess of the

tacit norms of its exercise. As formalizations increasingly spread out from programmable systems into those that exhibit greater degrees of unpredictability, the usefulness of implementing recursive forms increases. One notable recent example is the use of eye-tracking devices to monitor, control and derive information from the eye-movements of those watching CCTV feeds (Vural and Akgul, 2009).

The answer to the question of who controls control is, then, that when control controls controlling, control is formally dextrous enough to con-jugate itself, endlessly. An automatism that has acquired such solid entrenchment in the perceptual, affective and conceptual habits of experi-ence that it acquires an agency all of its own. This creates a situation in which there is a cyclical deferral of control, no identifiable centre to it, and at the same time, control is able to enact itself at multi-scalar levels with more or less appropriate specificity and variety, enacted through a 'business ontology' (Fisher, 2009: 17) that is codified in protocols and standards of corporate governance used to structure action through a flexible, abstracted formal-technical grammar. At this point, resistance to control is not something of interest simply to underlings or those who are used to being the appendages of their devices, but to any who need to take the initiative of utilizing disturbance or taking a little creative auton-omy. Needless to say, the anonymous algorithmic perfection of such an admirably constructed world does not yet exist, except in tendency. But as a concrete abstraction unfolding with hands-free autonomy into the various locales of the real, it offers much to desire. Not to mourn, but to organize.

However, such organization does not arise from a revolutionary rationalism, an imperative to establish media systems as a 'clean slate',[8] to ground all future operations on a foundational scission with the past and start anew under perfect conditions, but rather from work-ing with the messiness, intractability and chaos which pertains. What needs to be established is the minimally homogeneous continuum of relations to enable all this recursively constructed activity to take place – this is the strategy of cloud computing and social network facili-tation, for instance. Such a stratagem is one that works well to supple-ment or triangulate the perils of audit in which quantitatively fixed terms of required achievement simply become fixtures to be worked around. With recursion, the workaround is already anticipated, tracked and installed as the next target: it operates in a cybernetic dance of target finding and avoidance.

The stratagematic efficacy of recursion as a technique derives from the way in which it draws on particular kinds of patterning that already exist in things, people, processes, organizations themselves. Yet the risks that it poses derive from the inevitably incomplete characterization that a recursive function provides: extending a process through recursion can generate forms of continuity that rapidly diverge and loop off in

directions initially unforeseen. The formal and the empirical do not mesh: poorly implemented recursion may even have the propensity to rapidly generate extreme phenomena.[9]

Look after Your Relations

Within the panoply of technical devices that have established a crucial importance in the generation of digital media infrastructure and the topological continua they help produce, the database has a critical but under-theorized role. Like much in the field of infrastructure and the technical and sociological discourses relating to it, it has the grey, attenuated, aesthetic quality of being boring. A crucial but often unremarked grey media form, the database generally fails to stimulate – and stimulates the failure of – attention (Star, 1999: 377). Such a quality is not without its merits, since inciting failures of attention – through the grey recession and withdrawal of contrasts – is also a crucial means of veiling things of most interest. However, the database also offers another possibility – that of drawing participants into, and/or implicating them within a system that draws on their activity in the production of socio-technically conditioned topological continua. Whilst not exactly making databases immediately gratifying, this is a possibility that can be achieved via the popular – Web 2.0 – approach of facilitation at the front end, data-mining at the rear – although there are also other openings. Relational databases have become such a crucial part of the conceptual and material infrastructure of the present that it is difficult to imagine many contemporary media systems without their existence as a foundation.[10]

In a short series of key papers founding his development of the Relational Database Management System (1990), Edgar Codd (1970) established a sophisticated understanding of all entities in a tabular system as dynamic, in states of possible or actual combination. Such combination was made possible either through the analytical fragmentation of entities into predicates articulating qualities or attributes as data or, without undergoing any preliminary fragmentation, by creating the conditions for 'born digital' materials to be generated, *ab initio*, as such entities. Work of this sort establishes the conditions for data not simply to be stored but to be structured, and Codd's work also went on to establish these states of combination as fundamental, but finite, entities to be handled as such and in their own right. The development of a field of reality the material stuff of which is to one degree or another interpretable and manipulable as elements in a table allows for the amassing of relations between the entities in that table. Importantly, guided by a keen insight into the importance of bringing data-handling out of the hands of specialists, Codd also shifted database design towards the realm of natural rather than formal, procedural languages. Data-banks were to

become useful to people other than stock-controllers or technicians. Gradually, as data entry, deletion, modification, sorting and query, grew, perhaps by one or more remove, into the habits of daily life, such entities also began to populate the everyday.

Because of their high degree of abstraction as structure-building devices, relational databases are immensely useful and work as a critically generative part of what we can understand as the abstract infrastructure of flexibilization and of the increasingly interpretable nature of processes and resources. The data model that a database implements provides a rough and ready sketch of the ontology of the entity or entities modelled – task, role, process, department, organization – that is usually glossed as a 'universe of discourse'. However, the interpretability to which databases give rise should not be mistaken for transparency – in part because transparency should not be so mistaken either – and all kinds of users would be wise to recognize and to work with this.

The tractability of data and the relations it entails depends in no small part on the degree of normalization of that data and the structures it is entered into and becomes an element of. Normalization – technically understood as part of the optimization of the design of a database – involves the treatment of each piece of data and each relation as a separate entity. It involves the stripping away of unnecessary hierarchies or other structures within data and the literal abstraction of the attributes of an entity and the treatment of these as entities in their own right. For the entry 'God' in a nominal table 'Deities', the attribute 'Good' would thus be stored in a separate table (along with other possible attributes – 'Evil', 'Omnipotent', etc.) and a 'key' linking the two be created. This means that as data is updated, deleted or inserted, it does not carry with it any dependencies on other data or structures (such as a nesting within a set of parent-child nodes). If God is deleted, one need not delete the Good as well – the relational algebra of the normalized database allows some other entity – Man, Capital, etc. – to be inserted in his place. Normalization implies a certain neutrality as to the relative importance of one datum compared to another. And what it thus allows is for a query to be formulated through any point in the set of relations mapped by the table. 'SELECT * FROM dbo.Deities WHERE dbo.Deities.TranscendentValue NOT IN ('Good','Evil')'. Non-normalized data offers one kind of resistance, in that it requires nested sets of dependencies. A red round thing may be a cricket ball or an apple, and neither may exactly be round, but once they are normalized and interpretable as simply exemplars of bearers of one or more of the categorizations, red, round, thing, they lose their specificity. The quality of irreducibility is transferred from the entity described to the categories its qualities are organized into. Or, to put it more speculatively: in the normalized ontology of the database, every predicate is presumed alienated from the outset: the more tractable the data becomes for machine

handling, the more the predicates it seeks to capture in a structured way, the more abstracted it becomes as a generative matrix, situated on a 'body without organs' or recording surface (Deleuze and Guattari, 1987) for the senseless proliferation of relata.[11]

Relational databases have, in principle, infinite capacities of scalability, complexity and – due to their capacity for abstraction – variety, although to affirm such a capacity is to test luck as much as logic or logistics. The unlimited addition of predicates to any entity whatever – approximating what philosophers might call the infinite comprehension of a concept[12] – is always possible, albeit at the cost of 'performance degradation' (the more attributes an entity has, the more tables have to be searched and so on). Built upon the ability of a Turing Machine to make possible the computation of any formalizable statement, databases enable the organization of populations of normalized statements – generating machinically formulated discourse, of the kind one finds as the result of a 'search' or which provides the matter of decision support systems. That the data itself is normalized has no bearing on whether what it handles – what the data is 'about' – is in turn formalized – although a world in which life imitates data has more than a little desirability. This is why databases are so crucial in establishing productive or generative links between rules, structures and the outside world. This capacity for logical ordering enables the induction of combinatoriality and sorting for things without the database as well as within it; the introduction of new kinds of entity that are natively 'artificial' (Simon, 1996); and the production of new rules for relations, the harvesting of relations generated by the population of databases by live data-generating processes.

But whilst databases, and the ontology of models that they develop, are typically understood in terms of a logic of representation, as a device to enable better logistical control of the entities that the database models (stock in a warehouse, music downloads, security profiles), a more interesting way to think about the database is as a kind of topological *machine*, a device that intentionally or unintentionally engineers connections between things, generating continuities. Any table of related data, a nomograph or even a bus timetable, establishing links between a finite number of stable, discrete, and interconnected entities, is a topological machine. They establish networks of relations, the points of intersection between data and what that data links to and triggers. Topology tends to describe a network from a position outside of that network (it would require a higher dimensional topology to incorporate the topological generation of topologies). But when considered as topological machines, relational databases work through systems of relations to create, confirm or discover relations, and, as such, work to generate new and potentially arbitrary kinds of continuity as well as the properties of the figures thereby generated. Where topology offers an analytic device for

understanding proximities, continuities and so on, topological machines operate synthetically to generate the same.

As more and more data flows through and into the databases established to capture it, something other than the logistical imagination is able to grow. Data-mining allows for the identification of unforeseen relations and factors (hidden variables, new patterns between existing variables, an 'evidence base'). This in turn establishes the possibility for actions predicated on the basis of topologically abstracted patterns of data, which are thereby enacted into existence: market niches (the subprime mortgage stratum), actuarial risks (the subprime mortgage stratum), no-go areas for political discourse (the subprime mortgage stratum), and so on. Concentrations of data, and the information it grounds, establish new centres of gravity as they couple with sorting systems, giving shape to a politics based on probabilities, the seductive allure of small numbers, and the correlationist certainties of large ones. This may give rise to multiple kinds of masking of hidden factors beneath a shimmer of data abstracted from its relation to other scales of reality. On the other hand, relational databases make tractable, sortable and usable relations that are not apparent otherwise. On the face of it, most databases are best understood as describing sets, operating through the working methods of predicate logic (Kuhns, 1967). They allow the selection, differentiation, union, analysis and possible projection of the attributes of a relation, opening up a set of possibilities, configuring a field of action, facilitating a decision, in the absence of any direct consideration of the state or states of the referents to which the data 'belongs'.

The relational algebra of the database entails that it can – in theory – usually be entered at any point, via predicates (or attributes), by relation or by entity, allowing data to be retrieved and sorted on that basis. In this way, every element can be sorted by its actual relations, consisting of its categorical, relational derived relation or non-relation to all other elements. As databases increasingly face towards users configured as consumers, the restraint of access to such ways of working is often a key feature. For instance, try to find a way of searching for all books of a certain price on an online bookseller. Whilst they offer a parade of desire from one title to the next, to sort them by other means remains unavailable.[13] Ways into the network of relations are constrained. Certain ways of accessing data are preferred, as normalized connections between tables suggest particular kinds of orderings – the potentially flat quality of a network of elements is technically organized as a hierarchy, arranging the links in a manner in which they only flow one way. Gaining access to the knowledge of a topology implied in the formal algebra of relations is thus a tricky matter. Whilst topological machines typically only allow the privileged gaze of overview to those with the correct access setting, this is only to read them as conforming to traditional models of power and does not address the broader possibilities to which they give rise.

One way in which databases can encourage us to develop an understanding of other formations and modes of exercise of power is through a quality that is inherent to them: the production of relations and of disassociations. The aggregation of vast 'banks' of data – to work with a term that described them at their birth – sees the operation of all the forms of experimentation, consolidation and power to convince that are typical of those banks that specialize in money. Whilst a taxonomy of the modes of aggregation, circulation, speculation and dissipation of capital is constantly being drawn up, it is at present left solely to the stratagematic imagination to work this out in practice in the case of data. A means by which this imagination stimulates itself is in the ability to cross-reference data from different sources,[14] and to aggregate databases using common standards, effectively consolidating them into one body. Such strategies are relevant across all sectors, but there is little rigorous work done on their effective yields in control and prediction, and hence little advance restraint upon them or their consequences. With the possibilities for formally consistent working across databases – maintained as if they were one vast description of the ontology of the model of the world embedded in data – being currently rather limited (despite the optimistic promotion of open data models[15]), the induction of arbitrary relations between them, implying false continuities, abrupt changes of person and personality, status, credit rating, security risk and so on is an ever present possibility. Uncanny proximities are generated by separate sets of data that don't quite match, there is a calculated generation of conflicting qualities, and a systematic production of ambiguity as databases mesh slightly or fall grossly out of synch with each other and other scales of reality. In the extensively surveilled transparency of database nations, opacities that yield malice and misfortune – but perhaps also the scope for black humour – offer the starting point for the empirical investigation of the arbitrary topologies of the laboratory of the world.

Conclusion

It is not always easy to abstract out or distil the stratagematic qualities of the techniques by which specific relations, modalities of the exercise of and processes for the formation of power are generated. This is especially so when such techniques are operative within a broader domain of relations loosely characterized, and poorly understood, as socio-technical. At least when Schopenhauer wrote *The Art of Always Being Right* he had centuries of philosophical reflection on – and regulation of – language to draw on. In the grey media that give form to the present, by contrast, it is a matter for practical experimentation, the densely connected, highly ramified consequences of which are better explored with the tutelary help of topology. Such exploration is a task that is as important as it is difficult, particularly if one seeks to avoid the ever-present temptation

to understand or explain (away) the myriad socio-technical forms that make up the abstract infrastructure of the contemporary by simple reference to pre-existing macro-agents or structures.

By questioning the presumed order of articulation of the technical and the scientific implicit in technoscience, a sensitivity towards the weightiness or flightiness (or both) of affective or intensive state that we experience in our relations with such toolings can be created, pointing towards the contingently – and hence contestably – constructed quality of the relations thus produced.

The stratagems explored here, then, do not provide a unified, continuous or even consistent vision. Linking formalism to the faulty, glitchy materiality of the empirical, they thus emphasize the unsettled, not quite stable aspects of the topology of socio-technical relations emerging through techniques of unspoken or unseen media. Whilst media studies itself remains largely screened off from such processes, all the while they go to work.

Notes

1. By 'grey' media we mean those technologies and techniques of mediation that are often discussed in terms of 'information infrastructure' or which tend to figure within the workplace as component elements of business information systems and so on. A more extensive exploration of such media, adopting the position taken here, is proposed in Fuller and Goffey (2012). Further consideration is given there to the axiological qualities of the operations of such media.
2. Recent work on Machiavelli draws attention to uncertainties in the reading of him as an advocate of deception and emphasizes the ironic practice of dissimulation evident in his writing. See Benner (2009).
3. In this respect stratagems are not unlike the practices constructive of bodies without organs in Deleuze and Guattari: a surface is constructed at the same time as the elements that circulate on it. See Deleuze and Guattari (2004).
4. The contrast between algebra and topology has been a crucial element in the work of Alain Badiou, who uses it – in part – in a speculative exploration of the continuum hypothesis. The *subject*, for Badiou, occupies a crucial role in the excesses of continuation (see for example Badiou, 2009). From a somewhat different point of view, Whitehead marks this problem with his claim that there is no continuity of becoming 'only a becoming of continuity' (Whitehead, 1978: 53).
5. As in the mise en scene of globalization staged by Friedmann in his commentary *The World is Flat*. In a telling turn of phrase he evokes 'shooting' digital content round the office (see Friedman, 2006: 279).
6. It is to the statistical effects of the law of large numbers that Deleuze and Guattari (1987) appeal in their critical analysis of the gregariousness of the social cut off from desiring production.
7. The notion of a 'technique' – if not exactly a 'technics' – of relation is explored in Pignarre and Stengers (2011). The discussion of statistics proposed here is best read in conjunction with the imaginative claims about the

connections between statistics and perception proposed by Gabriel Tarde. See in particular the helpful preface to Tarde by Antoine (2001).

8. As in Stephen Toulmin's (1990) account of various versions of the founding of modernity.
9. Cf. Baudrillard (1993).
10. In this regard, they should be considered absolutely central to the operation of what Cochoy, Callon and Law, and Thrift have referred to as 'qualculation' (see Thrift, 2004b; Callon and Law, 2003).
11. A more detailed argument to explore the value of the Deleuze-Guattari concept of the body without organs and the quasi-Leibnizian hypothesis of the disjunctions of signs that are generated on it is unfortunately beyond the scope of this paper.
12. See the discussion of the Leibnizian logic of the concept in Deleuze (1994).
13. Equally it is worth considering the structuring role that restricted – proprietorial – access to the databases that sit 'behind' software applications can play: when an organization is unable to gain access to or modify the tacit ontology such a database embodies, organizational practices are tendentially obliged to model themselves and the knowledges they require on what the database allows.
14. See for example the United Kingdom's Regulation of Investigatory Powers Act 2000 (RIPA).
15. Hence the production of data exchange standards, often by some form of messaging protocol, but also through the development of datasets in a variety of domains (e.g. healthcare, insurance).

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