Cities are Flows of Urban Magma

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Introduction

In recent years, the urban development community has debated the merits of 'participative' modes of city planning. In the context of this discussion, several approaches to increase and 'deepen' citizen participation in urban planning have been explored. However, as a rule, these approaches have retained the centralised, hierarchical 'diagram' for how urban structures are to be constructed. Indeed, in some cases, the practice of citizen participation is used in an instrumental manner, so as to serve as a guarantor for the efficacy of the planning process.

As a parallel discussion, the notion of 'self-organisation' has emerged as a catch-phrase for non-hierarchical, spontaneous 'self-building' of cities. Inspired by self-organising structures in biological – and other non-social – systems, protagonists within this discussion describe instances in which urban structures emerge 'spontaneously', apparently without the influence of centralised control.

Though interesting in their own rights, these theorists of urban self-organisation utilise the concept 'self-organisation' in a metaphorical manner. Thus, citizens are seen to be 'self-organising' by virtue of acting through civil society organisations, or by virtue of simply using given urban structures in a manner not originally not intended by city planners.

In this text, the city will be described though a DeLandian realist ontology, drawing on the idea that cities emerge through intensifications of flows of matter-energy. The term 'urban magma' will be used as shorthand for this flowing 'raw material', drawing on the notion of magma as unformed matter-energy flowing under the crust of the earth's surface.

When it comes to theory, the things that it says is far less interesting than the things that it *does*. The ontology sketched in this chapter does (at least) three things: First, it depicts the city as a place that hosts a 'superabundance' of energy, reversing 'commonsense' conceptions of the urban economy. Secondly, it draws attention to the logics of assembly that turn these flows of urban magma into structures. Thirdly, and more specifically, it uses the idea of self-organisation in a material, non-metaphorical manner. Thus, when this text discusses magma, it talks of physics, not poetry; when it discusses protocols, it talks of algorithmic code, not cultural conventions or diplomatic conduct.

The point of departure for this exploration of urban magma is a participatory urban planning project, staged in Gothenburg in 2006, regarding development of the south bank of the Göta Älv river. In these public consultations, the authors formed a part of a team Rhizom; a constellation of architects, designers and social scientists.

One of the key characteristics of this team was to avoid two structural traps of city planning. On the one hand, the Rhizom team did not want to act in a classical social engineering manner – acting as the privileged experts in the planning of the south bank, applying their exclusive knowledge about function and aesthetics to sketch a blueprint for the city. On the other hand, the Rhizom team also tried to steer clear of the cliché role of the 'critic', who has assumed the role of debunking or deconstructing the claims made by the established architects and city planners.

Shunning these twin traps, the multidisciplinary team wanted to explore alternative means to assemble the city. The aim was to explore how abstract logics of self-organisation could replace traditional hierarchical planning, and how Deweyan publics could replace expert opinion. After further exploration into the ontology of the city (section 1), the text will review the outcomes of this project (section 2). The text is concluded with a discussion on future experiments with the flow of urban magma.

1. The City as Emergy

> *In terms of the nonlinear dynamics of our planet, the thin rocky crust on which we live and which we call our land and home is perhaps the earth's least important component. The crust is, indeed, a mere hardening within a greater system of underground lava flows which [...] are the main factor in the genesis of the most salient and apparently durable structures of the crusty surface. [...] It is almost as if every part of the mineral world could be defined simply by specifying its chemical composition and its speed of flow: very slow for rocks, faster for lava.*[1]

In *A Thousand Years of Nonlinear History*, Manuel DeLanda lays out an economic, biological and cultural history, all based upon a Deleuze-informed ontology. Life and order emerges as flows of energy, rippling through the material world, tapping the immanent, morphogenetic potentials of matter itself. This 'neo-materialist' account of history is closely intertwined with recent developments in complexity theory, and – via Deleuze – an 'orphan line of thinkers'[2] , beginning with Lucretius.

In *On the Nature of Things*, Lucretius puts forward the theory of the *clinamen*, the 'swerve':

1. DeLanda (1997: 257-258)
2. Massumi (1992: 2)

when atoms are travelling straight down through empty space by their own weight, at quite indeterminate times and places, they swerve ever so little from their course, just so much that you would call it a change in direction. If it were not for this swerve, everything would fall downwards through the abyss of space. No collision would take place and no impact of atom on atom would be created. Thus nature would never have created anything.

In other words, as Lucretius saw it, order – as well as life – emerges as a result of turbulences created by swerving atoms bumping into each other. Order emerges from, and is sustained by, dynamic and unpredictable flows of matter-energy. However, the burgeoning natural sciences rejected this perspective of the world, and chose to see Lucretius idea of the clinamen as a poetic metaphor. Physics developed in a different direction – inspired by Plato and Kant, accelerated by Newton – focusing on ideal states of static equilibrium that could be described mathematically through simple linear equations. The emerging natural sciences depicted a frictionless world where equilibrium is the norm, where order and life was contingent upon stasis, and where turbulence meant disorder and death. Therefore, *On the Nature of Things* has largely been read as a literary text; as poetry.

Nevertheless, during the latter half of the 20th century, this worldview based upon Newtonian physics started to buckle. Observers noted that

we are at a crossroad between [Newtonian physics], whose laws describe the movement of bodies in efficient systems tending toward equilibrium (unless acted upon by an external force), and the more chaos-oriented thinkers, such as Poincaré, Einstein, Bergson, Schrödinger, Rene Thom, and Ilya Prigogine, who found new laws for the behaviour of systems that are far from equilibrium.[3]

One of the first to re-read Lucretius in light of the new developments within the natural sciences was French philosopher Michel Serres[4], who argued that the idea of 'the swerve' ought to be seen as scientific theory, as 'physics proper'.

Lucretius's De Rerum Natura is a treatise on physics. In general, the subsequent commentary of both critics and translators has refused to consider as such, avoiding the nature of things as they really are, relating the knowledge given in the text to some unknowing prehistoric era, and discoursing instead about morality and religion, about politics and liberty.[5]

In his claim that Lucretius' idea of the swerve was actual physics and not metaphorical poetry, Serres was standing on the shoulders of physicist giants: It was only through advances in physics that he could make such a claim.

The fact that [...] that we have remained blind to such a simple phenomenon is really quite normal [...] Until the beginning of this century, no one could bring himself to describe flow in all its concrete complexity.[6]

3. Muecke (2006: 280)
4. Serres (1982; 2001)
5. Serres (1982; 2001)
6. Pp. 102-103.

Thus, the science of fluid dynamics, and subsequently chaos and complexity theory, were armed with a new set of descriptional tools – the differential geometry of mathematicians Gauss and Riemann[7], as well as computers. These new tools allowed scientists to describe the world, and – unlike Newtonian physicists – *not* take frictions and other 'nonlinearities' out of the equation.

> *Nonlinear systems generally cannot be solved and cannot be added together. In fluid systems and mechanical systems, the nonlinear elements tend to be the features that people want to leave out when they try to get a good, simple understanding. [...] Nonlinearity means that the act of playing the game has a way of changing the rules. [...] That twisted changeability makes nonlinearity hard to calculate, but it also creates rich kinds of behaviour that never occur in linear systems.*[8]

Thus, some natural scientists showed that in far-from-equilibrium states, life and order seem to emerge spontaneously. In such situations, the nonlinearity yields *emergent properties*, where the whole cannot be reduced to the sum of its parts. These natural scientists also argued that life could *only* exist in such far-from-equilibrium states. This perspective can be described in the following terms: The second law of thermodynamics states that the universe as a whole is becoming more and more disordered, tending towards entropic equilibrium. But, as John Gribbin notes:

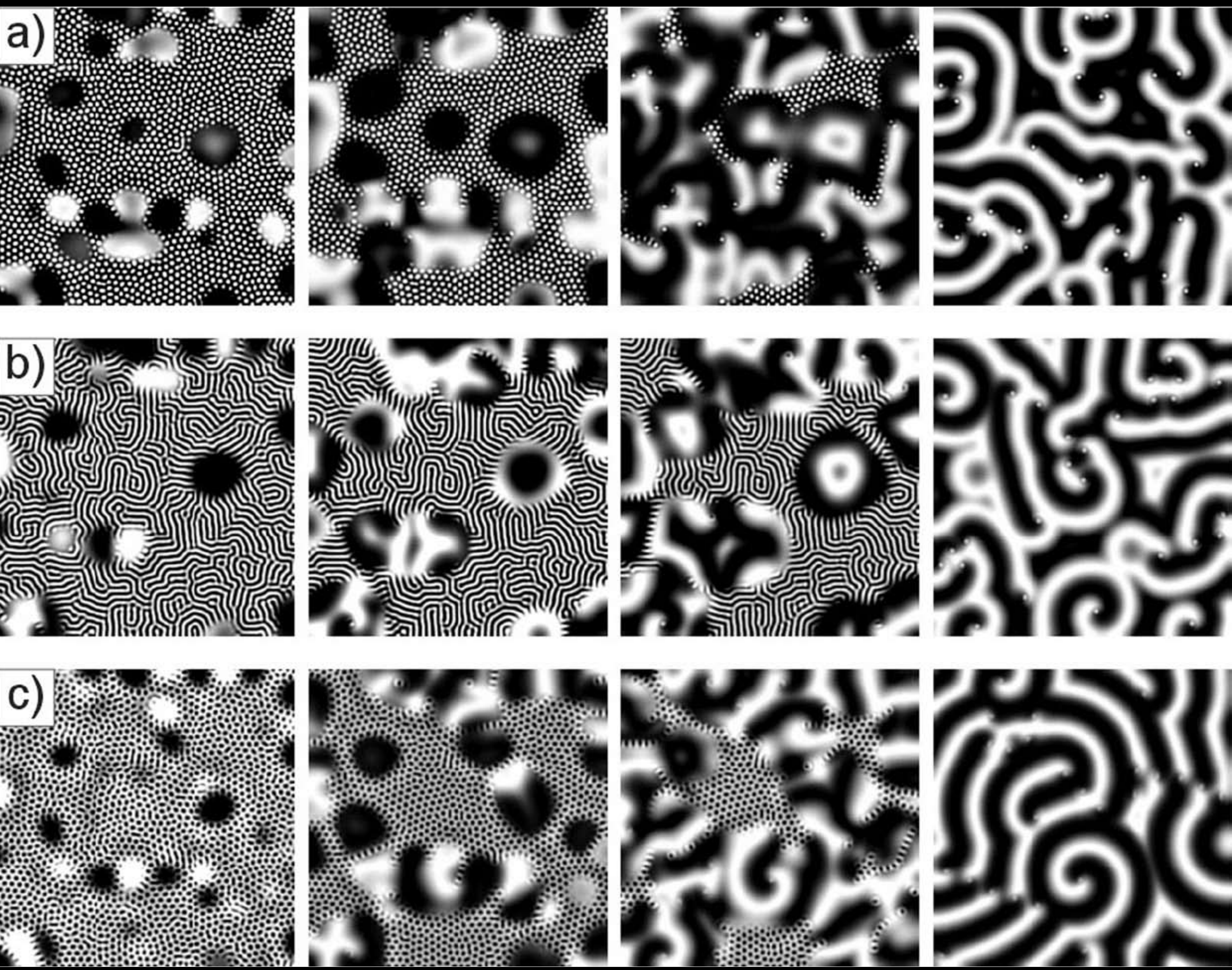
> *Life, of course, seems to defy this process, by creating order and structure out of disordered (or at least, less ordered) materials. A plant builds its structure, and may make beautiful flowers, out of carbon dioxide, water, and a few traces of other materials. But it only does this with the aid of sunlight, energy from an outside source. The Earth, and in particular life on Earth, is not a closed system. It is possible to show [. . .] that anywhere in the Universe that a pocket of order appears, it always does so at the cost of more disorder being produced somewhere else.*[9]

Due to the fact that all physical systems tend to strive towards maximum disorder (entropy), order and life can only be sustained if energy flows through the system, sustaining turbulence, maintaining and recreating life. Only dead matter is truly in equilibrium and truly non-turbulent. The contribution of complexity theorists is that they started to explore how processes of self-organisation emerge spontaneously in far-from-equilibrium situations, as energy flows through the system. One such theorist was Alan Turing (also known as a computer theorist), who wrote a paper on 'The chemical basis for morphogenesis' in 1952, stipulating that order could emerge out of chaos. A few decades later, Ilya Prigonine showed that '[a]way from equilibrium, a flow of energy can, under the right circumstances, create order spontaneously[10].

Complexity theorists also found that *similar processes* of emergent order were often found *in different settings* – in weather phenomena, in populations of animals and so forth. [11]Thus, in this ontology of flows, *all* entities can be described as complex systems, displaying emergent properties, coming to life in far-from-equilibrium, turbulent situations:

> *The universe of Epicurus and Lucretius is a reconciled one in which the science of things and the science of man go hand in hand, in identity. I am a disturbance, a vortex in turbulent nature.*[12]

7. As described by DeLanda (2002)
8. Gleick (1987: 23-24)
9. Gribbin (2004: 26-27)
10. Jacobs (1969: 146-147)
11. P 30.
12. Gleick (1987)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other ordered structures, kept away from the entropic drift stipulated by the second law of thermodynamics, the city requires a steady flow of energy to be sustained. Steven Johnson writes in *The Ghost Map*:

> *High-density collections of human beings, by definition, requires significant energy inputs to be sustainable, starting with reliable supplies of food. The towns of the Middle Ages lacked highways and container ships to bring them sustenance, and so their population sizes were limited by the fecundity of the land around them. If the land grows only enough food for five thousand people, then five thousand people became the ceiling.*[13]

So, just like rainforests or coral reefs, cities are complex ecosystems, direct outcomes of 'the energy that flows through them' [14]. Indeed, DeLanda describes historical expansions of cities as dependent on intensifications in the flow of energy passing through urban structures. [15]Not only does this intensity of energy flows determine the size of the city – they also determine the qualitative, cultural traits of the city. As we know from Jane Jacobs, density is in direct relationship with diversity:

> *Towns and suburbs [...] are natural homes for huge supermarkets and for little else in the way of groceries, for standard movie houses or drive-ins and for little else in the way of theatre. There are simply not enough people to support further variety, although there may be people (too few of them) who would draw upon it were it there. Cities, however, are the natural homes of supermarkets and standard movie houses plus delicatessens, Viennese bakeries, foreign groceries, art movies, and so on, all of which can be found co-existing, the standard with the strange, the large with the small. Wherever lively and popular parts of cities are found, the small much outnumber the large.* [16]

There is thus a close link between rigid, built structures and cultural flows. DeLanda, using his ontology, is however stressing that these flows follow *the same* nonlinear dynamics. Thus,

> *cities arise from the flow of matter-energy, but once a town's infrastructure has emerged, it reacts to those flows, creating a new set of constraints that either intensifies or inhibits them.*[17]

Humans tend to discriminate between structures that they register as rigid (such as rocks and continents) and structures that they register as in flux (such as cultures and languages). However, as hinted in the opening citation, they are merely flowing at different speeds. Indeed, in DeLanda's 1000-year history, fast-flowing memes and norms are partly configured by the slightly slower flowing flesh and genes, which are partly configured by even slower flow of geological matter. Similarly, cities can be construed as consisting of *both* slow-flowing, hardened structures, *and* fast-flowing, ephemeral phenomena – both results of *the same* patterns of nonlinear dynamics.

13. Serres (1982: 121)
14. Johnson (2006: 5)
15. P 6.
16. DeLanda (1997: 28)
17. DeLanda (1997: 28)

What is then the nature of the 'urban magma' that drives the hardening of urban architectures, as well as the urban circulation of flesh, genes, memes and norms? One answer is that this form of matter-energy appears in many guises – in urban flows of money, people, cement and memes. Thus, it is important *not* to construe the flow of urban magma as a homogeneous one – it is the intermingling of different flows that generate turbulences. The fact that Antwerp has a lower density of human flesh than, say, Bochum does not prevent it from playing host to several creative vortices.

Another answer is to stipulate that the matter-energy pushed through the city can be 'locked' in urban structures, be they rigid or intangible, through a process akin to 'charging', yielding emergent properties. As mentioned above, intensified flows of energy can lead to the triggering of qualitative shifts in the properties of a structure, such as the emergence of a diverse commerce culture in high-density cities, described by Jane Jacobs.

Here, the concept of *emergy* is a useful tool. The term originates from Howard T Odum, who describes it as

> *the total solar equivalent available energy of one form that was used up directly and indirectly in the work of making a product or service* [18]

Australian physicist David M Scienceman also describes emergy along the lines of:

> *'energy memory', meaning a measure of the quantity of original form energy which has been totally used up or transformed into a new form of energy. The original form has disappeared and has become only a memory, a memory stored up in emergent properties and transformity.* [19]

In this manner, nonlinear flows of urban magma can push through certain thresholds, so as to create semi-stable urban structures, where the energy has become a memory. Due to the fact that such flows of matter-energy are temporarily locked in bodies with emergent identities, emergy is sometimes referred to as 'embodied energy'. As is obvious from studying its mathematical definition, emergy (E_m) is the total exergy (E_x, 'energy available to produce work') loaded into the body from the beginning of time to the present. The amount of exergy 'charged', in turn, is a function of the intensity of the flow, the exergy power (P_x, 'the rate of work produced'), as it fluctuates during this period of time.

$$E_m = \int_{t=-\infty}^{t_0} P_x \, dt$$

This text does not set off to measure the emergy (E_m) in a certain urban structure: Assuming that the energy flowing through a city is 'superabundant'[20] such measurements would make little sense. Moreover, while different cities may have different quantities of matter-energy flowing through them, the qualities of the city is as contingent upon the heterogeneity of the flow, and the magnitude of the turbulences generated.

18. Odum (1996)
19. Scienceman (1997: 210-211)
20. Bataille (1988: 29)

Therefore, the emergy concept will be used *as if* it could be measured. In other words, it is used in the description of the city as an emergent outcome of flows of 'urban magma': The focus will be on exploration of, and experimentation with, the flows themselves. As this section has endeavoured to show,

> *life deviates from equilibrium. How can this be explained materially? By visible and tangible phenomena that can be produced in experiments on flows; by analogy with the concrete model.* [21]

In this spirit, the next section will study two ways in which such flows 'congeal' into hardened structures, as well as the shifting of the thresholds for attaining emergent effects. In particular, it will explore how man-made 'protocols' for urban development can influence such processes. The subsequent section will outline the contours of an upcoming experiment on how to tap the intense, yet non-monetised, flows of urban magma.

1.2 Creating a Protocol for Urban Development

> *Geological strata are created by means of (at least) two distinct operations. [...] Once the raw materials have been sorted out into more or less homogeneous groupings deposited at the bottom of the sea (that is, once they have become sedimented), a second operation is necessary to transform these loose collections of pebbles into a larger-scale entity: sedimentary rock. [...] This operation consists in cementing the sorted components together [...] into a more or less permanent 'architectonic' structure.*[22]

In DeLanda's nonlinear history, sedimentary rock (such as sandstone) serves as an example of an actualisation of a general class of systems: hierarchies, or 'strata'. As mentioned in the quote above, the 'recipe' for assembling a stratified structure is a two-step operation: first, a collating and sorting of homogeneous elements (pebbles); secondly, a 'cemeting together' of the different elements, so as to form a unified, monolithic and totalised structure (sandstone). In social hierarchies, the first operation is generally achieved through the use of material, tangible components, whereas the second is generated from expressive components (knowledges etc.) that 'overcode' the structure.

This hierarchy-building recipe has become widely adopted in the modern world. Urban planning is no exception from this rule – it has utilised these *same* logics of assembly that in nature yields sedimentary rock. A planning office's modus operandi thus relies on the abstract machine of 'stratification', incarnated in the material tools of planning: top-down maps of areas from "God's perspective"; the emphasis on streets and block outlines, borders between boroughs, statistic colouring, and highlighting of transit roads and highways. These tangible tools for planning are signs of how this mode of operation is hard wired into the structure itself, a logic articulated through its sedimentary structure. In addition to these material components, there are a number of expressive components that overcode the structure – not least the belief in the merits of top-down, scientific planning. The planning office in itself is an infrastructure headquarters, a command central of concrete and steel, from which chains of command operate the building machine, elevated far from the people on the streets.

21. Serres (1982: 102)
22. DeLanda (1997: 59-60)


This is a structure of command as well as a mode of operation for city planning, perhaps most famously incarnated in the Haussmann's boulevards in Paris. It is also exemplified in Marshall Berman's *All That Is Solid Melts Into Air,* depicting the planning works of Robert Moses in New York. Here the planning apparatus starts to live a life of its own, as a stratified self-propelling automaton. Moses integrated various authorities so as to form

> *an immensely powerful machine, a machine with innumerable wheels within wheels, transforming its cogs into millionaires, incorporating thousands of businessmen and politicians into its production line, drawing millions of New Yorkers inexorably into its widening gyre.*[23]

This machine is set into action for the execution of the Cross-Bronx Expressway, which resulted in massive evictions and population transfers. Moses, the great city architect, boasts about how he has to work his way through the densely populated Bronx area: 'When you operate in an overbuilt environment, you have to hack your way with a meat axe'[24]. Moses also constructed an infrastructure that itself served as a people-sorting machine, as in the building of the Long Island parkways, 'purposely built too low for buses to clear them, so that public transit could not bring masses of people out from the city to the beach'[25]. For as his co-workers said about him: 'He loves the public, but not as people'[26]. This stratified perspective focuses on a certain pattern in the flow of urban magma, of one connected to the format of the automobile industry to allow the flow of 'sheer quantity – of moving vehicles, tons of cement, dollars received and spent'[27].

Sedimentary rock, social hierarchies: Stratified systems exist in several different registers, usually called by different names. In the context of computer programming, the logic of assembly exemplified by Moses' big planning apparatus is called a 'cathedral'. In programmer Eric S Raymond's now classic text *The Cathedral and the Bazaar,* two logics of assembly are described: the centralised architecture; and the decentralised, bazaar-like distributed network. In Raymonds' book, Microsoft Windows is the archetypal cathedral, and open source operating system Linux is an example of a bazaar structure.

It was this bazaar-like logic of assembly that inspired the Rhizom team to explore other forms of planning and participation in the processes of assembly. Like the 'rhizome' structure described by Deleuze and Guattari in *A Thousand Plateaus*, bazaar structures can emerge spontaneously, 'synchronised without a central agency'[28], given that 'local operations are coordinated'. The same goes for the bazaar-like distributed networks that exist in the world of computers:

> *A distributed network is a specific network architecture characterized by equity between nodes, bi-directional links, a high degree of redundancy and general lack of internal hierarchy.*[29]

In the computer world, this local coordination is secured through what is called a 'protocol'. The protocol is not the hardware itself but the interface between adjacent parts, allowing other forms of information, matter energy or goods to flow through.

23. Berman (1983: 306)
24. P 293.
25. P 299.
26. P 304.
27. P 308.
28. Deleuze & Guattari (1988: 17)
29. Galloway (2006: 317)

> *Protocols are systems of material organization; they structure relationships of bits and atoms, and how they flow through the distributed networks in which they are embedded.*[30]

So what the protocols steer is not only code or simply written "text". Protocols coordinate the flow of urban magma; food, genes, biomass, memes, trash, initiatives and spontaneous behaviour. As such, it too can be seen as assisting in a logic of assembly, different from the one detectable in stratified systems. Again, as DeLanda notes, this logic of assembly exists in several registers. So, in the geological register, flows of magma does not only yield sedimentary rock:

> *Igneous rocks (such as granite) are formed in a process radically different from sedimentation. Granite forms directly out of cooling magma, a viscous fluid composed of a diversity of molten materials. [...] As the magma cools down, its different elements separate as they crystallize in sequence, and those that solidify earlier serve as containers for those that acquire a crystal form later. The result is a complex set of heterogeneous crystals that interlock with one another.* [31]

DeLanda thus speaks of another type of general class of structure – 'meshworks' – that are visible in granite, street markets, and catalytic chemical reactions. As already mentioned, the same 'abstract machine' is put to use in the context of computers, using protocols.

The Rhizom team thus wanted to tap this same 'abstract machine', and explore whether urban magma can be organised so as to form igneous architectures, and also create a heterogeneity of smaller initiatives and interventions in the cityscape. In this way, the dangers of the sedimented stratified planning machine of Moses could be avoided. Similarly, the Rhizom team could steer clear of the role of the 'deconstructing critics': rather than simply pointing to the well-known failings of the top-down planning of sedimentary structures, it could devise modes of bringing igneous structures into being.

This however requires a safeguarded a space and a format protecting the protocols from being re-sedimented into sandstone. This format we called a "Constitution" a code of operations within the Södra Älvstranden area. It was a tool for guaranteeing the rights and room for small-scale interventions, balancing the emerging protocols to the surrounding laws of land use exploitation. The constitution formed several layers of negotiations with the adjacent city order.

As part of the first steps was a re-forming of SUAB, the "south bank development company", into a "SUPIC", a public interest company. This would mean putting the overall control of the development and planning into a not-for-profit social enterprise ruled by large board consisting of politicians, planners and citizens. This SUPIC would be the main negotiator with the authorities concerning the interfaces to the rest of the city, like rules and regulations, infrastructure etcetera, shaping the overall framework to let action spaces evolve guided by the protocols.

The team also described the need for an 'Infobox', which would serve as physical place which could facilitate the decentralised coordination of citizens.

30. Galloway (2006: 319)
31. DeLanda (1997: 64)

As such, it would serve informational purposes (disseminating ideas on how the area is developing) as well as deliberative/decisional purposes (constituting a Latour-inspired 'parliament of things').

A possible source for funding suggested by the group was the remaking the official Gothenburg carnival, 'Göteborgskalaset', into a new culture support system based of micro finance – small loans to allow low-level spontaneous initiatives to flourish. These would all be experimental in form - such as street markets, street festivals, alternative sports competitions, DIY events, street swaps (exchanging activities between centre and periphery in the city), and otherwise decentralized or uncontrolled events usually emerging at 'reclaim the streets' demonstrations (with an emphasis on celebration, not throwing stones).

An immediate objection to this form of organization is the unpredictability, possible unrest or even unlawful behaviour such emphasis on protocols could bring into being. Protocols should however not be read as a step towards anarchy, but instead it creates a new set of tools for renegotiating and organizing control, attempting to avoid the traps of the sedimentary planning machine:

> *distributed networks create new, robust structures for organization and control; they do not remove organization and control. Compared with pyramidal hierarchies, networks are indeed flimsy, ineffective and disorganized. But this relationship of asymmetry is precisely what, in the long run, makes them robust.*[32]

The south bank should thus not be seen as a free-state or 'anti-protological' structure, or a Temporary Autonomous Zone (or T.A.Z.) as proposed by philosopher Hakim Bey in his book[33]– the constitution is merely an add-on to the regular laws of society, a licence to operate, a General Public License. Thus, the protocol envisaged by the Rhizom team does not lead us away from power as such. Rather, it enables us to imagine a logic of assembly for city architectures that is igneous; self-organising in a very physical manner. Moreover, it creates an entitlement for citizens to tap the flows of the city themselves, creating their own turbulences. This would then constitute a radical break with the present, when these actions are centrally-devised, focussing less on the emergence of a plethora of heterogeneous micro vortices cascading in the cityscape.

Moving on from the Södra Älvstranden urban planning project, the next section will delve deeper into the ontological description of the city as a flow of urban magma, and describe an upcoming experiment that aims to tap these flows.

1.3 The Urban Turbine

> *At first sight, it is easy to recognise in the economy – in the production and use of wealth – a particular aspect of terrestrial activity regarded as a cosmic phenomenon. A movement is produced on the surface of the globe that results from the circulation of energy at this point in the universe. The economic activity of men appropriates this movement, making use of the resulting possibilities for certain ends. But this movement has a pattern and laws with which, as a rule, those who use them and depend on them are unacquainted.*[34]

32. Galloway (2006: 318)
33. Bey (2003)
34. Bataille (1988: 20-21)

For Bataille, sunshine is – in a very material sense – the source of human wealth. Life and order emerges through the sheer energetic 'pressure' generated by solar radiation. Economics – the science of the allocation of scarce resources between competing ends [35]– may therefore cause us to make false assumptions regarding social ontology. Notions of 'scarcity' and 'lack' are simply human constructs thought to enable a certain type of economic order.

The morphogenesis of structure, however, is best understood through a Copernican reversing of these terms: Like other intense processes that unfold on the surface of earth, economies emerge due to the sheer 'superabundance of energy'[36]. Most of this abundance has to be 'squandered' – exuberantly or destructively – due to the fact that there is always an 'accursed share' of 'excess energy' that cannot be harnessed for growth.

What are the implications of this Copernican revolution for our understanding of urban structures? How do we get a sense of this supposed 'movement' of urban magma, that 'has a pattern and laws' which we generally fail to register? Can we even find strategies of tapping these abundant flows?

In describing his ideas on 'the mystery of capital', Hernando de Soto has described the economy as a river flowing from a mountain lagoon. It may be obvious to the outside observer that there might be edible fish in that river, or that s/he can find enjoyment from swimming in the stream. Nevertheless, beyond those attributes, de Soto notes another property of the lagoon:

> *What is not obvious is that when the weight of that water is released, then potential energy becomes kinetic energy, and eventually it becomes mechanical energy, and electrical energy that can light up a whole city.*[37]

This, of course, can only be achieved if there are special contraptions for tapping this energy – tools for 'extracting' the 'hidden values that are inserted in objects'. In other words, this energy is 'squandered' unless there is a turbine there to convert the intensive flows of matter-energy into other forms of value. Indeed, Bataille construes technology as a means to harness more of the superabundant energy that flows through the societies on the crust of the earth. Thus,

> *human activity transforming the world augments the mass of living matter with supplementary apparatuses, composed of an immense quantity of inert matter, which considerably increases the resources of available energy. [...] The techniques have in short made it possible to extend – to develop – the elementary movement of growth that life realises within the limits of the possible*[38]

Hernando de Soto argues that key tool for the extraction of this hidden value is a solid framework for property rights: Granting property for the poor supposedly unleashes 'the mystery of capital'. However, for the purposes of this text, this approach is less useful. First, the urban magma described above – memes, norms, and elements of 'germ capital'[39]– that circulate in urban centres cannot be easily captured by legal contracts. Secondly, and more importantly, the introduction of such rights also amounts to an introduction of scarcity into the system. When tapping intense flows of urban magma, it is therefore preferable to delay the conversion of energy into money – a resource defined by

35. Kay (2003: 65)
36. Bataille (1988: 29)
37. de Soto & Leonard (2003)
38. Bataille (1988: 35-36)
39. Lepinay (2007)

its very scarcity. Thus, the contraption for citizens wishing to tap the flows of urban magma has to work on another basis: Devising urban turbines for city dwellers has to be about something else than granting them property rights, or about means of 'monetising' flows of urban magma.

The link between money – a scarce resource – and the superabundant flows of urban magma is nevertheless interesting. One way of charting this link is to couple the idea of microfinance with urban turbine generation. Imagine the following experiment: a number of urbanites get a small amount of money as seed capital for the creation of saleable goods or services. These goods or services will be peddled on a given day, during which the participants are instructed to tap existing flows and turbulences in the city – an amateur football match, a queue of excited clubbers, a reading at a poetry club, a narrow passage populated by a stream of Saturday *flaneurs*. A number of questions arise: What flows and turbulences are tapped during this exercise? What additional vortices are created? By what conversion rates are money transformed into energy, and transformed back into money? What is the global (as in 'overall') result of this injection of microfinance?

Key to such an exercise is the mapping of these interventions, and the tracing of the associations brought into play. As already hinted, the aim of this activity is not so much to measure the intensity of the flowing matter-energy, tally the exact time when the phase transition from laminar to turbulent flow occurs, or quantify how much exergy work is locked into emergic urban structures. Indeed, the superabundance of energy implies that such measurements lead us to focus on the wrong parts of this system. As we know from Deleuze and DeLanda, morphogenetic processes are to be understood primarily through the study of intensive – not extensive – properties, which are often more difficult to capture in practical experiments. Thus, the point is to treat this urban reality *as if* it could be measured. This 'natural science inspired' experiment is thus an effort to convey a sense of realism regarding the flows of urban magma that causes cities to emerge.

The links to the natural science is, however, also a way to explore how urban phenomena occur. For instance, fluid dynamics have a taxonomy for describing the phase transition from laminar to turbulent flow. At a certain point in an intensifying flow, marked by the 'critical Reynolds number', the inertial forces of the flowing medium takes the upper hand of viscous forces, triggering the qualititative shift in the structure that is called turbulence. What does this mean in an urban context? How can the speed and the mass of the flow be increased, how can the viscosity of the flowing matter be decreased – even in smaller-scale

$$Re = \frac{\text{Dynamic pressure}}{\text{Shearing stress}} = \frac{\rho v_s^2 / L}{\mu v_s / L^2} = \frac{\rho v_s L}{\mu} = \frac{v_s L}{\nu}$$

cities?

Thinking about the city in these terms – in a *non-metaphorical* manner – can lead us towards other forms of urban development methodologies. When we write 'non-metaphorical', we mean two things: First, that *the same* abstract machine may be actualised in different settings (such as the formation of sandstone and the formation of organisational hierarchies, as discussed by DeLanda); secondly, that these flows of urban magma exist no matter we humans say about them. The words we humans use to describe them can indeed be seen as discursive elements that is fed into such flows, but nevertheless – urban magma ought to be seen as a part of a reality that exists independently of the human mind. In other words, this is a 'realist' rendering of the becoming of the city.

The measurement of these 'quantum flows' of urban magma is a means to convey a sense of this reality of matter-energy. As mentioned above, the point is not that we purport to capture *all* of these flows through measurements – the point is to think *as if* these quantum flows can be measured. However, on a more pragmatic level, we also hope that these measurements can fill a practical purpose. Hence, using notions such as emergy, and measuring the flow of urban magma (in kilogrammes, Joules etc.), new urban development methodologies can emerge.

These methodologies may complement our traditional palette of planning tools, enhancing the emergent properties from these untapped urban flows at low scale. The result may well be a multitude of small urban turbines, running in a distributed network, generating more power, turning more people on – in Bochum, Gothenburg and elsewhere.

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Illustrations

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