

The Problem of Scale: The City, the Territory, the Planetary

Doctoral Dissertation
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INTRODUCTION

In recent years theoretical thought on scale has been neglected. Given its supposed centrality to the discipline of architecture - a key concept in any standard introductory textbook - one would expect to find evidence of sustained reflection on the topic.¹ With some exceptions, this evidence is difficult to locate. Where scale has become the subject of inquiry it has tended to assume a specific, marginal form, such as investigations of analogies between scale in building and scale in music.² Despite often being used as a synonym for size, as in 'large scale' or 'small scale', the terms historical richness and ambiguity suggest a more complex payload. Very few studies make useful attempts at a definition, and often mix conceptual distinctions, such that scale refers to extent, level and hierarchy all at the same time.³ The use of scale in disciplinary procedures, instruments and representational practices draws less intellectual attention within contemporary scholarship than it does in its relation to ego-integration, color theory and musicology, to name some recent examples.⁴ It has certainly not aroused the

same sustained scrutiny devoted to terms like 'form' or 'function', though its use could hardly be less ubiquitous.

In the introduction to a recent volume, *Scale: Imagination, Perception Practice in Architecture*, Gerald Adler maps out what he considers to be the two critical shifts in the architectural notion of scale.⁵ The first is the increasing reliance on mediated forms of information; the second is the apparently 'scale-less' properties of virtual design tools in which differently sized elements co-exist. Adler makes this argument because he sees the relation between the proportions of a drawing and the body of the draughts-subject to be more stable than the dynamic, variable geometry appearing on a designer's computer screen. Following this argument about perceptual instability, contemporary design software and the consumption of digital imagery produces a shortened mode of attention that has less time to 'fix' onto its object. The result is that a supposedly intrinsic and 'natural' relation to scale, as formed under the previous mode of production, is thought to be lost, taking the body's ability to form a sense of scale along with it.

Outside of architecture the situation is different. During the last 30 years in geography, scale has been subject to a vigorous re-conceptualization, becoming one of the discipline's most contested and relevant terms.⁶ Technologies like Geographical Information Systems (GIS) have attracted a fair degree of writing and critique within geography, though geographical scholars have rarely called for a re-evaluation of scale in the age of GIS. Both disciplines point to different reasons for reconsidering scale in the present moment. Where Adler looks to an intrinsic shift in the making of architecture, geographical writing looks to an extrinsic one: globalization.⁷ Perhaps the difference between the two does little more than point to a dependency within architecture on the techniques of production and its continual projective stance. Nonetheless, it is with the advent of financial integration, free markets, increased mobility, telecommunication, mass urbanization and far-reaching environmental change - in short all those processes that emerge under the name globalization - that geographers have been forced to reassess the ways in which scale and scalar concepts frame geographical phenomena.

Few would argue that these processes have left architecture or urbanism untouched. On the contrary, the sense that human settlement is undergoing a period of intense transformation is now a common point of view within architecture and urbanism, and yet there has been little attempt to conduct either a historical investigation or theoretical speculation into the notion of scale, which would be adequate to this transformation, leaving something of a theoretical vacuum. There is little value in trying to date the beginnings of globalisation (in many ways it is thousands of years old). However, it is clear that a paradigm shift occurred during the 1960s and 1970s. To study urban development since this period, as this thesis intends to do, is to enter into a network of dispersed causal links that tie together manufacturing hubs, care chains and labor markets; it is to pass through a multi-layered matrix of conflicting legal jurisdictions, to witness the trans-border migration of people, of animals, of pollutants and of remittances. The prevalence of these complex spatial entanglements poses difficulties for a discipline that has naturalised scalar concepts drawn from the Renaissance and later from the nineteenth century. This thesis will address these difficulties in architecture by constructing a concept of scale that works through these contemporary conditions.

The difference in the treatment of scale in architecture and geography suggests a historical change in the concept's significance. From the Renaissance onwards, scale was a humanist concept guiding the emanation of proportion from man to world and establishing man as a correct and proper measure of all worldly things.⁸ During the nineteenth century scale underwent a significant transformation in the relation between the individual and the series, or between the ideal and the population. The gradual transformation of the concept of human scale is indissociable from the processes of industrialization and the associated divisions of labor in the middle of the nineteenth century, when questions regarding efficiency of movement in the workforce begin to be addressed through a scientific paradigm. Moreover, during this period the body begins to be constituted through the frame of a statistical project. Ergonomics and its relationship to mass production signaled an extension in the idea of proportion: what was fixed to a

single and ideal specimen shifts to one in which proportion is fixed to a mean drawn from a population. What emerges is a relationship between the series and the individual in which the ideal measure of one thickens to form a statistical bandwidth enclosing all.⁹

The scientific study of the proportion of the human body (or anthropometry) emerges from the need to bring large collections of people, mainly workers and soldiers, into functional and repetitive contact with tools. In order to optimize both productivity and human well-being, the distribution of bodily proportions and the functional capacity of the limbs in human populations provided powerful techniques for calibrating human activity to the various procedures, devices, instruments, and spaces that characterize modernity. Ergonomics is evidence of what Lorraine Daston and Peter Galison have called 'collective empiricism' - a term that describes processes in which separated sites of knowledge production establish conventions allowing for consistent measure and assessment.¹⁰ The results of this operation are cumulative procedures for the production of truths about the body in which diverse areas of investigation - say the work place or the barracks, are made visible through a consistent epistemic frame. The cumulative effect of this project is a statistical ideal, an ideal that begins to govern routine correlations between human postures, space and tools. An epistemic frame refers to the convergence of a form of knowledge on phenomena, such that a phenomenon is made known and available for action. This process of convergence draws together different types of knowledge in a collective project that aims to individuate a model or other type of representation. Through various forms of data gathering, representation, comparative analyses and testing, this collective empirical effort moves away from one type of idealist argument and begins to be formed and guided by a specific 'epistemic virtue', namely the concept of 'objectivity'.¹¹ The individual capacity of human movement understood collectively and inscribed within a scientific body of knowledge replaces one type of ideal diagram with another. The scalar correlation is no longer drawn from an unchanging essence; instead it emerges from the relation between any given task and the amount of expended energy needed to complete it. A fixed Renaissance ideal is complemented by a

regulatory one, one that takes the form of an open relation governed by ideals of 'fit' or 'efficiency'.

In an analogous way, metric tables and charts based on the proportion of bodies, vehicles, and other common architectural elements such as chairs and desks have become standard features of architectural practice able to dictate maximally efficient arrangements, and so forming ready-to-hand references for decision-making. These 'objective' conventions conceal values behind their seemingly neutral appearance and widespread acceptance, and so open themselves to critique on a number of fronts. Firstly, on the grounds of their claims to normativity, that they are in fact socially or culturally biased and/or constructed; secondly, on the grounds of their inherent conservatism, in that they promote repetition and uncritical deployment; and finally on philosophical grounds, in that these references always presume the existence of a known subject that exists before the 'fit' with the task or object. While there is validity in these critiques of convention and standardization, this thesis will turn its attention to the processes through which these procedures of knowledge production repeat a specifically empirical and collective effort common across architecture, in which scale is able to take specific sites of knowledge and produce generalizations from them. In the same way that regularities of posture and routine become inscribed through anthropometry into work and domestic space, in the everyday practice of architecture, scale allows regularities in the morphology of cities, of infrastructure and of building types to be compared, so that deductions can be made across different locations. Though humanism and ergonomics describe the basic contours through which human scale is still understood, the communicational dimension to the scalar convention produces an anonymous disciplinary knowledge that exceeds the limits of either.¹² In other words, the slow, cumulative drift of scalar conventions as they build on top of the other produces both momentum and inertia. Reinforced through repetition, bound together by habit, conventions drift, influenced by - but never wholly reducible to - the values that have informed them. Though these values have been humanistic since the Renaissance, initially inflected through universal ideals and empirical ones thereafter, the drift of the collective disciplinary convention takes on a

form of autonomy from its constituent ideas. This autonomy radically undermines the agency of humanism within the discipline since it must contend with an impersonal force that is collective and anonymous.

Exhuming this anonymous collective agency plays an important role within this thesis, bringing forth implicit values behind natural facts and contingencies behind necessities. In this sense, the thesis takes on a classical position of critique towards the construction of the convention of scale. This critical aspect of the thesis is important only in so far as it opens up some doubts and uncertainties regarding the use of scale and its naturalization within architecture. The more important question that is addressed here is how to move from this initial critical opening into something more constructive, both in conceptual and pragmatic terms. If neither sacred geometries, the body, its creativity or experience can ground the beginning of thought on scale then what can? If scale emerges from the conditions that are non-human as much as human, anonymous as much as individual, the question that remains is how to understand the genesis of scale from these conditions? This thesis answers this question by proposing a new idea of scalar individuation.

This schema explains the formation of scale as an epistemic response to an ontological provocation. Part I of the thesis (comprising of this introduction and the first three chapters) establishes the main philosophical contours within this debate as they surface from a history of ideas within philosophy and science. Grappling with questions of complexity in nature, Part I tracks specific currents within these fields in order to foreground epistemic shifts and realignments in the concept of scale. Implicit in this argument is that scale is both *ontological* and *epistemological*, that is, it refers to things and behaviours in the world, and also to the forms of knowledge that make those things available for understanding and action. This thesis is not a critique of the discourse of scale in architecture. Nor does it simply recognise that other disciplines, most notably geography, have been developing more theoretically rigorous accounts of scale. Rather, the thesis displaces architecture from a privileged historical relation to scale, and

repositions the way in which scale might be usefully understood in relation to the organisation of material phenomena. It situates questions of scale relative to other disciplines whose relation to scale is itself a question of the scale at which material phenomena appear and are understood.

The thesis is thus organised in two parts, with three chapters in each. As described above, Chapter 1, *The Scale of Matter*, and Chapter 2, *The Scale of Truth*, set out the main philosophical, scientific and epistemic points that are necessary to understand the reconceptualization of scale deployed in the case studies. Chapter 3, *Disciplinary Conflict*, applies this re-conceptualization to the disciplinary questions of geography as it can be said to be a historical successor to architecture in terms of the relevance of this re-conceptualization of scale. This is followed by three case studies that span differently scaled phenomena in order to demonstrate the utility of this re-conceptualization in historical and theoretical terms.

The central hypothesis of *The Scale of Matter* is that individuation has been obscured, covered over and poorly understood because of a hylomorphic conception of materiality. Therefore, individuation, if it is to acquire its full force as an explanatory mechanism, must settle accounts with the problem of hylomorphism first. Beginning with Aristotle, this chapter shows that in each case, whether it is Descartes' mechanistic model of nature, or the paradoxical status of self-organization found in Kant, a transcendent operator is understood as the cause of change in nature. The hylomorphic schema that is first articulated clearly by Aristotle splits form from matter, such that the former will always impress itself on to the later. Matter, rendered inert, now seeks shape in the command of a creator or the mysterious vitality of some unknown life force. It is important to begin with this philosophical material since what is at stake here is not a comprehensive history of the concept scale, which would have entailed an entirely different set of references, not to mention arguments. Instead, what is being introduced is a proposition, an idea of scale which will come to play an important role in the relationship between complexity and the forms of knowledge that emerge around it. A

central theme is the relationship between materiality and representation, a theme that is opened by Aristotle in the separation of matter and form, and finds a distinctly moral universe with Kant. This theme will be picked up again in the second chapter in which the mathematical model begins to play the role of mediator between complex material systems and the acquisition of knowledge.

It is not complex systems, or complexity theory as such that is of interest here. If scale is always a specific way of *framing* the world, of establishing certain limits and conventions that organise knowledge around phenomena, then it is no surprise that what writing there has been on scale, has always focussed on the specific forms and disputes over these conventional frames.¹³ Instead of pursuing this specific historical mode of inquiry, this thesis sets out to examine the conditions of possibility for the emergence of scale. The intention here is to establish a clear conceptual and philosophical account of the genetic process by which scale is specified. The issue of complexity returns not so much as a subject in its own right, but as a certain impetus within the natural world that spurs on attempts to formulate specific kinds of explanations. It is this motor between the provocations of complex conditions, be they natural, economic or political, and the attempt to secure a reference for knowledge and action that forms the focus of this discussion.

This is not a thesis about 'scale in architecture' in any conventional sense, if convention can be said to dictate an analysis of a certain kind scale like a building, or a system of proportion, say Le Corbusier's 'modulor'. Instead, this discussion begins with a more fundamental line of inquiry, investigating the framing, formation and organization of knowledge around matter, such that architectural concerns have historically coalesced at a particular scale as a result of the questions asked, not because they are inherent to architecture as a kind of natural property. In some ways geography as a discipline supersedes architecture historically by asking questions of scale at a *different scale*, that is, attending to the complexity of matter through a different epistemological frame, and in a recognising the historical transformation of how scale has been understood. The

importance of the present thesis then, is to re-examine architecture's reflexive adoption of its current scale of practice as natural rather than contingently determined. It is the hope that this might better adapt this discipline to the increasingly complex conditions it now faces.

The Scale of Matter concludes by introducing a key theoretical concept: the idea of individuation. This has been described by Gilbert Simondon (though the concept predates this work in important ways) and was later developed by Gilles Deleuze. If the conceptual history of ideas evolved alongside evidence of change found in the natural world, set in motion by the mysteries of plant and animal life, industrialization, mass production and the increased technologisation of life give birth to a new set of concerns. In this regard, Simondon is important in a number respects, firstly for formulating a rigorous concept of production as 'individuation', but perhaps even more importantly, for dealing with this concept in relation to technical and social registers, Simondon considers the individuation of technology as well as the collective individuation of subjectivity, with the ontological, epistemological and psychic partaking in the same immanent economy.

The Scale of Truth turns to the problem of epistemic individuation. Manuel Delanda's seminal text, *Intensive Science and Virtual Philosophy*, is critical with respect to the preceding themes. It sets out a point-by-point exposition of the mathematics operating in the kinds of open systems described in Chapter 1, marrying them to a series of philosophical concepts formulated by Gilles Deleuze. *The Scale of Truth* will focus on two key aspects of Delanda's work. The first is the introduction of a nested scalar model in which like parts interact to form emergent entities, in what is typically called a 'bottom up' process. The second aspect is the linking together of philosophical and scientific claims for truth. Despite the repeated call for concrete historicisation within ISVP, despite strenuous attempts at avoiding essentialist or atemporal accounts of nature, and despite setting out to present a dis-unified and heterogeneous image of scientific practice, Delanda still abides by an ahistorical understanding of scientific objectivity. That is, in

the terms used before, Delanda fails to attend to the anonymous discursive drift that lends scientific inquiry its historical relevance.

The historiographical critique of Delanda's use of science depends on ungrounding the security that scientific discourse lends to philosophical claims. In order to destabilize the certainty of science and its 'transcendental objectivity' within Delanda's work, *The Scale of Truth* will turn to Deleuze's critique of the 'Image of Thought' in *Difference and Repetition*. The 'Image of Thought' provides a number of important tools for rethinking individuation. First, it describes the genesis of concepts before they solidify into consensus or convention. Second, it provides a means for understanding the claim for truth as immanent to a field of other questions that lend it relevance. Third, it proposes a model of linked phenomenal and psychic individuation. Finally, it conceives of epistemology according to a vector of approach, a process rather than a pre-given frame.

Deleuze's critique of the 'Image of Thought' is complemented in important ways by two books published by Foucault in the preceding years: *The Order of Things* and *The Archaeology of Knowledge*. Though broader ontological claims hover in the background, both Foucault's books are more explicitly concerned with uncovering the conditions of knowledge and determining that matrix against which the relevant and the irrelevant, the general and the singular in any given field might be assessed. Most importantly, Foucault discovers how this matrix – what he will call the historical *a priori* – drifts over time. Occupying a position in a genealogy of French thought concerned with science and the critique of Cartesian rationality that begins with Bachelard and Canguilhem, Foucault's presence within *The Scale of Truth* allows for a historicisation of the scientific discourse that Delanda relies upon. Delanda attempts to bond philosophy to science since he reads philosophy *as* science. This is not to suggest that philosophy is a more original guarantor of truth, rather it shows that the contingency of truth differs in unique ways across both disciplines.

The final thinker to be taken up in *The Scale of Truth* is Alan Garfinkel. Writing as a social scientist critiquing reductionist forms of social explanation, Garfinkel explores the semantic structure of linguistic explanations, especially the way causality is expressed through statements. The thoughts of Garfinkel have much in common with the aforementioned writers, though he is neither as well known nor as prolific. Garfinkel accomplishes two things that make him critical for the argument in this thesis. The first is that he proposes a rigorous account of explanatory scale, so that a clear correlation can be established between ontological and epistemic registers. The second is that he sets out a semantic argument for an irreducible uncertainty or ambiguity in any form of explanation. Both Garfinkel and Delanda detect a form of objectivity in explanation, especially the scale at which the explanation is posed. And while both Garfinkel and Delanda commit to the existence of an indeterminacy within explanation – which forms the counterpoint to the objective indeterminacy of the phenomena being explained – Delanda does not historicize the question of objectivity as such. In other words, he misses the radicality of Deleuze's concept of the problem and Foucault's notion of the historical a priori. As Foucault reminds us the distribution of what is relevant and irrelevant applies to questions themselves as much as answers, since they form the conditions of possibility for what will count as relevant knowledge in any given epoch.

These first two chapters, *The Scale of Matter* and *The Scale of Truth*, set out and discuss the main theoretical aspects of the proceeding argument, illustrating that the ontological and epistemic domains are linked together through the problem of scale – a link that is explored through the critique of hylomorphism. Chapter 3, *Disciplinary Conflict*, initiates a move away from a conceptual terrain to explore the way ideas around scale have begun to affect geographical disciplines, since in an extended process of critique, many of the aforementioned issues and indeed some of the same philosophical and theoretical resources have come to play an important role. This is not to say that any consensus can be said to have emerged on what scale means or what it should be applied to.¹⁴ In fact, it is safe to say that with some exceptions, the general sense within geography is one of exacerbated confusion. Though scholars might not agree on how to

describe scale's basic parameters, even holding differing points of view as to scale's epistemological or ontological status, there is widespread consensus that with the advent of globalization and especially the expanded networks and entangled causal chains that have come to characterize it, scalar categories are due for reconsideration. The result of this is a re-evaluation of some of the basic parameters and descriptors used to make scalar claims, putting into doubt the coherence of such accepted terms as 'local', 'urban', 'territory', 'region', and 'global'.¹⁵

This sense of uncertainty brings into question the definition of scale. Does it refer to extension? Does it allude to an epistemology, method, or network? Many scholars agree that scale is plastic, unstable and subject to continuous transformation. Furthermore, scale is not pre-given, despite the relative stability of the terms used to describe it. Instead it constitutes an arena for creative political action, a 'geometry of power' that can be mobilized by different actors according to different 'scalar practices'. In this way scale is brought in to re-frame a myriad of geographical questions, such as workers' disputes, indigenous rights claims and environmental controversies. More recent work drawing on concepts from Deleuze and Guattari, Bruno Latour and Manuel Delanda have been employed by geographers to decouple scale from its metaphorical binaries such as ascent or descent (in the case of top-down or bottom-up). Even more radically, it is argued that scale can no longer be understood in terms of extension or even hierarchy.¹⁶ This history of reformulation, now more than 30 years old, has no equivalent in architecture or urbanism. Obviously, the demands placed on a concept like scale within architecture or urbanism, as compared with geography, are different. Though they might begin with roughly analogous phenomena such as mass urbanization, decentralization or densification, they are oriented towards very different purposes. The projective impulse of architecture means that scale will always be folded into routines of work directed towards design. Although an ambition for social action may be common to both, social action as it appears in design intervention cannot be said to reflect social action as it appears through the mobilization of a labor force or claims for indigenous rights. Nonetheless there is something within the constructive idea of scale in architecture

and the nuanced account of social, environmental and political complexity within geography that begins to resonate. *Disciplinary Conflict* will conclude by summarizing the main pre-occupations and challenges around contemporary geographical writing on scale before counter-posing them to the theoretical propositions put forward in the preceding two chapters.

Part II of the thesis will work through a series of case studies that deploy the aforementioned theoretical propositions at three scales: the architectural, the territorial and the planetary. Each case study will explore a specific historical event, a paradigmatic moment in which the individuation of a problem emerges alongside the phenomena it wishes to frame. These events include spatial co-existence in Lebanon during the post-war period, territorial management in Chile under Latin American socialism in the 1970s, and conflict over carbon capacity and temperature increase in global climate forums. These case studies individuate three specific forms of scalar knowledge: architectural type, cybernetic management and climate models.

One of the primary purposes of the case studies is to track two histories: the evolution of the phenomena and the evolution of its epistemic frame, understanding their disposition to each other as a unique form of relationality or accompaniment. The abstract nature of this conceptual schema could lend itself to any one of a number of case studies. The decision to select three situations characterized by political instability is because such situations provide an opportunity to track the formation of scale from the moment of confrontation with a nascent problem, through to its stabilization as an epistemic frame, and finally to its final frustration and frequent failure. These three stages, compressed into differing time periods in each of the following case studies open a window into scalar origins before they are established as convention.

These particular examples have also been chosen to reinforce the idea that there can be no simple commensurability across different scales. That is to say, there can be no general theory of scale, only a unique individuation of problems that will actualize in

different ways and at different times. The incommensurability between different scales thus suggests that examples should be selected not for their agreement, but for their differences, even if they all express similar tensions between calculability and models, and even more so if they all conceal complex political pre-suppositions in their quantitative blind spots. If there is a broader intelligibility that is to emerge from the case studies, it will not illuminate a general rule through specific moments, but a universal problematic expressed in paradigmatic moments.

The initial case study, *Spatialising Co-existence*, turns to a moment within the formation of the Lebanese state in which a high-modern architect, Oscar Niemeyer, was commissioned to design a new Fair and Exposition Site in the Northern Lebanese city of Tripoli. This project is unique within the context of Lebanon and the Middle East for attempting to produce - on a large scale - a new national imaginary using modern architecture as a vehicle. The commission, the project, and its subsequent interruption due to the civil war reflected the way multiple scalar demands exist in a state of conflict. From the geopolitical ambition to signal a post independence state, to the urban ambition to improve the efficiency of the city's infrastructure and catalyze new forms of development, to the scale of the newly civilized subject called into existence through the exposition idea and its spatial manifestation, a series of distinct scalar problems faced the project. Each problem solicits a specific epistemic model from the architect - the abstract vocabulary of high-modernism, the freeway model of Le Corbusier's plans for Paris, the neutral datum and civic promenade of an exposition or fair. The architecture and the urban plan can thus be understood as an attempt to mediate between these often-conflicting ambitions and wrestle them into a unified form. Through a close historical reading of the context behind each one of these ambitions, this case study will suggest that the possibility of unity within architecture and urbanism is always undermined by differences between scalar problems, despite the aesthetic consistency these differences fall into.

The second case study examines an event in the 1970s, as the government of Salvador Allende struggled to rally the productivity of the newly nationalized Chilean industries. A management specialist from the United Kingdom named Stafford Beer was invited to implement a territorial scale system of monitoring and feedback in order to 'tune' the performance of the economy. The resulting network of communication infrastructure stretched across Chile's entire landscape, linking a dispersed series of industries to a central control room in Santiago. The Chilean experiment in cybernetics is a paradigmatic moment when the cybernetic diagram that animates advanced liberalism went live. The mathematical modeling of the Chilean society and economy proceeded according to the latest scientific notions of self-organization, non-linearity and complex feedback, all of which could be calculated into a series of equations designed to regulate Chilean society and maintain its homeostasis. The experiment is paradigmatic for two reasons: firstly, it proposed a scale of governance both in time and in space that was unprecedented; secondly, the system's fragility directly related to the unquantifiable political pre-suppositions that were already growing around Allende. This case study will recount both the dramatic individuation of a new territorial ambition in Allende's Chile and the concerted scientific effort that went into it, as well as the fatal blind spot – the objective indeterminacy of any complex system – that finally brought this cybernetic fantasy to a halt.

The third and final case study explores the 2009 Copenhagen Climate Summit, especially in relation to how public attention focused on two questions. Firstly, would there be an accord or not (would it be binding and to whom)? Secondly, what would be an acceptable average global temperature increase (would it be 2 degrees, 2.5 degrees, 3 degrees etc.)? At stake in this contest is a complex scalar calculus involving differential heating, historic responsibility for climate change, future access to carbon and therefore to industrial progress, as well the significant impacts caused to migration due to the increase in temperature. This calculus is orchestrated, managed and processed by the largest collective scientific project in human history: climate modelling. The individuation of climate phenomena through computational modelling forms the

backbone for arguments behind organizations such as the United Nation's Intergovernmental Panel on Climate Change (IPCC), The inherent complexity of modelling non-linear systems at multiple scales forms one dimension for importance of climate models. The other is the way knowledge from climate models enters into public discourse, especially in the kind of questions asked of the model and the scale at which the answers are given. This case study will conclude by pointing to the way mono-scalar arguments about temperature increase conceal important political pre-suppositions.

Taken together these three case studies fit within an urban, territorial and planetary series of scales. However, it is one of the primary aims of this thesis to demonstrate the way in which this categorisation of scale – using descriptors likes 'urban', 'territorial', or 'planetary' - bundles together problems without any specific dimensional relation (whereby the planetary is 'bigger' than the 'urban' and so on). The complex entanglement of the problems bound together by these deceptively simple names relates to issues both near and far, strong and weak, large and small. Every phenomenon is as big as the planet if only the networks of alliances that radiate out from them are tracked far enough. The delimitation of this expansive network of links is the job of scale, to allow for the genesis of a frame around the problem, rather than arbitrarily superimpose one from conventional dictates.

In broader terms, the ambition of the following is to address an impasse facing contemporary architectural and urban practice as well as pedagogy, the problem of complexity. The notion of complexity is used more and more as a sign that the material conditions of architecture and urbanism, being the city and the environment, now pose challenges that are of such a wide, heterogenous and interconnected nature that the possibility of intervening in, and transforming them verges on impossible. Complexity becomes a short-hand for situations in which architecture and urban design become radically unmoored, unable to formulate a clear line of inquiry nor a space for action within it. The conventions that have accumulated in the body of the discipline like sediment seem ill equipped to cope with the challenges posed by increased urbanisation,

globalisation, environmental degradation and exacerbated disparities of wealth. At the very moment in which the amount of built mass being produced to house human beings is at its most unprecedented level, the discipline has retreated into ever more solipsistic exercises and irrelevant experimentations. Both the practice and the body of knowledge of architecture and urban design attempt to play catch up to a condition that is racing ahead of both. Not only has the decline of the welfare state model led to an abandonment of large scale intervention within the city, a practice that is now the sole preoccupation of corporatist or one party states, but the very existence of this scale of intervention, when it does come to pass, is increasingly indebted to private interests with the expertise to manage the risks entailed within large scale urban intervention. In this situation, the question of scale becomes of paramount importance, since it is the both the medium and the mechanism by which a complex problem comes into existence, is made knowable and finally amenable to transformation. In order for this to take place, a different sense of the term will have to be produced, one that no longer proceeds from the position of convention, taking its historical formation as a natural given, but instead attends to the emergence of new problems and the provocations they pose for knowledge and for action.

THE SCALE OF MATTER

1. Divine miscalculations

The displacement of a single electron by a billionth of a centimeter at one moment might make the difference between a man being killed by an avalanche a year later, or escaping.¹

Democritus used to annotate atoms by letters of the alphabet. The elementary, indivisible components of matters had to be understood in analogy to the elementary and simple components, which encode the sounds of language.²

This chapter investigates the idea of an open and unbound system - a system with edges that emerge not as clear limits but zones of exchange and regulation. The future of an open system is always, by its very nature, indeterminate. Only through its actualisation does it become determinable.³ Biological mathematicians Giuseppe Longo and Francis Bailly argue that the impossibility of computing non-linear behavior in open systems can be attributed to the non-trivial difference between the continuous nature of

the phenomena, and the repeatable addressability of discrete points in the systems used to describe them. In every interval of approximation - between every zero and one - an incalculable quantity of matter swarms.⁴ Integers, letters, codes and symbols work as representations because they work as repetitions. An 'x' might refer to a variable quantity in an equation, but it will call on that value in a reliable way every time. Unlike the continuity of the material systems they are often called on to describe, the discrete character of numeric, linguistic or symbolic representations can be depended on again and again to perform exactly the same task. Matter, by comparison, cannot repeat with the same diligence and predictability.

The question posed by Longo and Bailly is how to measure behaviors that fluctuate below the threshold of measurability, which is why they argue for a strict partition between epistemic and objective complexity, or between internal functions and external conditions. Open systems can be made discrete (that is to say made known and computable) but only at the cost of predictability in the models used to describe them. For Longo and Bailly, it is possible to say that language and matter are incommensurable, or rather, that while computers can repeat, only God can miscalculate.⁵

Turing's quote sets into play a powerful spatial and temporal conflation, an electron and an avalanche, a moment and year. By bringing these radically different elements into proximity, he implies an affinity both in time and in space between events that seem disparate. Because the electron stands in for a binary unit while the avalanche stands in for a natural phenomena, Turing implies a relation between a form of symbolic knowledge and the world this knowledge sets out to describe, with the scale of one relating to the scale of the other. In their radical conflation, a different sense of scale emerges, one that reaches beyond the confines of spatial or temporal dimensions that are in common. It is the aim of this thesis to set out toward this conflated, uncommon sense of scale, such that bringing together events that do not share temporal or spatial coordinates will no longer be understood as an exception.

Scale is often overlooked, both historically and conceptually. It remains under-determined in fields such as philosophy and architecture. At the same time it is strangely ubiquitous as an implicit register and yet rarely explicated in its own right. Called on to explain the distinctness and coherence of biological processes by Giuseppe Longo and Francis Bailly, or the minimal yet critical difference between a symbolic representation and an event by Turing, scale works as a correlation between things, events, and the knowledge that forms around them. Scale is therefore always working between an ontological and epistemological register.⁶

Unlike speculation into, say, the nature of substances or primary versus secondary qualities, scale is not a typical theme for philosophical speculation. What speculation exists takes different forms in different eras, yet it always remains a primarily mathematical or geometrical concept. This genealogy, which stretches back to Plato, Aristotle and Euclid, is intensified during the Renaissance such that issues of scale or proportion within architecture at least, become the expression of humanist values par-excellence. This begins to shift during the seventeenth and eighteenth century when proportion begins to be instrumentalised through an empirical and functionalist discourse, rather than an ethical or cosmological one (evident in the work of Claude Perrault and Jean-Nicholas-Louis Durand).⁷ It is only during the twentieth century that debates around proportion return. This time however they will be severed from humanist principals and drawn into an argument about architecture's autonomy as a discipline, an autonomy that will be expressed through self-referential games of geometry.

Architectural debates on proportion tend to take place as arguments over measure, as specific *proportional* responses to intensive problems - be they theological, economic, ideological or technical. Such debates include the alignment of the microcosm with the macrocosm, the idea of harmony in mathematical intervals, the gestalt, the economy of repetitive and manufactured parts, the return to humanist principals, Le Corbusier's modulator, and the current interest in parametrization.⁸ Often used synonymously with scale, as a noun, proportion is defined by the Oxford English Dictionary as a "part, share,

or number considered in comparative relation to a whole". Also "the correct, attractive or ideal relationship between one thing and another or between the parts of a whole". Defined as a verb, proportion means to "adjust, regulate (something) so that it has a particular suitable relationship to something else".⁹ Intrinsic to this definition then is relation and value. The architectural arguments cited above take place because, at least until the late twentieth century, proportions are seen to directly embody values such that an argument over proportion was not just an argument over dimensionality but also a declaration of a world-view. The amputation of broad moral or ethical principals from proportion occurs in the mid-twentieth century in a reaction against humanism in the direction of autonomy.¹⁰ The present legacy of this push for autonomy however is a discipline more uncertain than ever as to its social and political value. This is a legacy this thesis aims to directly address by returning to the question of value, albeit under new terms.

The definition of proportion can be abstracted into a more diagrammatic form. Proportion works to establish a correlation between a measure and an aspect of the world according to a set of beliefs. This correlation has been influenced by different world-views with their attendant set of values, as in the aforementioned case of humanism. Is it possible to examine this diagram outside of its specific manifestations? Can an abstract model of the individuation of scale be formed? This thesis will argue that it is possible and that by doing so each scalar regime can be more clearly located within its own historical subconscious. It is the intention of this thesis to attend to this background and the problems that precipitate out of them. Scale emerges in relation to a problem, here; the problem takes on an ontological reality, being a precursor to, and forming conditions of, a possibility for scale.

Both forms of knowledge and the phenomena they take as their object are subject to contingent historical processes. The historicisation of conventions within knowledge is often obscured in their ready-to-hand use value, lending them the sense of being natural or transcendent objects. This is true for the concept of scale as well as the specific

conventions that go with it, such as drawing ratios. The intention here is to problematize this conventional use of the idea, not with the aim of replacing it with another more 'correct' version, rather it will be shown that scale is intrinsically problematic, a quality that incites address and rectification even if none is possible. More important still will be to show how this problem is produced, so that the scale and the problem are immanent. If the genesis of a problem is immanent with the genesis of scale, neither the problem nor its scale can be presumed. Instead, an account of their emergence will have to be given.

The following chapter begins with an investigation into the way philosophical reflection on science has been conditioned by hylomorphism. By starting here it will be possible to clarify the difference between a transcendent and immanent model of scalar genesis. Although the following account is presented in chronological order, this should not be taken to suggest a history in which each episode improves on its predecessor. On the contrary, it is the contemporary persistence of the hylomorphic schema within philosophical and scientific reasoning that induces us to retroactively select and confer relevance to episodes drawn from a complex and non-linear set of texts and events.

1.1. The hylomorphic schema

Aristotle's *Physics* set out the hylomorphic schema in clear terms. This chapter will begin its inquiry from principals found in *Physics*; first with the distinction between form and matter and second with his description of causality. *Physics* opens the door to a line of speculation that moves between science and philosophy, simultaneously asking 'what exists' and 'what can be said about it'.¹¹ It takes the form of a search for principals according to a logical method and dialectical structure, the search aims to discover and set out reasons for the evidence of change in the world. To begin with, Aristotle divides the world into two categories, first distinguishing between things from nature and things from art. Things from nature might be: "the animals and their parts... and the plants and simple bodies (earth, fire, water, air)."¹² Examples of things from art could include manufactured objects such as a house or a weapon. The second division Aristotle makes

is between motion and rest. Though seemingly straightforward, this second explanatory framework presents a difficult problem: how to distinguish between movement as displacement and movement as growth or development. The refinement of the response given (which is explained in more detail in the following extract) goes some way to explaining its resulting longevity as an explanation. In his commentary on the *Physics*, Aquinas articulates Aristotle's explanation in precise terms:

Since a thing acts only insofar as it is in act, the aforesaid inchoate state of form, since it is not act, but a certain disposition for act, cannot be an active. And furthermore, even if it were a complete form, it would not act on its own subject by changing it. For the form does not act, rather the composite acts. And the composite cannot alter itself unless there are two parts in it, one of which alters, the other of which is altered.¹³

Aristotle's separation of matter from action remains persistent within western metaphysics. In conceiving matter as passive with respect to an agency that can never belong to it, Aristotle constructs a philosophical model of morphogenesis that is hylomorphic ('hylo-' meaning '*wood or matter*' and '-morphic' derived from '*morphe*', meaning '*shape*').¹⁴ The practical legacy of this metaphysical split between matter and form reverberates in the separation between male and female, master and slave, form and content, information and substrate, DNA and cell. In short, it reverberates any time a binary is conceived according to active/passive identity. Matter, in so far as it is understood as a certain 'inchoateness of form' is not *in action*, but is only the disposition of something that must be *acted upon*. Matter cannot be said to be active, it is only the composite that acts. The composite is split into passive and active parts, one of which will act, the other, which will register that action. The situation is the same with regards to movement, which resides *within* those things in which 'there is an active principle of motion'. Conversely, with matter, whose proper principle is as the passive receptacle for this movement which it inherits from *without*. As Aristotle writes:

Now the principals, which cause motion in a physical way, are two, of which one is not physical, as it has no principle of motion in itself. Of this kind is whatever causes movement, not being itself moved, such as (1) that which is completely unchangeable, the primary reality, and (2) the essence of that which is coming to be, i.e. the form; for this is the end or 'that for the sake of which'. Hence since nature is for the sake of something, we must know this cause also.¹⁵

For Aristotle, matter is by nature passive, it awaits the imposition of form but cannot be the source or origin of an active formation itself. Matter is disposition, a passive tendency that can only take shape as it is seized by an external active tension (that animates it). The qualities of matter - it being hard or soft, heavy or light - will play a role in its movement or its development, but these qualities are only ever actualised by the active potency of a force that must agitate these latent possibilities, since the disposition of matter, for Aristotle, is always a passive potency.

In order to distinguish between displacement and growth a further passive/active distinction becomes necessary even though it will not be sufficient in itself to account for development. In order to resolve the question of development vis-à-vis change, Aristotle sets out in the second book of *Physics* to outline four accounts of causality that attempt to address this question. The 'four causes' being: material, formal, efficient and final.

The material cause is simply the material from which something is made or develops, such that clay is the material cause of a pot. The efficient cause might be understood such that the origin of change is in the knowledge possessed by an artist or an advisor. The formal cause is the pre-existing essence of a thing, an idealised template that serves as a model for actual development, as in the way a sketch serves as the model for a mural. The final cause is the 'telos', is that for which the sake of the change occurs, rather than temporal direction of development towards some conclusive state. It is sometimes understood as 'purposiveness' or 'intention'. Though even this interpretation of the term

comes under strain when the development of living beings is considered. One cannot say that an infant animal 'intends' to develop into its adult form, so it is better to understand final cause as the process of development toward some more or less regular state. What holds together these descriptions of morphogenetic development is that they locate the active agent or *motivating force* as external to matter. It might be said that with regards to the hylomorphic schema, what is real has no agency and what is an agent has no reality. To suggest then that the conspiratorial interaction of things in the world is the result of material tendencies, rather than transcendent forces, is to be critical of hylomorphism. To propose that it is within the realm of material interaction itself - in the interfaces, conflicts, resistances, flows and pressures that the material world is able to take on a form of individuality and life that is wholly its own is move toward an immanent account of change.

1.2. Transcendence - immanence

Within the Judeo-Christian tradition, the relationship between form and its genesis is conceived according to a divine commandment. This commandment might be said to operate in two related senses: the first is that the utterance of a word directly creates the world, the second is that this word brings order to a chaotic state or void.¹⁶ That said, the relationship between the production of something out of nothing and the constitution of some order or organisation out of a chaotic state poses a problem.¹⁷ By conceiving of chaos as a 'non-state' - an abyss of utter non-determination that awaits the transformational force of a command to arrive, creation remains caught between a formless void and specificity. The *word* or *logos* functions as original instruction. Critically, the '*word*' is not *of* the '*world*', it stands outside of both the manifest realm of things and the exigencies of time. The commandment is at once without location and atemporal. In the grace of this commandment the material world is born and the abundance of complex life forms in it is presented as evidence of divine benefaction.

According to this view, the material-terrestrial realm is conceived as both object-of, and subject-to the will of a creator. An immaterial spirit animates the unfolding of material life. And though it is risky to draw too many relations between diverse sets of beliefs, in everything from animism, to Christianity, the idea of a material world as an inert substance that only comes to life via the impulsion of a transcendental injunction is not uncommon.¹⁸

It is important to note that the hylomorphic schema extends beyond this theological register. The transcendent account of morphogenesis is situated at the very origins of contemporary scientific rationality, between the period in which Descartes began to conceive of non-human life as pure automata and in which Galileo and Newtown began the mathematical description of complex natural phenomena. During this period, the question of growth and development begins to acquire a mechanistic answer, such that variability and change in the natural world would proceed according to a clockwork model of forces and collisions where causes would always be transmitted through a physical point of contact. This mechanistic explanatory model marks a particular moment of unification between language and matter. Though both Turing and Longo assert the importance of a split between the two in the citations that introduced this chapter, this split, in both philosophical and mathematical terms, is a more recent phenomenon.

Turning to this later explanatory model, in a Newtonian conception of time, what is initially given is given for all.¹⁹ Change equals a mechanical transfer of force from one location to another.²⁰ The mechanisms by which these elements are displaced, and by which these forces are transmitted, already exist at both the start and at the end of the interaction.²¹ More importantly, reversing the direction of the interacting components can reverse any specific sequence of movements and translations since the systems forward and backward modes are time-symmetrical and indistinguishable. By reversing time (or the value for 't' in the equation) the process of interaction reverses. Time plays a purely functional, rather than productive role - shifting the parts with regards to one

another but having no effect on the structure or the organisation.²² As Ilya Prigogine writes: "Classical dynamics has been the prototype of the scientific approach. In French the term 'rational' mechanics is often used, implying that the laws of classical mechanics are the very laws of reason."²³

For Descartes, the mechanical transmission of force via the displacement of elements can be extrapolated from the limited cases from which it emerged – say the collision of two bodies – into an account of the functioning of nature. According to this argument all natural living beings – save man – might be understood as little more than complex clocks. This mechanical conception of life in which man – in his self-reflexive capacity – stands in solitude amongst other forms of life conceived as nothing more than automatons, repeats the hylomorphic schema, since development is reduced to mere displacement of parts according to a time-invariant sequence.²⁴ Matter has no active agency, a ghostly force inhabits the mechanism and propels it forward. Descartes makes the analogy between living beings and machines as follows: "It is no less natural for a clock to tell the time because of the various wheels it is made of, than it is for a tree to produce the type of fruit it does because of the seed it was grown from."²⁵

Here, Descartes extrapolates an idea drawn from the scale of a machine and finds in it a logic so compelling it might be applied universally. The universality he perceives within the mechanical schema compels him to reproduce it, this time as a general principle, applicable to all scales and to all phenomena. This enthusiasm for conflating one explanatory model with another will recur throughout history, reappearing in everything from biological explanations of the city (as in the Metabolists) to evolutionary explanations of art (as in Henri Focillon and his student George Kubler).²⁶ In Chapter 2, *The Scale of Truth* the sense in which these ready to hand metaphors form useful accounts of complex phenomena will be contextualised within the primarily Foucauldian idea of the episteme or historical *a priori*. Before this can be set out, important moments in this genealogy of hylomorphism must be described, especially its persistence through the biological sciences.

1.3. Invisible fluids, entelechies and protoplasm

For Descartes, the divine light of modern reason emanates from the "clear and distinct" articulation of parts and their mechanical relation.²⁷ A mechanistic universe is a constant-sum game; all that remains is to re-shuffle and recombine the atoms, gears, levers and wheels. Life is little more than interacting parts, development nothing more than their fortuitous connection: "When Descartes, the founder of modern philosophy, wrote that our ideas 'in so far as they are clear and distinct' must be true, he grounded belief in the existence of a God who could be trusted not to deceive us."²⁸ Hylomorphism implies that the projection of a plan and its reception in inert matter is an event that occurs in - but is not affected by - time. Time becomes a passive receptacle for the event as matter becomes a passive receptacle for force. However, the frustration with the mechanistic world-view espoused after Descartes and Newton hinges around the impossibility of conceiving of a machine producing its own parts, that is, a machine responsible for the production and organisation of itself or an offspring. In a move that will be repeated through history, the evidence of embryonic life will be marshalled to testify against the constraint and rigidity of life conceived according to the model of a machine.

In classical physics, change is understood as motion. Philosophically speaking, it privileges the play of already existing beings over the possibility of their becoming. Change is shuffling or the exchange of positions (as in motion for example) but it is not the calcification of bones or the development of limbs in a foetus. Development is not displacement, and so 'life' will eventually constitute a problem for mechanistic explanations. As Ernst Mayr notes:

The recognition that in the biological sciences we deal with phenomena unknown for inanimate objects is by no means new. The history of science, from

Aristotle on, has been a history of endeavours to assert the autonomy of biology, and of attempts to stem the tide of facile mechanistic-quantitative explanations.²⁹

The formation of life as a distinct and new problem can be traced to the dispute and opposition surrounding vitalism in the seventeenth century. Vitalism emerged out of a widespread scepticism and rejection of what was the commonly held mechanistic view of morphogenesis. While one might question his historical ordering of the problem, Mayr's summation of Vitalism's aims is useful because it speaks to the way a concept can - despite being incorrect in its conclusions, successfully pose the problem in correct terms:

Vitalism, from its emergence in the seventeenth century was decidedly an anti-movement. It was a rebellion against the mechanistic philosophy of the Scientific Revolution and against physicalism from Galileo to Newton. It passionately resisted the doctrine that the animal is nothing but a machine and that all manifestations of life can be exhaustively explained as matter in motion.³⁰

Born out of a negative reaction towards the promotion of reductive causal mechanisms, vitalism resorted to a number of vague and imprecise notions in order to account for the problems posed by life, problems that could not be answered through mechanistic understandings.³¹ The ability of an organism to evolve, to develop, to reproduce seemed critical to any understanding of life and yet it was precisely these things that could not be adequately explained from by the mechanical automaton. All manner of invisible fluids, entelechies, protoplasms and ethers were hypothesised to explain how matter might become animate.³² The scepticism of the vitalists was well founded and yet vitalism existed in an era prior to the discovery of natural selection. The intuitive critique of the mechanistic answer could find no basis in existing science. However, in formulating an opposition to mechanistic notions of development, the vitalists successfully reorganised the field of problems that would be taken up by

successive inquiries. The failure to produce a satisfactory account from the point of view of scientific discourse far from cancels out the very real success that would occur in the debate that is to follow, especially around developments in microbiology.

The problem of hylomorphism as described thus begins in a philosophical register - described through the work of Aristotle, especially his writing on causality in nature. This philosophical line of thought is in turn related to a diverse tradition of theological thinking, both of them sharing a transcendent account of creative development. It was also shown that far from being confined to metaphysical speculation, the hylomorphic split between matter and content also occurred within the scientific tradition of the seventeenth century and the biological tradition of the century that followed. This suggests that structures of thought repeat not just across different periods of time but across different bodies of knowledge. The following section will extend this analysis to show the way the problem of development and transformation poses difficulties within the distinctly moral landscape of Immanuel Kant.

1.4. Kant and the problem of self-organization

For Kant, the question of the organism's self-organisation poses something of a 'paradoxical problem'.³³ The question of teleological direction in the development of the organism is understood as an end or purposiveness in nature. Kant therefore needed to explain this development without basing it in either a 'blind mechanism' or design. Basing development in a mechanism could not explain the self-differentiation of development, nor could it explain the functional correspondence between developmental features and environmental necessity. In other words, recalling the critique of the Cartesian idea of mechanism; given that organisms are clearly adapted to their environment, how can the organism *as* machine account for this adaptation? Kant refers to the wings of a bird in order to explain the dilemma of adaptation:

So where the structure of a bird, for instance, the hollow formation of its bones, the position of its wings for producing motion and of its tail for steering, are cited, we are told that all this is in the highest degree contingent if we simply look to the *nexus effectivus* in nature, and do not call in aid a special kind of causality, namely, that of ends (*nexus finalis*). This means that nature, regarded as mere mechanism, could have fashioned itself in a thousand other different ways without lighting precisely on the unity based on a principle like this, and that, accordingly, it is only outside the conception of nature and not in it, that we may hope to find some shadow of ground *a priori* for that finality.³⁴

If nature operates according to an efficient cause in which the simple interrelation of co-existing parts is the only agent for trialling and retaining spatial forms and arrangements, then it would seem (according to Kant), that the fine calibration between functional performance and morphology would be directed by nothing more than the chance encounter between parts.³⁵ The probability that a small cell, let alone an organism, could accidentally self-assemble is astronomically large. The question then is how to understand development as finely tuned to environmental criteria without introducing an agent to direct the teleological change towards some end or final cause?³⁶ An account from the point of view of design cannot succeed in explaining the developmental characteristics of an organism, for an organism cannot be said to design itself, while to introduce a transcendent creator would be to explain nothing at all.

This question occupies a unique position in Kant's philosophical landscape, characterised as it is by ethical moral questions that double and reverberate with strictly biological ones. The question of ends or purposiveness is related to a corresponding current of ethical inquiry: "Although the idea of *self-purpose* is, strictly speaking, 'restricted to the sphere of the ethical' ...it possesses a *symbolic counterpart* in the phenomena of the organism."³⁷ Since Kant identifies the autonomy of the self with its ability to 'self legislate', the autonomy of the organism thus forms a 'natural complement'

to this specifically ethical or moral one. As has been noticed, this tension between the developmental evidence of directed growth and the impossibility of locating the director of this telos in either of its conventional categories (autonomy or heteronomy) produces significant tension.³⁸ For Kant, the category of autonomy would apply to beings capable of self-legislation directed towards moral ends, in its application and extension to the natural world, difficulties for his philosophical project are posed in that, in the organism – specifically in its teleological development - there can be no natural equivalent to the subject.

Organisms might be thought of as ends for themselves, they might be shown to be capable of desire and fully able to assert their autonomy - but this would be to grant the organism a sensible and conceptual apparatus, that is to say a life they it cannot have. On the other hand, to think of the organism along the lines of a system of parts whose interaction proceeds, according to the propagation of forces conditioned by mechanical law, would necessitate the introduction of a transcendent causality external to the system itself. In the *Opus Postumum* Kant formulates the problem as follows:

A natural thing which, as the movable in space, is an object of the outer senses (outer perception), that is, *matter*, cannot be self-organising through its own forces and form organic bodies. For, since this requires a composition of the material according to purposes, matter would have to contain a principle of the absolute unity of the efficient cause – which, as present in space, would be an atom. Now all matter is divisible to infinity and atomism, as a ground of explanation for the material composition of bodies from smallest parts, is false. Hence only an immaterial substance can contain the ground of the possibility of organic bodies; that is, matter does not organise itself, but is organised by what is immaterial. One is not, for that reason, entitled to assume this efficient cause to be a soul inherent in the body or a world-soul belonging to the aggregate of matter in general...³⁹

As indicated above, Kant subscribes to a notion of matter as lifeless and inert. In fact as Zammito notes; "there are few ideas Kant struggled to keep divided more than life and matter".⁴⁰ The motivating force that activates matter must itself be immaterial. The tension arises because Kant must exclusively reserve the category of 'life' for the human subject, in that it may exercise its free will and reasoning. How then would it be possible to reconcile the lifelessness of matter with the abundant evidence of self-organised behaviour. Furthermore, how to do this without disrupting the metaphysical partitioning Kant's system has worked so hard to erect.⁴¹

Kant moves to address this impasse by articulating a clear distinction between the domains of scientific and metaphysical speculation. The opaque inscrutability of organic development must operate according to mechanistic principals, but these principals are not accessible to determinative – that is, objective – judgement. The problem of development in the natural world properly belongs to the domain of reflective judgement. The reason for this is that reflective judgement might impute purposiveness to nature based on empirical experience, as in Descartes extrapolation of the mechanism from the scale of the machine. The difference here is that this imputation must remain speculative as to the objective criteria for morphogenetic differentiation, since only through the methodological operations of scientific proof and reasoning can empirical speculation on causation be admitted to objective judgement. Kant essentially sets up the disciplines of science and philosophy as two differently limited modes of inquiry. Science is concerned with the phenomenal world, not in terms of objective states, but in terms of the possibility that a rational framework for knowing about that world is possible. Philosophy is about the noumenal level which transcends the action of the intellect. This is *not* to say that Kant introduced a transcendent agent to account for the development of the organic world. Rather it points toward the inscrutability of a mechanism he takes to be wholly rational:

Design is ascribed to nature, i.e. to matter...[But] no design in the proper meaning of the word can possibly be ascribed to inanimate matter...Hence we

...speak quite correctly in teleology...without either making an intelligent being of [nature], for that would be preposterous, or even without presuming to place another intelligent Being above it as its Architect.⁴²

The problem here is that organic development operates as a complex mechanism that does more than simply transfer force between parts – it is able to make ends of their production. As Dawkins will come to write some 200 years later of Darwinism, which would finally and irrevocably transform these questions:

All appearances to the contrary, the only watchmaker in nature is the blind force of physics, albeit deployed in a very special way... ...Natural selection, the blind unconscious, automatic process which Darwin discovered, and which we now know is the explanation for the existence and the apparently purposeful form of all life, has no purpose in mind. It has no mind and no mind's eye. It doesn't plan for the future. It has no vision, no foresight, no sight at all. If it can be said to play the role of watchmaker in nature, it is the blind watchmaker.⁴³

1.5. Pitiless indifference

The pitiless indifference of selection is well captured in the analogy of a watchmaker, conveying both the activity of assembly and its lack of telos, the blindness of the action being both literal and conceptual, neither a visual or a mental image orienting assembly towards its goal. In the discovery of natural selection, Darwin locates the creative potential of life firmly within the resources of the terrestrial world. The reconciliation of *purpose* as it emerges through the morphogenetic development of complex life forms, with the simple chemical and physical interaction of matter, was always obscured by the sense that this calibration of complexity to function – as is the case in the oft cited example of the eye – seemed to be evidence of some intent that is

directed towards a goal, as seen with Kant. Darwin breaks the 'directedness' of biological morphology by demonstrating for the first time that to speak of a 'goal' with regards to biological life was only possible in the most relative and contingent of senses. Any argument regarding teleology that was not entirely immanent to the relation between species and environment could not hold.

Evolution involved a considerable random element; the idea that chance governed development was antithetical to an era that conceived of development as the teleological progress towards a goal. This sense of blind development was heresy - predictive outcomes were the only legitimate validation of any scientific theory.⁴⁴ Darwin is significant not just because of the Copernican displacement of divine authority but because for the first time a collective category (the species) is understood to have a relative autonomy from its parts with regards to the process of evolution. He ends the privileged position - not just of man vis-a-vis the animal - but more importantly of the individual vis-a-vis the collective. Now the creative possibilities of life would come to depend upon a population of which the individual member was only a part, the fleeting bundle of animate flesh endowed with 'life' being only highly elaborate containers for the transmission and propagation of genetic material.⁴⁵

Natural selection powerfully articulates the idea that development takes place through iterative repetition and difference, and that its subject is always both individual and collective. Evolution thus raises interesting problems with regards to the spatio-temporal development and progression of a series. Accumulation of genetic material over time operates as a ratchet mechanism that allows for the stabilisation of adaptations once they have been developed. However, it cannot be said to constitute an idea of transcendent progress. This is for two reasons: firstly, criteria for progress are immanent to the relation between the construction of the environment and the development of the organism. There is no absolute reference against which one could measure progress. Instead, it only ever figures in relation to the dynamic of fitness, which is always mutual or co-evolutionary. Before describing this co-evolutionary dynamic as either driven by,

or structured toward, a telos that is transcendent to the relation, it is important to note that any notion of optimisation is always a strictly local and immanent outcome.

Secondly, one can say that adaptations are as likely to become useless, as they are to become useful, causing organisms to slowly shed accumulated traits while simultaneously acquiring them. According to Richard C. Lewontin and Stephen Jay Gould, evolution proceeds through the contingent re-appropriation of traits that may have evolved independently of natural selection.⁴⁶ For Lewontin and Gould, the notion of adaptation lacks nuance and is over-applied. It lacks nuance because it fails to distinguish between, or often conflates, different levels of adaptation. It is over-applied because it is reflexively attached to any morphological development or trait as its only reason for being.⁴⁷ Gould and Lewontin want to paint a picture of evolution as a sort of contingent, opportunistic bricolage. To do this they must neutralise the dominance of adaptation and natural selection as the only explanatory framework for phenotypic development. They will argue that adaptations can arise as the consequence of other processes and not as the object of natural selection. Moreover, these ‘accidental’ developments that may at first provide no fitness advantage can be co-opted or appropriated later through what they call ‘exaptation’. Where adaptation would suggest a one-to-one relation between a trait (say bright plumage on a bird) and its reproductive advantage (visibility to a mate), exaptation suggests that traits subsist within the organism as a kind of developmental inertia even if no more advantage can be gained from them. This vestigial trait can however be re-appropriated in creative ways by the organism, directing its evolution according to new forces and constraints, the example they jokingly cite is the forelimb on the Tyrannosaurus Rex, a withered leg reduced to erotic foreplay, though human wisdom teeth would also fall in this category.

In order to make this point more clear, Gould and Lewontin turn to an architectural example, the spandrels of San Marco in Venice. A spandrel is the interstitial space between an arch and a ceiling, between two arches or more generally between two openings. Abstractly, it constitutes a ‘second order’ space left over as the consequence of

two primary ones. Whilst architectural discourse characterised by sensibilities inherited from modernism often take the interstitial as a sort of waste to be expelled or minimised, for Gould and Lewontin, what is interesting about these spaces is precisely their structural position as consequences rather than primary objects. According to the authors, they are open to discovered uses as much as an intended one. Gould and Lewontin argue that: "evolutionary biology needs such an explicit term, spandrels, for features arising as by-products, rather than adaptations, whatever their subsequent exaptive utility."⁴⁸ The spandrel indexes solutions posed in response to non-spandrel problems: "...a spandrel is any geometric configuration of space left over as a consequence of other architectural decisions."⁴⁹ The structural position of this term – in a logical and not an architectural sense – is as a side effect or consequence, it can never be elevated to the main object of production, instead it is retroactively functionalised.

By dividing the development of the organism into parts according to separate traits and with their own developmental trajectories, Lewontin and Gould make a unique multi-scalar argument for evolutionary fitness. In other words, the epistemic and ontological dimension acquire a new kind of relation where the explanation of development no longer exists in a unified way at the level of the entire entity, instead it is broken into a field of differently arranged parts, each with their own contingent yet interrelated developmental pathways. It is possible to say that the problem being posed to the organism is diversified, producing a diversification of responses within it, but more pointedly, that the historical evolution of these responses bears upon and constrains their future possibility. The history of the organism is also no longer a unified one. This point will be increasingly important in the final sections of this thesis, where the problem of scale is seen to break open the possibility of a unified reading of development within the case studies.

The reason for the present reconstruction of this problem in terms of immanence or transcendence is that the idea of scale that will be set out later depends on conceiving of the part as a specific response to a problem it is immanent to. At different scales: that

of the population, the trait and the environment, a plurality of problems is mediated. Each scale within this assemblage reciprocally determines the other. Moreover, the histories of these assemblages adapt not just to the others, but also in regards to the constraints established by their own unique evolutionary trajectories. In the case of biological systems, Gould and Lewontin understand this in terms of the way traits are acquired and shed, but also through the concept of exaptation as a transformational side effect. Nonetheless there is a danger in limiting this inquiry to biological systems only. As was mentioned previously in the case of Descartes' automaton, extrapolating scalar structures from one system into another is a fraught operation. This is exacerbated with biological systems in that – despite the multiplicity of scalar problems being posed to the organism *and* the multiplicity of responses these problems engender; the organism nonetheless functions as a kind of unity.

In biological systems the interaction of each functionally distinct and interacting population serves as the basis for a synthesis into another functionally distinct and interacting population. Cells interact to form organs, organs interact to form individuals, individuals interact to form populations, populations interact to form species in a continual nested structure where one group resides within, and forms the basis for, another. The nested organization of biological functions integrates parts along two distinct axes, interactions between 'like' parts are based on relationships of *exchange* such as enzymatic, biochemical and genetic reactions, while relationships between 'unlike' parts are based on *regulatory* relations that are circulatory, respiratory, and hormonal.⁵⁰ In biological systems, each part individuates along two dimensions: the exchanges between 'like' parts forming a synthetic emergent structure that retroactively regulates its constituent population in a process of feedback.

It is no accident that the bodies of knowledge that emerge alongside these distinct states are organized in a scalar structure that runs according to the horizontal exchange relationships between like parts. Biology is organized into molecular, cell, developmental and evolutionary sub-disciplines. The striking scalar structure of biology in which

functionally distinct scales serve as the emergent basis for further functionally distinct scales may be part of the reason why this structure often becomes such a common scalar metaphor to explain non-biological phenomena. For example, when the interaction of individuals is said to form institutions, which in turn interact to form urban centers, which in turn interact to form nation states, and where each level both forms the basis of and retroactively constrains the previous level. In order to ward off a conflation of scalar analysis across different kinds of systems, such that a biological metaphor of nested parts could begin to explain an urban agglomeration, this argument will attempt to clearly set out the important scalar differences across the different kinds of phenomena that will be drawn on in the case studies. In this regard, the next section in this chapter turns back to the question originally raised in the introduction to the chapter: the question of open systems.

1.6. Aleatory collisions

Natural selection locates a creative force in an immanent field composed of reproductive populations and their environments. Within this field, the capacity for self-organization is situated at a number of biological scales, both within the organism and the reproductive group of which it is a member. The idea that an element would randomly mutate within a set, and that this mutation would provide the material for selection, forms the basis for mainstream Darwinism. As Lewontin suggests, 'the organism proposes while the environment disposes'.⁵¹ This sense of a disposing environment and an ineliminable random element recalls a lineage of thought that can be traced back to the atomist philosophy of Lucretius through to the recent work of Michel Serres in philosophy, as well as scientific research into non-linear behaviour by the physicists Ilya Prigogine and Isabelle Stengers. The idea that non-organic matter could self-organize at different scales without recourse to some transcendent operator or form-giver would be heretical to many of the figures that have been described so far. For Aristotle and Kant, the idea that matter was passive and inert was a basic premise.

In *De Rerum Natura* the Epicurean poet Titus Lucretius Carus (ca. 99 BC – ca. 55 BC) explores the vagrant action of primary particles and their role in producing change in the world. In a series of chapters that gradually increase in their scale of inquiry, Lucretius proposes an ontology of matter that is both active and - since it is indeterminate, affording of free will. He suggests that this creativity can be located in the random swerving of the most elementary particles, or the clinamen. The clinamen is the minimum deviation within a smooth laminar flow required to produce a collision. For Michel Serres, whose work, *On the Birth of Physics* is a re-reading of Lucretius's *De Rerum Natura*, makes possible a rich repertoire of complex material behaviours.⁵² The result of these small deviations is to produce aleatory collisions that disrupt the smooth undifferentiated movement of particles in continuous parallel lines. Thus, Serres remains wholly within the Lucretian tradition. Echoing the heretical invocation of blind chance in Darwin, Serres states: "Now there is only a single governance, nature is fortune, physics is aleatory. *Natura sive fortuna*, nature and fortune."⁵³ The introduction of this small deviation makes dynamism deeply contingent, but more importantly - and this is where Serres begins to elaborate upon the Lucretian reference - it forms the basis for connecting contingency to the production of form.⁵⁴ Serres populates this book with elaborations on the fundamental qualities of fluid dynamics and the forms that emerge from this minimum disturbance - effects such as vortices, swirls, eddies and turbulence.

As Prigogine has pointed out, the tension between modern physics and modern thermodynamics revolves around the contradiction between the determinism of a mechanistic description of the world and the entropic evidence that the world provides.⁵⁵ A deterministic view of the world in which chance played no part cannot be reconciled with the empirical experience of nature as involved in the production of novelty and more significantly affords no free will on behalf of its participants. For this reason extrapolating a future configuration from any given starting point ignores the multiplicity of potential trajectories within the systems. The actualisation of one or another of these trajectories can be triggered by very small perturbations in the system,

perturbations that, as Turing and Longo have pointed out in the introduction, can often exist in a sub-measurable domain. This uncertainty has led to the development of mathematical models that attempt to describe non-linear systems as a set of possibilities rather than linear extrapolations.⁵⁶ It is not so much that the observer is blind to the systems future, but that the system itself is blind; its future is literally open to multiple actualisations.

At this stage in the chapter, six important moments in the history of hylomorphic conceptions of matter have been set out, to re-iterate these were: 1. The conceptual splitting of form and matter within Aristotle especially in his account of change and causality in nature. 2. The model of change within Descartes which furnishes the basic tenets of the Aristotelian doctrine with metaphors drawn from mechanics. 3. The Vitalist frustration at the mechanistic explanatory model of change and the positing of an *elan vital*, life force or *entelechy* as an alternative, therefore correctly posing the problem if not yet providing a credible alternative. 4. The position of self-organization within Kant as expression of the paradoxical problem that matter might trespass into a strictly moral domain. 5. The Darwinian revolution which inaugurated a turn away from transcendent accounts of change within the natural world finally locating variation within a wholly immanent explanation. 6. The non-organic complement to the Darwinian model in the work of Lucretius and Serres.

Looking back, though abbreviated, these six points serve to demonstrate the various inflections the hylomorphic schema has adopted as it moves through different historical periods and different bodies of knowledge. The question now is what sort of conceptual resources can be drawn out of these six points and can these resources come to serve the argument in the rest of the thesis?

The key figure in this regard is Gilbert Simondon and the idea of individuation. Simondon is vital for thinking through a non-hylomorphic, operational account of morphogenesis, furnishing philosophy with a series of concepts abstract enough to be

activated in the diverse fields of research the present thesis moves through. It is important to try to go through Simondon's work in some detail because the idea of individuation can be understood to operate in a number of different kinds of registers. Simondon describes it in regards to material systems, technical invention, the psychic formation of a collective, and to epistemologies. While this chapter has been concerned with tracing a line through the material dimensions of hylomorphism and the tension between transcendence and immanence, the following chapter, *The Scale of Truth*, explores the way different bodies of knowledge form around these problems, arguing (as does Simondon) that there is an individuation of knowledge as much as there is an individuation of matter. Moreover, the correlation between the two is brought into being by the existence of a problem, which forms their respective condition of possibility.

1.7. Individuation

As previously described, the defining characteristic of open systems is that multiple futures are co-present and only ever made real through the *event* of their actualization. In the transformation of matter, this is described as a *phase transition*. Crystallization is the most well known example. At a specific point, a solution reaches meta-stability where collisions between molecules become capable of - but as yet do not - form bonds. This state is *pre-individual* since the solution has not yet crystallized. The pre-individual state is made up of disparate scales; the global scale made up of the total solubility and saturation point, and the local scale composed of the discrete but as yet non-interacting molecules. This condition is intensive, traversed by still incompatible parts held in a field of co-existence. At a specific solubility threshold, molecules begin to pack together in a process of nucleation. In order for this to take place, a microscopic difference in the solution must seed the first symmetry break and trigger crystallization.

The edge of the first crystal serves as the precursor for the next; beginning a process of growth that now cascades through the solution. The reason this occurs is because the system needs to resolve an energy difference, more precisely crystal growth solves a transportation problem in entropy. Unfortunately, transport suggests the movement of an object *through* space but what takes place here is the *differentiation* of a medium not the movement through one. A more accurate term for this would be 'transduction'. Simondon uses this term to describe the progressive *structuration* of any metastable system:

By transduction we mean an operation - physical, biological, mental, social - by which an activity propagates itself from one element to the next, within a given domain, and founds this propagation on a structuration of the domain that is realized from place to place: each area of the constituted structure serves as the principle and the model for the next area, as a primer for its constitution, to the extent that the modification expands progressively at the same time as the structuring operation.⁵⁷

Simondon's work on the notion of individuation marks a philosophical reorientation; to be interested in individuation first and individuality second is to effect a reversal of philosophical attention in which categorical questions (such as what counts as an individual?) are only secondary to or contingent upon processes of production. How was this individuality produced? What pre-individual state does it emerge from? To put it more clearly, the ontology of individuality searches for criteria it can use to distinguish *between* things; the ontology of individuation asks how these things were formed. This shift to a processual account reflects a turn away from what Gilles Deleuze describes as an 'error within philosophy': "Traditionally, the principle of individuation relates to an already made, fully constituted, individual. The only question regards what characterizes an already individuated being. Since the individual is 'placed' before the individuating operation, and consequently, above individuation itself."⁵⁸

To transduce is to communicate in a specific sense, where communication would not mean the emission and reception of intelligible signals between a sender and a receiver, but rather the creation of a new compatibility between different registers. More precisely: the invention of a sender and a receiver that is co-extensive with the invention of the signal. For Simondon, it is not the fact of communication but its possibility that must be explained. In this sense the phase transition forms the condition of possibility for communication between the molecules in the case of crystallisation, the moment when molecular bonds 'discover each other'. Transduction is the genesis of the relation and its terms, as Deleuze notes: " it *solves the problem* posed by dispartes, by organizing a new dimension in which they come to form a single set of a superior degree."⁵⁹

For Simondon, heterogeneity is an ontologically primary state. This state is characterised by an excess of difference and divergent tensions that exist prior to the possibility of any relation. Simondon sets out to establish the ontogenetic basis for the mutual emergence of relationality and the complementary individuation of the individual that takes place with it. Though mainly occupied with developing an account of individuation that does not depend on the existence of already individuated terms, but rather emerges from a meta-stable pre-individual state, Simondon also notes that individuation can nonetheless proceed from an already constituted individual.⁶⁰ In other words, though an account of individuation cannot *depend* on the existing individual, this does not mean that existing individual cannot be admitted as a resource for further individuation.

The constitution of the individual does not exhaust its pre-individual potential in the mere fact of its constitution - the individual always carries unresolved pre-individual tensions along with them.⁶¹ In this sense individuation does not conclude, but *continues* in an open relay, where individuals enter into new relations with each other. The example of crystallisation serves as an opening for further understanding the idea of individuation with regards to matter. In order to draw out the potential of this concept such that it can begin to work through other kinds of individuation, it is necessary to set

out the conceptual architecture of this concept more clearly. In the following section a series of questions surrounding the idea of individuation will be examined: what is the precursor to the process of individuation? What is the relation between this precursor and the individuated entity? What is unique within the concept of transduction?

These questions work toward the following conclusion: that individuation always emerges in regards to a problem and that this problem acquires a full ontological reality.

1.8 Metastability, emanation, resonance

To install individuation as the determinate condition of individuality does present a challenge. The formation of the individual out of some precursor condition has to occur through operations that do not presuppose the existence of the new entity. This difficulty is present in two ways. First, by relying on pre-existing entities as resources for individuation, and second, by manifesting itself through a pre-existing principle that guides the course of individuation. To locate the conditions of individuation in either the determination of a pre-formed individual or the determination of a guiding principle is to nonetheless locate individuation in a determination that pre-exists the moment of production itself.

If individuation is to supply a creative account of production it must account for the production of its own terms. Neither a genetic principle that guides the course of individuation or an entity that operates as precursor can be admitted here because to do so would rob this processual ontology of its properly creative dimension.⁶² Locating individuation in a form that pre-exists its emergence would merely repeat a Platonic framework and locating the operation of individuation in a principle would repeat a hylomorphic one. Simply doing away with the isomorphism between an idealised entity and its instantiation, and then replacing it with a principle that is non-isomorphic with its instantiation, does nothing to improve the situation.

It is not the symmetry or resemblance between the pre-individual and the individual that is at stake here, it is that the event of actualisation plays no properly creative role in either part because in both cases the motivation for development can be located transcendentally. As Virno notes: "The capital error... ...consists in assigning the constituted individual an ontological primacy, then proceeding backwards in search of its purported germinal element."⁶³ If all is given in the predetermination of a plan, and all that remains is for the plan to be executed, then what is left looks more like a translation than a creative production. In fact, to even speak of plans is to invoke some transcendental motive that organises the individuation of material entities. The plan/material binary is only the content/form binary under the guise of instruction rather than resemblance.⁶⁴ If both of these difficulties need to be avoided, the question remains, what kind of pre-cursor forms the properly immanent condition for individuation?

For Simondon, the pre-individual condition is characterised by the following qualities: it is an excess of energy / surplus of tension, it is heterogeneous and non-relational, it is meta-stable and not simply chaotic. The condition of pre-individual being is far from being undifferentiated; on the contrary it is excessively differentiated. But this differentiation is intensive - a gradient of tension traversed by mutually incompatible tendencies. The non-relational heterogeneity of the pre-individual is given the name *disparation* by Simondon. With its evocation of the disparate and expiration, it conveys something of the divergent temporality of pre-individual, whereby an excess of non-relational tensions gather strength and dissipate. This can be understood clearly in the previous example where just prior to crystallisation the molecules act as non-communicating dynamic singularities, at close to saturation point, a heterogeneous element seeds a drive that channels the entropic energy in the system, inventing the existence of one set of molecules *for* the other, such as when the correlation length of bonds extends and makes them suddenly 'sticky'.

The role of transduction is akin to the production of a communication or compatibility between pure differences because transduction is the means by which a

relation is actualised. To be clear, transduction must be thought of as an emanation with no object or target. The target or receiver will only come into existence via the emanation or transduction, that is, the communication produces the possibility of its reception through a receiver. The genesis of relationality occurs when these divergent forces begin to resonate or phase together. This resonance is the invention of a compatibility or communication between them. Another way of putting this is that transduction is the communicative operation that emerges in response to a problem. The 'problem' in this case does not refer to a specifically human condition or to a lack or epistemic deficit, but instead to a real feature in the world; "a perfectly positive, objective structure which acts as a focus or horizon within perception".⁶⁵ The proper structural relation between a cause and consequence becomes important here, since the crystals do not exist prior to the propagation. Their shape, dimension and structure are a side-effects of an original problematic difference in energy as it is being driven toward resolution: "Individuation emerges like the act of solving such a problem, or – what amounts to the same thing – like the actualisation of potential and the establishing of a communication between dispartes."⁶⁶

Both Simondon, and Deleuze following him, conceive of this state of dispartation as a problematic field. This condition poses a distribution of potential determinations, which can only be brought together through some inventive event. This would close to the sense that Deleuze has of solving a problem; the creative process by which differences can be held together in a state of co-existence, not a resolution that fully resolves and annihilates difference. It follows on from this that any individual always carries a reserve of pre-individual energy, a potential resource that can be used to drive further individuations. This means that an individual - as a solution to a pre-individual problem - is only ever provisional containing 'an internalized' dispartation that is not exhausted in the mere fact of its individualisation.⁶⁷

These concepts: metastability (referring to the energetic tendencies of the pre-individual state), dispartation (referring to the divergent tensions of the pre-individual

state) and transduction (referring to the action of constitution and propagation by which a relation is formed) should make clear the ways in which Simondon's ontology of the pre-individual offers a precise conception of morphogenesis, without becoming entrapped in the hylomorphic schema described earlier.⁶⁸ These ideas will structure the methodology of the case studies carried out in the final chapters, helping orient the line of inquiry into scalar individuation. Furthermore, as Massumi notes with regards to Simondon, the kind of individuations described so far trigger a co-individuation of knowledge also, such that the ontological and the epistemic co-individuate together:

Further, Simondon approached the question of epistemology as a function of ontogenesis. There is an individuation of thought, he said, by the same token by which there is an individuation of matter, on the physical plane and from there on to the plane of life, and following--or prolonging--the same constitutive principals.⁶⁹

Both the ontological and epistemic registers undergo processes of progressive differentiation; the structure of the bodies of knowledge is evidence of this fact already. What is unacknowledged and what forms the central argument of this thesis is that this co-individuation is, in turn, structured by scale. These two processes accompany each other, an accompaniment that is governed by a scalar correlation because there is no ultimate individuation to which all belong, only a series of partial, limited co-individuations forming a specific kind of scalar immanence between ontological and epistemological planes. This however, will need to be set out in more detail in the following chapter, with examples given in the case studies that are to follow.

THE SCALE OF TRUTH

2.0 Introduction

In the previous chapter an abbreviated history of the hylomorphic relation was charted, examining attempts to split and recombine form and content according to a transcendent or immanent conception of the natural world. Beginning with Aristotle and the distinction between active and acted upon, hylomorphism was traced as a persistent presence across historical periods and different bodies of knowledge, posing difficulties for Cartesian and Newtonian views of the world, especially in their attempt to form a direct correlation between the rational calculus of a machine and evidence of natural change. Hylomorphism takes on various guises, appearing as *élan vital*, *entelechy*, *purposiveness* and the *clinamen*, with varying degrees of recourse to an inexplicable agent, either internal or external. In each case, the different explanations should be

understood as a response to ambiguities in the natural world, ambiguities that were unsurprisingly explained by drawing on the prevailing metaphors of the era.

It would be all too easy to critique these explanations with the benefit of hindsight; contemporary science is governed by its own particular metaphorical concepts.¹ The reason for going through this account of philosophical and scientific history is not to correct the record. It is to set out the important role that ambiguity plays in structuring a problem and the kind of explanations that form around it. In fact, the proposition put forward in this thesis is in distinct opposition to an attempt at rectification, arguing that ambiguity is an objective feature of both the phenomena and the explanation that emerges around it. This was touched on in the previous chapter with regards to the fundamental unknowability of open systems described by Prigogine, Stengers and Longo - their acknowledged 'blindness' to the future and the capacity for multiple realizations. In this chapter the focus will shift from the objective ambiguity of the ontological condition, to the objective ambiguity in the explanation. That is to say, it deals with the individuation and stability of the epistemic frame used to produce an explanation. In *The Scale of Matter*, the hylomorphic schema was critiqued for superimposing a transcendent cause and sacrificing an immanent one. The rectification of this schema with regards to nature proceeds for reasons of scientific objectivity – as in the case of natural selection and non-linear chaotic systems. But is there not another subsequent and parallel risk that the 'idea' of objectivity *as such* will come to take the place of the transcendent actor evacuated by God or Man?

For Cartesian epistemologists, the Cartesian method is unchanging because the world and the problems it poses are fundamentally consistent. The suspicion that rational scientific knowledge might itself also be historically determined first appears with Hegel, where the spirit of the age takes on a radical and unique quality, making historical eras and their claims to transcendent rationality discontinuous.² If the critique in the first chapter argued for a historically determined account of natural creativity, and this creativity could occur wholly within the resources of nature itself, such that time and

variable repetition give the potential co-presence of different futures, is there not a similar critique to be made with regards to knowledge?

This critique will draw on a close reading of four specific thinkers. It begins with the work of Manuel Delanda, who has attempted to read Deleuze as a pre-emptory of contemporary science, especially within fields of mathematics such as topology and physics. Delanda's success, and his invention of a 'Deleuzian Science' or perhaps a 'Scientific Deleuzianism', hinges on the point-by-point correlation he makes between philosophical claims and mathematical or scientific ones.³

This is unsurprising, since as he states very clearly at the outset of *Intensive Science and Virtual Philosophy*, the text had a specific ambition in mind; bridging, an unnecessary gap between continental and analytical traditions. Deleuze's philosophical menagerie is brought into close proximity with a series of scientific facts, such that philosophical speculation appears to be given an objective ground. The difficulty, as this chapter will try to point out, is that both the idea of 'objectivity' and mathematical 'truth' are contingent and historically shaped. Furthermore, philosophical truth procedures are not the same as scientific ones. Conflating the two binds the success or failure of one to the other unnecessarily.⁴ More important than the temporal nature of a truth claim however (and as an avowed realist Delanda would commit to types of incontestable truths) is the issue of their relevance with regards to the field or discipline they emerge from.

At stake in this blind spot in Delanda's work is more than historiographical accuracy. It is argued here that truth is a question of power, where a truth claim effects a re-distribution of relevant and irrelevant points such that a true statement is defined as one that connects to and transforms many other statements. This definition moves away from an idea of truth as something that is correct.⁵ According to this argument then, the implicit background support to a statement operates as a kind of network, where its degree of relevance is an index of its connectivity to other questions, and where its truth resides in its capacity to transform them and be transformed by them. As the following

chapter will argue, the blindspot in Delanda's conception of objectivity and rationality is ineliminable. This blind spot puts more at stake than historical attentiveness; it directly bears upon questions of power and politics, questions that are suppressed within the unique materialism Delanda advocates. In order to activate this critique, the thesis will turn to three sources. The first of these is Gilles Deleuze, beginning with a close reading of 'The Image of thought', the third and middle chapter of *Difference and Repetition*.⁶

This chapter opens with the question of beginnings within philosophy.⁷ As John Protevi has pointed out, 'The Image of thought' is a point of inflection in Deleuze's work, where the direct engagement with historical figures such as Spinoza, Kant and Nietzsche - that characterized his early work - begins to twist and open into a philosophy that will be 'done under his own name'.⁸ This inflection point initiates a gesture, that of a continual pulsing between background and foreground that subsequently repeats throughout the book. For Deleuze, this oscillation in the structure of explication and the scale of analysis makes visible the panorama of conspiratorial forces that envelop every object of thought. The effect of this continual shift is to make the object not more but less secure, since in *Difference and Repetition*, the context does not stabilize its object but always threatens to engulf it.

Deleuze proceeds from the following questions: Where to begin in philosophy? What counts as a first statement? He suggests that philosophy usually sets out to eliminate pre-suppositions from the original statement, to carefully remove the assumptions that every subsequent statement would rely upon. The history of philosophy repeats this original reflex, and in different ways attempts to construct a wholly original principle without background pre-suppositions. Referring to this dilemma, Deleuze distinguishes two kinds of pre-suppositions: objective and subjective. Objective pre-suppositions are contained within concepts. The example given is Descartes, who does not want to define man as a rational animal since this would rely on the existence of two concepts that pre-suppose his starting point: rationality and animality. Instead Descartes will turn to the second, subjective type of pre-supposition, one that appeals to common

knowledge rather than specific concepts such as animality or rationality.⁹

Since it can be assumed that 'self', 'thinking' and 'being' are clearly evident and thus common, the *Cogito ergo sum* is able to transfer the ground upon which the original philosophical claim will be made, moving it from a logical and conceptual register to a subjective one. However, this only appears to be a more original beginning because it shifts the logical referent in the concept to the empirical referent of experience. Concluding that there can be no useful way out of this circularity and thus 'no true beginning in philosophy', Deleuze suggests that attention might turn to the way both objective and subjective presuppositions function in grounding the very idea of a beginning. The question is not; where is the beginning, rather: what sort of conditions make the claim for a beginning seem possible? The effect of this inquiry will be to radically destabilize the link between a truth and thinking in common, a point that - as will be demonstrated - has important consequences for thinking about rationality in an ahistorical way.

In a different but related sense, Michael Foucault's work, especially *The Archaeology of Knowledge* and *The Order of Things* set out to critique the idea of an origin within structures of power – a discursive history of small events whose accumulation and interrelation do not radiate out from a sovereign point of authority, and whose points of contact do not take the form of direct injunctions or commands. Instead, they cumulatively form the warp and weft of what can and cannot be said, what will and will not make sense in a specific historical condition.¹⁰ Foucault's purpose in these endeavors is not philosophical speculation per se; rather it is related, at least in the two early works, to theories of epistemology. If Foucault moves away from this more general ambition for a theory of knowledge *as such* towards specific material histories – as shown in the difference between the early work and the later disciplinary work – it is perhaps because he realizes that there was still too close a proximity to Kant, and a circularity in which the conditions for the possibility of knowledge are simply provided by different conditions of possibility.¹¹ Nonetheless, both these early projects are characterized both by an extension

and a critique of the Kantian project. Foucault pursues the question of the conditions of the possibility of knowledge with a radical, sometimes anarchic energy – radicalizing the Kantian system by removing the origin about which everything orbits: the moral authority of man. What remains in its place in an empty seat enveloped by diffuse relays of power.

If Deleuze's critique of philosophy from Descartes to Kant is premised on the consistency of the *sensus communis* and the transcendent orientation of thought it brings about, for example man's innate inclination for truth, Foucault's critique of Kantianism replaces the transcendent/sovereign form of power as a basic limit with a series of overlapping ideas such as the *historical a priori*, *episteme*, and *problematic* that together form a kind of anonymous discursive limit on what can be known and said.

Finally, this chapter will look at the work of social scientist Alan Garfinkel. Garfinkel's work is a critique of transcendent forms of explanation that works at the scale of discursive utterance itself, especially the capacity of a statement to transmit meaning. Garfinkel's ambition is to critique reductivist forms of explanation within social science by pointing to the ambiguity in the linguistic and semantic structure of statements and the implicit domain in which they operate.

Though different, each line of inquiry resonates with the problem of knowledge - its constitution, transmission and communicability - in different ways and according to different scales. Deleuze offers a philosophical critique of representational thought, which he initiates from the point of a particularly ambiguous section of Plato's *Phaedo*. Foucault's is a critique leveled at the scale of an anonymous discursive collective which does not begin in any original sense - existing within archives like the *Annales d'hygiène publique et de médecine légale*. Garfinkel attends to the structure of individual statements examining sentence structure and meaning as a mathematical problem in stability. Each author has a different though related problem in mind, how to begin to explore the ambiguous sub-representative domain that gives sense to any statement, but each begins

their task according to a different audience, a unique scale of analysis and a specific vector of approach.

Drawing on these texts it will be argued that the objective indeterminacy of the phenomena described in the previous chapter, *The Scale of Matter*, is accompanied by an objective indeterminacy in the types of explanations of those phenomena. In other words, there is an immanent economy at work in both the ontological and epistemic registers. More importantly, the form of the correlation between these registers - the questions that can be asked of material phenomena - has a rigorous, though objectively indeterminate, scalar aspect.

What is missing from Deleuze's, Foucault's and Garfinkel's account of epistemology is an explicit setting out of the scalar dependency operating within any claim to epistemic genesis or rupture. This scalar dependency, as will be shown in what follows, works to correlate an explanation to its respective phenomena. Scale is a type of frame; moreover it is a frame whose capacity to correlate between things - say between an event and its explanation - can be objectively determined with the qualification that this objectivity is in turn also historically determined. Since this objectivity is not independent of the pre-suppositions that also lend it sense; it becomes immanent to the shifting field of cultural attitudes, political dispositions and technical instruments that give it shape. In what follows this background will be shown to both situate and jeopardize the security of the foreground, an oscillation that can be thought along the lines of an always-provisional individuation caught up in a meta-stable pre-individual field.

2.1 Delanda's transcendental objectivity

In *Intensive Science and Virtual Philosophy*, Delanda stages an encounter between a technical account of morphogenetic development taken from mathematics and science and meticulously weds them to Deleuze's conceptual innovations in an attempt to bring

together continental and analytic traditions. For Delanda, morphogenesis inscribes the concrete individual within a historical trajectory of variation that emerges from a topological landscape of potential. The individual has no essential properties that stand outside the exigencies of history.

The following section tracks two distinct phases in this work. The first is the critique of transcendent and essential properties, carried out through topological mathematics, especially with reference to phenomena described in chapter 1 such as non-linearity. The second section attends to the epistemic models Delanda draws on to explain the way knowledge has been formed around those phenomena. Delanda is aware that forms of knowledge undergo their own experience of historical change, but he misses a critical point in his determination to shake off any accusation of social constructivism and embrace a strongly realist position. Even if one accepts, even as avowed relativists like Foucault did, that there are certain incontestable truths or objective facts that are unlikely to be significantly revised, it is quite another thing to conclude that these truths will always be relevant. In a sense, the very definition of history is to look back on important problems of the past and be struck by their triviality. The historical background that lends sense to scientific laws may not change their status as truths within science, but it can certainly change their relevance.

The attempt here will be to turn Delanda's method back on his own work, reading Deleuze's 'The Image of thought' in *Difference and Repetition* point-by-point and positioning it against Delanda's final chapter in *Intensive Science and Virtual Philosophy*. This chapter, *Virtuality and the Laws of Physics*, is where Delanda strives to turn his own model of concrete historical genesis towards epistemology. As will be argued here, Delanda falls short, leaving the argument vulnerable to accusations that it dangerously depoliticizes science.¹²

2.2 Truth and relevance

Delanda begins with calculus in order to show how this development in mathematics transformed in a very fundamental way; the typical approach to solving problems within the aforementioned dynamic systems. Rather than attempt to track all the constituent elements by describing their parts, possible trajectories, forces and interactions, the calculus of variations took a different and collective approach. The calculus posed the problem of change according to new terms in which the set of all possible processes was understood as a field of solutions establishing all possible configurations. Solving this field involved a sorting process in which possible solutions would be grouped into two sets, one ordinary and one singular. The singular set was the one that satisfied the principle of maxima and minima according to Hamilton's principle.

The point of critique here is that Delanda wants to argue that axiomatic versions of science and knowledge production transmit information mechanically through statements that draw deductions from axioms. A problematic view of science proceeds according to a different kind of method whereby a progressive specification of an explanatory model attempts to individuate the causal characteristic of the phenomenon in question. In the case of the calculus cited above, the explanatory model needs to capture the right distribution of singular points such that the salient features in the system are reproduced.

The final chapter of Delanda's *Intensive Science and Virtual Philosophy* is an extended elaboration of Deleuze's concept of the problem and the problematic from the point of view of science and science studies. Continuing the encounter between analytic science and continental thought that characterizes the project as a whole, Delanda explores the implications of the problem in terms of scientific laws and causality. For Delanda the epistemological dimension of Deleuze's thought draws *ideal* events out of *actual* ones, where ideal refers to the problematic aspect of the event. In other words "what it is about the event that *objectively stands in need of explanation*."¹³ Delanda intends to extrapolate Deleuze's ontological-epistemological relation, proceeding by critiquing the status of laws or axioms in science and arguing that the individuation of a

phenomenon, say, generating pasteurization through experimentation, needs to find its correlate in the individuation of knowledge. The approach that Delanda takes to question of epistemic individuation continues the emphasis on its problematic character described by Deleuze, which also goes back to Canguilhem and Bachelard, though the last two figures are not cited by Delanda.¹⁴

Delanda links together the idea of *mechanism* in the phenomena *to causality*, as well as linking the epistemological *question of 'why' to an explanation*. This is a key structural diagram in Delanda's work, whereby he builds a bridge between an ontological dimension (causality) and an epistemological dimension (explanation). It is the relation between these two things that forms the focus of the text's final chapter. In order to do this Delanda will draw on the work of Ian Hacking, Mario Bunge and Alan Garfinkel to produce an account of explanatory frameworks that are topological, and in some way isomorphic with the phenomena they set out to describe. In order to do this he will investigate the explanatory architecture in some detail, Delanda notes:

Answering a Why question typically demands supplying a causal explanation, perhaps in the form of a causal model or mechanism. ...Despite the fact that questions and answers are, indeed linguistic entities (could critique this actually), Why questions involve as part of the conditions that make them answerable, or well-posed, a non-linguistic or extra-propositional aspect which is properly problematic: a distribution of the relevant and irrelevant.¹⁵

The structure of these extra-propositional contrast spaces is as follows: Why did X happen (as opposed to Y or Z) - the space in the brackets being the contrast space - the list of implicit alternatives. This depends on two key ideas. The first is that following on from the calculus of variations, the idea of a solution to a problem will be considered in terms of its existence within a population first. Garfinkel's work on contrast spaces is critical in this regard because it provides a theory for thinking about the non or extra-propositional nature of explanations. Described as a contrast space, it is the list of

implicit alternative answers in any question. Setting out an idea of explanatory relativity, Alan Garfinkel explores the way in which any explanation always carries a background pre-supposition. In order to fully explain any event, one would have to give an account of every causal factor in the history of the interaction, a history that would trace back to the invention of the motorcar in order to explain a motor accident.

This infinite regress in which causal factors expand out infinitely in time and space makes it impossible to give a full account of any event. Instead, what is possible is the gradual pruning back of the web of causal links, carefully discerning between relevant and irrelevant linkages. The elimination of these linkages produces a space of pre-supposition; an invisible implicit background armature makes the explanation always relative. For Garfinkel this presupposition can be understood through the terms of what counts as a relevant or irrelevant difference to the event in question:

Why this auto accident – rather than what? Rather than another ten feet down the road? Rather than no accident at all? Rather than one, which was fatal?"¹⁶

The question of which causal antecedent to suppress is one of value and therefore also one of ethics. These contrast spaces are very often taken for granted. The example Garfinkel cites is the case of unemployment in which the presupposition is always 'given that people are going to be unemployed...'¹⁷ These presumptive questions, and the sense that with them comes an entire relation of power that limits the range of possible solutions is what will lead Deleuze to claim that the question answer relation is in fact an example of the master-pupil relation. The justification for these kinds of explanations is to fall back on an idea of realism or common sense. The critique of them is purely political in so far as 'pragmatism' within politics depends on an alignment of what is 'realistic' between different parties. Garfinkel writes:

The problem is that what is “realistic” to one may look myopic to another. There may be genuine disagreement as to whether an alternate economic system is “possible”, not in the abstract sense of possibility, but in the practical sense: a possibility that must be taken into account in practical reasoning, whereas another denies that it is practically possible. What shall we say about the nature of this disagreement between two such people? Is it a “factual” disagreement or a “value” disagreement? There does not seem to be a clear separation between the two¹⁸.

For Delanda, this aspect of multiple possibilities within the explanatory mechanism forms an analogue to the multiple realizability of the system being explained; in each case there is an objective open ended-ness that cannot be captured in advance. Furthermore, Garfinkel’s critique works according to a very particular idea of scale, whereby each of the problematics in a given event, such as the processes that give rise to them and the causal linkages between these processes necessitates different kinds of explanations. There is a sense therefore in which the explanation must correspond to its proper scalar dimension - certain questions only operational at a specific explanatory scale, such that 'not all objects of explanation are created equal'. The question then is how to determine how well a certain explanation captures the distribution of relevant and irrelevant points. In order to answer this, the idea of stability will be introduced.

2.3 Epistemic Stability

Garfinkel intends to critique the reductionist attitude to collective behavior, which always falls back on an account of the behavior of the individual components in a system without ever accounting for the structure of their relation to one another, as is the case often in economics, science and social theory. What Garfinkel would like to move to is an account of the overall patterns that are individuated in a collective set. In order to reach this goal he conceives of explanation along dynamic lines, as a relation between stability and instability. In order to ascertain whether or not one explanation is preferable to another he states that the explanatory model must be disturbed in order to determine

its structure and stability. The stability emerges out from the progressive destabilization of the model, each perturbation actualizing a distribution of resilient and fragile parameters.¹⁹ Garfinkel assessment is that: “a good explanation will be stable under perturbations of its own assumptions.”²⁰ In other words the focus shifts from one of accuracy and particularity to a kind of approximation that is true within a certain bandwidth of possibilities, what Deleuze will call the anexact but rigorous.²¹

Noting the importance of explanatory stability and its progressive specification through perturbation of parameters, this line of inquiry into the problematic nature of explanation will now attend to two further issues: underdetermination and overdetermination. If the contrast space in which the problem is posed has too much detail (where the contrasting possibilities are specified with too much information regarding individual parts) than the problem is overdetermined. If, on the other hand, the contrast space is specified with too little detail, and the account of the parts of the contrast space is too vague, the problem will be underdetermined. This is equivalent to saying there is either redundant or insufficient causality in the explanation. A further elaboration of the idea of overdetermination is given by Graham Harman who elaborates two further types of over-determination, which he describes as undermining and overmining.²² Undermining is too much emphasis on upward causality, whereby the interactions of members at a lower scale are granted too much agency over the emergent properties of the scale above (a form of reductionism). Overmining on the other hand refers to situations in which there is too much downward causality, such that the interaction of members at one scale overdetermines the properties of the scale below. Unfortunately Harman, much like Delanda, subscribes to a metaphorical description of bottom up top down in which entities seem to be nested within increasingly larger individuals. This refrain in Delanda, Garfinkel, Harman and indeed Deleuze continually refers back to a kind of excess or lack in the determination, suggesting that there is a 'proper' level, degree and amount of determination in the explanatory structure. What does 'proper' mean here? Alan Garfinkel refers to the following by way of explanation:

Consider for example a vibrating string, whose resonance pattern we wish to study. The usual procedure is to assume that the string is a continuum and that its position is a continuous function of time. In a sense this is false... A string “really” is a large number of molecules held together by binding forces of various kinds. The very idea of a physical continuum is in a sense, a fiction... For suppose we descend to the level of the analysis of the string as a billion-body problem in particle mechanics. We get no better explanation of the gross properties of the string than we had before...

In this case, the scale of the explanation has an objective relationship to the phenomena it wishes to describe. Treating the vibration in terms of its atomized elements does not capture the emergent level of the vibration itself. It is clear that for Garfinkel and Delanda, the relation between collective and emergent individuals is a characteristic not just of social systems but material ones as well. This layered model generates unique effects as one collection is synthesized into another, demanding a correlation between the scale of explanation and the scale of emergence, such as in the particles and the string above.

Taking aim at reductionist economic, scientific and social theories that secure behavior in things like rational choice, memes or egoism, Garfinkel claims that emergent and collective effects demand that explanation always operates at a specific scale. Garfinkel invites his readers to connect the epistemological and ontological together and to think of this connection through scale. Following from this it will be argued that the relation between a well-posed problem and its solution is the epistemic counterpart to the ontological relation between the virtual and the actual. The epistemological problem of knowledge is the counterpart to an ontological problem; both individuations accompany each other even if they are not symmetrical. The idea of a problem here is not limited to linguistic statements, on the contrary, the problem is an ontological property of the world - the example that Delanda draws on is molecules of soap film resolving their distribution of energy according to a minimum where surface tension drives toward a

spherical shape, or for that matter, molecules attempting to minimize bonds by forming crystalline structures.

This portrait of problems, presuppositions and contrast spaces, has gone some way to clarifying the structure of explanations and their relationship to phenomena, but has yet to provide an account of the way in which an explanation is itself subject to a process of assembly, that is to say there also needs to be an account for the way problems undergo their own process of individuation. Still, further questions are raised; how is this kind of scalar explanation produced? What criteria are available for objectively assessing whether it works at the 'proper' scale or not? In what follows the idea of an objective correlation will be set out in response to the later question, but in order to do so it is necessary to turn to the former one first and examine the process by which this kind of explanation can be produced through a progressive specification.

2.4 Progressive specification

In order to elaborate on this and connect back to the way in which problems are gradually specified, the argument will turn to the idea of hylomorphism set out in the first chapter. The main point to be made here is the difference between linear behaviors and non-linear behaviors, since linear behaviors tend to produce an image of form in which there is always a correspondence between force and its resultant transformation. Non-linear systems on the other hand are able to adopt multiple states through the process of bifurcation necessitating a problematization of their function.

For Delanda, the 'topological singularities' he finds in mathematics are doubled by the active properties of matter, the individuation of specific effects from one, complementing the description of these effects in the other.²³ The role of experimental practices, in progressively stabilizing the behavior of material in a laboratory situation is analogous to the artisanal mode of production described above, though - with exceptions

within the field of science studies - it is often left out of the account of science. The progressive differentiation of the problem is, for Delanda, a continuous effort at calibration, adjustment and recalibration that attempts to individuate new kinds of phenomena. As Delanda writes:

In learning by doing, or by interacting and adjusting to materials, machines and models, experimentalists progressively discern what is relevant and what is not in a given experiment. In other words the distribution of the important and unimportant defining a problem (the degrees of freedom matter, what disturbances do not make a difference) are not grasped at a glance the way one is supposed to grasp an essence (or a clear and distinct idea) but slowly brought to light as the assemblage stabilizes itself through the mutual accommodation of its heterogeneous components.²⁴

Through an iterative process, the ontological individuation gradually acquires an epistemic counterpart in the form of a model that captures and reproduces the causal structure of the phenomena. The correlation between this co-individuation is always scalar, the epistemic frame progressively converging on those features of the problem deemed relevant. The status of the correlation is objective in the sense that it is possible to determine whether the model is able to repeatedly reproduce the main behaviors in the system. However, the status of this objectivity is not as simple as Delanda seems to suggest. His examination of the history of mathematical topologies, their correlation to non-linear systems, and the correlation of both of these to the philosophical writing of Deleuze have had a wide influence across a number of different fields from geography to architecture. Yet, there is something troubling in the parallel accounts he gives of epistemic and ontological individuation, something too neat in the way one is bound to the other. The following section aims to explore this unease, asking whether Delanda's hylomorphic critique of matter in which the history of differentiation plays such a key role, can be applied to his own presentation. What is at stake in this analysis is the status of objectivity in the scalar correlation between the model and the phenomena it is

attempting to describe. To do this, the following section will turn to Deleuze, especially the chapter 'The Image of Thought' in *Difference and Repetition*.

2.5 The Discord of the Faculties

A symbol of the unease provoked by Delanda's use of science can be provided by posing the following question: What does the individuation of a new scale within the city and the crystallisations of molecules in a solution have to do with each other? For Delanda, it seems to be evidence of the same abstract machine, given his strange non-essentialist Platonism in which the same deep diagrammatic circuits lurk beneath populations of viruses, rocks and phonemes.²⁵ The danger with this approach is not only that it potentially elides the difference between radically different phenomena by declaring that they all share the similar underlying dynamics, but more importantly that it fails to differentiate between the way those same phenomena are presented and made available for thought through different bodies of knowledge and the distinct truth procedures they rely on. Delanda is not doing science, he is reading it, and moreover reading it is a incontrovertible fact. Williams puts the critique this way:

The problem for Delanda's science-based account of Deleuze's philosophy, despite its great explanatory power, is that it underestimates the need for a principled philosophical openness in light of scientific history and practice... How can we know that any given science is definitive or even on the way to being definitive?²⁶

In fusing science to philosophy Delanda gains a certain directness and immediacy but only at the cost of a sense of historical awareness and scientific scepticism. Science has a different disposition toward objectivity and therefore to the production of truth than philosophy, the question then is whether the avowed realism of his position is able to reflect on its own discourse.

Delanda focuses on the question of relevance raised by Deleuze, but he only applies it to a single scale because he sees the question of relevance as operating in the mathematical model. It is a phenomenon couplet, where the progressive individuation of the phenomena has as its correlate, the progressive individuation of a mathematical (or scientific) model of knowledge. Therefore, relevance refers only to the ability of the *structure of the explanation* to capture the salient *structure in the cause*. This is no doubt done for the sake of clarity, but the expense of this clarity is that Delanda neglects another scale at which the question of relevance operates. This scale does not structure the relationship between the explanation and the phenomena, it structures the relation between the explanation and the field of knowledge in which it comes to be posed. Delanda is entirely correct in pointing to the objectivity that correlates the model to its phenomena, but he misses the sense that this objectivity is in turn also historical. Though the truths produced by this individuation may well be long lasting, there is no guarantee that their importance will be. In one way, Delanda misses the specifically political dimension of the problem, the geometry of power that extends from the relevance of the question to the relevance of the answer.

It is Deleuze, in his texts on Henri Bergson, such as *Bergsonisme*, and later in *Difference and Repetition*, who first poses the concept of the problem in these terms. For Deleuze, the relation between the problem/solution and question/answer forms an integral part of the critique of negativity in the concept of difference, where the 'problem' comes to play the role of positive indeterminacy, a disturbance or singularity which 'acts as a focus or horizon within perception'. The problem becomes the genetic condition for processes of truth production such that specific answers exist as discrete precipitations from a general (and abstract) problem.

If the problem is posed adequately it exerts a force, provoking adjunct fields and re-distributing points within the virtual topology of other problems and their relation to each other. This argument depends on an image of a field of knowledge or a discipline as inherently topological, as a twisting landscape of singular questions distributed according

to their relevance, each with their own basin of attraction able to orient collective labour and attention. Critically for Deleuze, there is no teleology at work here, since the solution never exhausts the problem it addresses, it merely re-distributes the field of distinct points.

In fact it might be possible to read the history of architecture according to the problems that are taken to be significant at different points in time. Moreover, the change from an idealist to an empirical conception of scale can be understood according to the shifts in the kinds of questions that preoccupied different eras of architecture. If the correct proportioning of a column constituted one set of historical problems and preoccupations, the orchestration of work within a factory constituted another. In this sense, different notions of scale were always brought in to pose these problems in specific ways and make them available for action within the discipline.

Of importance here is the way the structure of collective forms of subjectivity are understood, especially the belief that they automatically secure an impetus toward truth. The metaphor of a landscape of attention can be given more shape by conversing with Deleuze, who, in the critique of the idea of a *sensus communis*, suggests that stupidity as much as truth is the likely outcome of any collective psychic individuation. This is as true for science as it is for a discipline like architecture, and it poses problems for Delanda's account.

2.6 Common sense as implicit presupposition

In *The Image of Thought*, Deleuze raises the following question: 'What is an implicit or subjective pre-supposition?' He answers that it always appears according to the same formula of 'everybody knows, nobody can deny'. This statement conceals the need for the explanatory labor, since there should be no need to explain what is already commonly accepted. As Deleuze remarks: "When philosophy rests it's beginning upon

such implicit or subjective pre-suppositions, it can claim innocence since it has kept nothing back – except, of course, the essential – namely, the form of the discourse.”²⁷

Deleuze locates an idea of common sense within the subjective pre-supposition and by way of opening a critique introduces two conceptual personae from Descartes’ late work, *The Search for Truth by the Means of the Natural Light*.²⁸ The first is ‘Eudoxa’, a character supposed to represent the common views of common people, the second is ‘Epistemon’, a scholar who has ‘learned all there is to learn’. Deleuze introduces them respectively as the ‘idiot’ and the ‘pedant’. The ‘idiot’ possesses a natural capacity for thought and the ‘pedant’ is ‘perverted by the generalities of his time’.²⁹ Descartes sides with the idiot, and Deleuze uses this to make a point about the difference between objective and subjective pre-suppositions, that is, the pre-supposition of the idiot is the private pre-supposition - the implicit assumption of a ‘natural capacity for thought’ - while on the contrary, the pre-supposition of the ‘pedant’ is public, based on the assumptions of concepts within collective forms of knowledge. The public nature of knowledge no less than its private manifestations will, for Deleuze, signal a radical turning away from Bachelard’s notion of the problem, since with Bachelard, the collective/public formation of knowledge, especially in science, seemed to guarantee a sense of progress if not absolute truth.

Deleuze recognizes the danger of attacking the idea of common sense on both an objective and subjective front, melodramatically protesting that it is not a question of being unorthodox, that is of simply being *outside* of doxa or on the *margins* of common thought, rather it is a question of ‘not knowing what others know’, of manifesting an ill-will and an incapacity to think either naturally or conceptually. Seeing two sides of the same figure in Eudoxa and Epistemon, the critique aims at the sense that “there is a natural capacity for thought endowed with a talent for truth or with an affinity with the true, under the double aspect of *goodwill on the part of the thinker*, and an *upright nature on the part of thought*’.”³⁰

The implicit pre-supposition of philosophy is the idea that common sense is universal. Therefore, it matters little whether philosophy begins with ‘the subject’ or ‘being’, since it is always implicitly draws on an idea of good sense as its background pre-supposition. What Deleuze will call the ‘dogmatic image of thought’ points to the existence of this common and consistent ground on which any original philosophical proposition tries to stand. Claiming disinterest in the concrete manifestations that inflect this question in specific schools of philosophical thought, this critique aims at the ‘image of thought’ as it applies to philosophy as a whole.

In this way Deleuze critiques Descartes for transforming nothing more than an ‘old saying’, (that the capacity for common sense is the most equally distributed quality among men) into a philosophical principle. This is a principle that is rarely grounded in fact. Since Descartes makes this claim ‘in principle’ rather than through facts, it is on the level of principle rather than by establishing contrary facts that interrogation occurs.

2.7 The concord of the faculties

This principle relates sense to its object through a specific method, that of recognition. As Deleuze writes: “Recognition may be defined by the harmonious exercise of all the faculties upon a supposed same object...”³¹ Objects are recognized when a faculty locates a similar impression in an adjoining faculty. Recognition therefore works according to a concord of the faculties, whereby the unity of impressions in different faculties accords with the unity of the object being recognized. The moment in which the idea of common sense is translated into a philosophical concept is based in the following idea: if the appeal to common sense and its affinity for truth is correct, the faculties must ‘collaborate’ in the same way for everybody.

The following three postulates bind Plato, Descartes and Kant to a conception of philosophy as doxa based on an image of man as possessing a natural and innate inclination for the truth. 1) The naturally upright nature of thought. 2) The purity of

common sense, which follows from it. 3) The model of recognition, which follows from this purity. The critique of thought as recognition is made on creative terms, it is not the already recognizable that must be attended to. This places no great demand on thought, in fact if common sense is the ground on which philosophical thought is built than philosophy can only appear as a redundant encrustation on a more fundamental and primary process. Rather, it is that which cannot yet be recognized – that is to say the newly created – that spurs thought to think itself anew: “The form of recognition has never sanctioned anything but the recognizable and the recognized, form will never inspire anything but conformities. Moreover while philosophy refers to common sense as its implicit pre-supposition, what need has common sense of philosophy?”³²

There is certainly something aristocratic in Deleuze at this point, reserving a privileged position for thoughts that are singular in their creative intensity. Returning to his critique of Descartes and the grounding of thought in acts of recognition, Deleuze argues that part of this principle weakness is its grounding in banal mechanical facts of reception, such as: ‘the cow recognizes the grass’. The alleged transparency of this model, where the faculties naturally converge on the nature of an object is questioned, since if we are taught how to apprehend every act of recognition carries values that are - to greater or lesser degrees – already culturally established.³³

It is at this point in the chapter that a slow twisting process starts to emerge, with Deleuze turning away from critique towards a positive formulation. Deleuze signals this by employing a Platonic dialogue in which the question of perception as *recognition* vs. perception as *disturbance* is raised. While recognition has been the subject of the previous critical analysis, now disturbance will be elevated to a positive feature of thought, freeing it from representation. The dialogue Deleuze turns to in this chapter concerns acts of perception in which the object of perception cannot be recognized, provoking thought to the point of uncertainty. Deleuze will use this to posit a notion of thought as encounter, writing that: “something in the world forces us to think. This something is not an object of recognition but of a fundamental encounter. What is

encountered may be Socrates, a temple or a demon. It may be grasped in a range of tones: wonder, love, hatred, suffering. In whichever tone, its primary characteristic is that it can only be sensed.”³⁴

The event of thought takes place in the world, deployed among things and circulating in the traffic of signs they emit. A sign is emitted when an object is no longer recognized as an object, but rather is encountered as a bundle of relational qualities, something being bigger or smaller, brighter or darker, louder or quieter. Though recognition attempts to tie these qualities back to the object in a clear way, there is a moment in which they present themselves to perception, provoking confusion and ‘perplexing the soul.’ Between this moment of initial discord - however slight - and the eventual formation of a concept for the object, Deleuze opens a space for an intricately structured account of the individuation of thought that will counter *the idea of the unspecified object as the correlate for the concord of the faculties in common sense* with the *idea of the sign as the correlate for the discord of the faculties and the problematic individuation of concepts*.

2.8 Kant’s analytic of the sublime

Deleuze draws on Kant’s analytic of the sublime in a gesture that is simultaneously a perversion and expansive generalization of the theory. The sublime is the one moment in Kant’s philosophy where a clear discord of the sensory faculties emerges, since the sublime occurs when an experience of pain cleaves the subject in two - a split in the face of the immensity of experience that cannot be processed, a discordant accord between the demands of reason and the faculty of the imagination. With regards to experience, this discord is an impossibility, its sensory dimensions cannot be accessed, imagined or reconciled, “but from the transcendent point of view, it is that which can *only* be imagined, that which is accessible *only* to the imagination in its transcendental exercise”.³⁵

According to Deleuze, Kant turns the discord of one faculty into the conditions of possibility for the accord of another. This move is clearly of great interest; it is the only moment in the Kantian project where discord rather than concord forms the condition of emergence for thought. Even though Kant will eventually resolve this discord transcendently, Deleuze will abstract from the Kantian schema, transplanting it from its origin within the theory of the sublime and generalizing it into the basis for all psychic individuation, such that thought would always be “communicated violently from one faculty to the other...”³⁶

The inherent ambiguity of the event is not a lack, it is an objective feature of the sign being emitted, and it disturbs the faculties, solicits the attention of the intelligence and calls on perception and memory to continue their inquiry. The schema recalls the mind of a paranoid lover more than a philosopher, someone for whom signs produce immediate pre-conscious intensity like a photographic plate registering particles of light. It is the chemical sensitization to the particle sign that initiates the production of thought, a model of truth grounded in intensities rather than *philia*, grounded in madness perhaps more than a common, reasoned inclination. In order for thought to take place, the world must provoke the perceptual apparatus of the mind into being, without recourse to explanations grounded in an innate ability to discern true from false. As Smith notes: “By taking the encountered sign as the primary element of sensation, Deleuze is pointing, objectively, to a science of the sensible freed from the model of recognition and subjectively, to a use of the faculties freed from the ideal of common sense.”³⁷

In the fifth postulate, Deleuze takes aim at the idea of error as 'a possible misadventure of thought', an accidental leading astray of faculties otherwise naturally inclined toward truth. If error is said to emerge from a mistaken apprehension of the faculties such that one faculty does not accord with another, then another name for error might be 'false recognition'. This purely negative definition of error as 'that which fails to recognize that which is true' only serves to re-enforce the 'image of thought' Deleuze sets

out to critique, an image of the faculties naturally tending toward correct apprehensions.

Deleuze puts it in the following way:

Error is only the reverse of a rational orthodoxy, still testifying on behalf of that from which it is distanced – in other words, on behalf of an honesty, a good nature, and good will on the part of the one who is said to be mistaken. Error, therefore pays homage to the ‘truth’, to the extent that, lacking a form of its own, it gives the form of the true to the false.³⁸

For Kant, the natural state is dogged by the possibility of error, which nonetheless does not preclude thought from being grounded in natural law. Error in this sense should be understood as the accidental distraction or diversion of thought away from its natural inclination. This propensity for error is far from being a critique of moral value within thought; instead the error serves to reinforce it by reflecting the idea of truth back through a principle of rectification.³⁹ In other words, thought is pure until it is destabilized by something external, and so the idea of stupidity, malevolence and madness are actualizations of the same mechanism, they are indistinguishable from the point of view of the principle in which something external arrives to disturb the *Cogitatio natura universalis*.

Deleuze wants to pose a different sort of problem to that of error as a negative image of the true. Rather than ask ‘why error?’, he will ask, ‘why stupidity?’. His reasons for posing this classical question in entirely new terms begin with empirical evidence of stupidity in history and the irreducibility of stupidity to mere error or misrecognition.⁴⁰

Rather than account for the historical evidence of stupidity in terms of an exception or aberration from an innately good human nature, Deleuze will elevate the idea of stupidity to a transcendental level, he will attempt to furnish the transcendental landscape with places for tyrants, slaves and imbeciles, arguing that

they are far from psychological aberrations or anecdotal incidents, they are structural features of the thought. Following Baudelaire, Flaubert and Bloy Deleuze will attempt to give the problem of stupidity its full cosmic, encyclopedic import.

2.9 The apprenticeship of the senses

If it is true that *Difference and Repetition* can be understood as a book of pure pedagogy, than this impression is confirmed in the last postulate on learning, in which Deleuze draws on the idea of stupidity to set out a concept of the problem as ontological and the error as mere ontic feature. He will do this by examining an idea of the problem according to relevance, rather than to the truth or falsity of a solution as it might be classically posed. The idea of relevance within a problem is, for Deleuze, exactly equivalent to its force, that is, its ability to transform further questions. Rather than ask what is the solution to a problem, he will ask: how many other problems does this problem produce or otherwise transform? Deleuze explains this, strangely perhaps, by referring to homework:

Teachers already know that errors or falsehoods are rarely found in homework... Rather what is more frequently found – and worse – are nonsensical sentences, remarks without interest or importance, banalities mistaken for profundities, ordinary points confused with singular points, badly posed or distorted problems.⁴¹

This is a critical passage in *Difference and Repetition* since this is the moment in which Deleuze specifies the re-orientation of thought and individuation in philosophy around the structure of problems themselves.⁴²

Deleuze uses the example of a proposition and its relationship to sense to make the point. It is not a question of whether the designated object in a proposition is true or false. For example, in the hypothetical statement: ‘the man is sitting’, the

designated object – the man, expresses the sense of the statement correctly (that he is in fact sitting) since the incorrect application of the proposition – say to a man who is standing still - makes sense regardless of whether it is correct or not. As Deleuze writes, “A false proposition remains no less a proposition endowed with sense.⁴³”. Deleuze's attitude here is interesting, he does not want to consider the logical formalism of the proposition in isolation from the conditions that make it operative, in this way it is less a question of whether the designation and the expression accord with the empirical reality of the situation, but more a consideration of the background conditions that form the environment in which this statement can come to be uttered, such that its importance or relevance *relies on* the situation in which the proposition is uttered. Because sense forms an implicit rather than explicit condition of any proposition, it is structurally always located in a ‘sub-representative domain’. Meaning, it can only be said transcendently and not empirically.⁴⁴

2.10 The topology of the problematic

Sense is the texture of the topological landscape used previously to describe the way problems orient collective forms of subjectivity. As Deleuze puts it:

Far from being concerned with solutions, truth and falsehood primarily affect problems. A solution always has the truth it deserves according to the problem to which it is a response, and the problem always has the solution it deserves in proportion to *its own* truth or falsity - in other words in proportion to its sense.⁴⁵

The reference to something 'deserved' and in 'proportion' in the above reference occasions another point of reflection on the importance scale plays here, in that the correlation between the problem and the field of solutions it actualizes can be determined according to some value. Though Deleuze makes few references to the question of scale in an explicit sense, the progressive specification of actual parts from a virtual problem suggests an implicit importance for the concept, no less real for being unarticulated.

In order to give the idea of a 'problem' its full weight and importance, it is necessary to go back to Gaston Bachelard, who uses the term in his work on the history of science. Bachelard's work, especially the critique of Cartesian epistemology and the history of scientific inquiry, would influence some of the most important epistemological work in France, important for Georges Canguilhem and Michel Foucault whose concept of 'episteme' and 'problematique' draw on Bachelard. It is not until *Difference and Repetition*, especially in the chapter *Image of Thought* that idea of the problematic created by Bachelard becomes radicalized, acquiring its full theoretical force. If its origin in Bachelard's work is obscure due to uneven translations of his work on the history of science into English, it is a well-established concept within French pedagogical thought, as Patrice Maniglier suggests: "A problematic in this pedagogical sense is not simply a set of questions; it is rather the matrix or angle from which it will become possible and even necessary to formulate a certain number of precise problems."⁴⁶

The idea of the problematic is perhaps key to realizing Bachelard's distance to Cartesian ideas of rationality.⁴⁷ As set out in the first chapter of the thesis, scientific reason depends on the natural accord between clear and distinct perception, and the essential qualities of matter – an accord on which all Cartesian reason is premised. However, this accord does not survive the scientific developments of the twentieth century, in which scientific phenomena are no longer available to the eyes and begin to appear *through* the complex mediations of mechanical instruments and scientific apparatus. Natural perception and observation skills become less and less important as developments in both chemistry and physics began to take place at a sub-observational

scale.⁴⁸ Bachelard thus gives birth to a shift, in which the productivity of a line of inquiry comes to supplant truth - taken to mean a clear and distinct correlation between a mental perception and an objective fact in the world.

Science does not proceed by filling in epistemic gaps in conscious perception; instead it is mobilized around the animating force of a problem, which forms the genetic condition of possibility for correlations between knowledge and objective facts. Reason has a history, and its history is produced through a series of shifting problems. This productive turn is clearly what appeals to Deleuze in Bachelard, though he will radicalize the sense that, for Bachelard, this animating force eventually takes a rational, communal and ultimately progressive form. There is an important point to make here. For Bachelard the problem takes on a wholly ontological reality in the world, it is not that the mind poses problems in the abstract sense, but that problems have autonomy of their own, exerting an agency on the minds that are drawn towards it.

2.11 Collective individuation

Importantly, the genetic function of the problem does not produce truth in a revelatory moment; instead scientific truths are progressively structured in an endless process of rectification and refinement.⁴⁹ Writing in *Corrationalism and the problematic* in 1975, in words that recall the later work of Bruno Latour, Bachelard states: “Thus between the two poles of the *world* destroyed and the *world* constructed, we propose simply to slip, *the world rectified*”.⁵⁰ The idea of rectification within Bachelard operates as a value able to guide the continual recalibration of scientific knowledge, leading to ever more precise kinds of statements and as usually expressed through finer and finer forms of measurement. This process is first established according to what Bachelard describes as an ‘approach structure’, a vector or entry point into any given problem. The approach structure is simply the initial terms in which a problem might be posed. It is important because in work that will eventually lead to Foucault’s notion of the episteme Bachelard understands that the truth of any scientific activity is immanent to the terms of the

problem it inherits or sets for itself. Or, as Bachelard puts it, “One must in this case know the method of knowing in order to seize the object to be known.”⁵¹

Moreover, the problem tends to inspire a collective discourse and a common form of inquiry that begins with what Bachelard describes as ‘inter-rationalism’ or a preliminary setting out of the field of inquiry and proceeds forward according to a ‘co-rationalism’. This can be explained whereby a group of intelligent subjects pursue a common line of inquiry according to an agreed upon field of terms. As Bachelard states:

In order to understand the statement of a problem, it is necessary to normalize the neighboring questions; in other words it is necessary to develop a kind of topology of the problematic... ..to be clear: to pose an intelligent problem to intelligent human beings is to determine a union of the intelligences.⁵²

The social dimension of scientific verification therefore plays a central role in Bachelard’s idea of epistemology, since objectivity cannot be detached from the social characteristics of proof. This may begin to recall the tradition of American pragmatism, especially the idea of the problem in relation to the forms of association that make up a public, for example, in John Dewey.⁵³ The reference is no accident; Bachelard draws on the work of Dewey but especially of William James, who as Mary Tiles points out is referenced no less than 14 times in the introduction to the *essai*.⁵⁴ It is the process based, immanent nature of inquiry that Bachelard finds useful in pragmatism, allowing him to formulate an epistemic theory outside of transcendental ideas around the foundation of knowledge or the security of method.

Returning to *Difference and Repetition*, where the subjective pre-supposition located in common sense, which underscores the natural inclination for truth, comes under attack, it is possible to note the exact moment in which Deleuze both agrees with and departs from Bachelard. Remember that for Bachelard, scientific thought had to also

“break with common sense, and this transition amounts to an epistemological rupture.”⁵⁵ Yet it also clear that Bachelard fully accepts as inevitable the return to normativity after this rupture, once the break has been assimilated and new epistemic values come to replace the old. In this regard Bachelard’s idea of scientific history is dialectical.⁵⁶

Deleuze shares Bachelard’s commitment to raise the status of the problem from its association with insufficient information to one in which the problem takes on a properly objective ontological status. Deleuze is trying to shift the understanding of what learning means, from something like a simple passage from insufficient to sufficient knowledge. The process of learning is subordinated to the supposed result of its exercise; knowledge. But they differ radically in their philosophical ambitions. Bachelard will ground the pursuit of scientific truth in the value of intelligence, innate cooperation, agreement and ultimately to the progress brought about by successive refinements to the precision of the statements that can be made. Deleuze has an entirely different model in mind, insecure in its moral value, ungrounded in natural virtue, lacking in good faith: “Who is it that in fact searches for the truth? It is not the friend says Proust, exercising a natural desire for the truth in dialogue with others, but rather the jealous man, under the pressure of his lovers lies, and the anguish they inflict upon him.”⁵⁷

As noted previously, it is malevolence and cruelty that must be explained as well as innate virtue. The problem does not naturally inspire virtuous accord of the faculties or of reason, instead it is a geometry of power that conditions the cases that form its solutions – in the process structuring not just a field of inquiry but a series of asymmetrical relations between subjects.⁵⁸ Deleuze puts it as follows:

We are led to believe that problems are given ready-made, and that they disappear in the response or the solution... According to this infantile prejudice the master sets a problem, our task is to solve it, and the result is judged true or false by a powerful authority. It is also a social prejudice with the task of maintaining us in an infantile state, which calls upon us to solve problems that

come from elsewhere, consoling us or distracting us by telling us that we have won simply by being able to respond, the problem as obstacle and the respondent as Hercules.⁵⁹

The example cited above illustrates Deleuze's own vector of approach to the individuation of thought, in that he tracks the vector of power that tethers a master to their student. He emphasizes relations between individual conceptual personae such as tyrants, pedants and teachers. It is interesting that the critique of the *sensus communis* proceeds along such lines, when it might be expected that an alternative account of collective individuation would form more of the focus. Indeed in his later work with Guattari, the question of collective subjectivity will return in an important way, especially in the first volume of *Capitalism and Schizophrenia; Anti-Oedipus*, but also much later in *What is Philosophy*.⁶⁰

What is important to take from the preceding argument is the idea of the problem as something that triggers transformations in ontological and epistemological registers. In summary, and starting with Delanda, an attempt was made to form a direct and objective correlation between the causal structure of a phenomenon and its explanatory structure. In order to open a space between philosophical speculation and scientific inquiry and drawing on the work of Deleuze, it was argued that the question of correlation between a phenomenon and the explanation must be extended to take into account the field of problems in which the explanation was embedded. Unlike Bachelard for whom the field takes on a fundamentally convergent quality, Deleuze emphasizes its basically divergent nature.

In what follows, Foucault's work provides another perspective on the field of problems and their capacity to consciously or subconsciously orient attention. By examining Foucault's work in the conclusion to this chapter it will be possible to more precisely historicize the objective claims for correlation made by Delanda and to understand the topological field of problems as it is manifested within discourse.

2.12 The historical *a priori*

In the early work of Foucault, especially *The Archaeology of Knowledge* and *The Order of Things*, it is possible to detect a different sensibility at work from the one attributed to Deleuze in the previous section. Employing Foucault, a critique of the thought in the individual can be expanded into a critique of collective knowledge, what Foucault will call a 'discursive formation'. The discursive formation can be understood as a collective and anonymous drift that conditions in advance what can be said, what can be asked, and how meaning follows from this. Foucault ungrounds the stability of collective forms of knowledge by introducing an idea of epistemic drift and rupture, which he describes through the idea of the historical *a priori*. What is common to both Deleuze and Foucault, despite the clear methodological differences between writing philosophy and history, is a specific relation between the depth and surface, figure and ground, in which the ground continually rises up to the surface. This relation is complex in Foucault, at times it is referred to in subterranean terms, something like the deep currents of the Annale school, but conversely this depth and its drift is formed by the most surface like of elements, mundane documents or records. *Savoir*, *episteme*, *archive* point to different aspects of this surface/depth theme that work to structure and systematize the possibilities of discourse. Both Foucault and Deleuze mine a sub-conscious space, a sub-representative domain in history and philosophy respectively. This idea of an unarticulated depth behind knowledge leads to a number of claims, as Ian Hacking states:

First Foucault commits to the idea that what counts as a statement is more regulated than we might care to think, and that these regulations change over time. Second, what appears to be a competing position within a field often merely occupies a different position within the same system of rules. Third, the depths that characterize systems of thought are often anonymous and autonomous, that is they are reproduced

through countless procedures and practices that unconsciously put them into play. Fourth, the collective interaction of these theses gives the subconscious below any system of thought.⁶¹

Foucault is aware that the historical depths he is trying to sound will not be reducible to individual psychology nor to psychic and causal explanations of interactions between social groups. Setting a different tone to that articulated by Deleuze in the aforementioned work, As Han suggests, Foucault fears that these factors would be “too susceptible to variation from one individual to another, and which could not determine necessarily the way that given knowledge of an epoch must be formed”.⁶² He sets out according to a different method, drawing from the French epistemological tradition of Bachelard and Canguilhem. The archaeological method extends the insights of its preceding work *The Order of Things*, which is less an analysis of the relation between norms and empirical practice and more a tool for uncovering the generation of norms as such. The generality of this ‘*as such*’ creates a difficulty for Foucault since it is an attempt to determine the conditions of possibility for knowledge *abstractly* and without recourse to specific empirical bodies of knowledge. Foucault thus moves beyond the horizontal relations *between* practices within and between disciplines, supplanting them with a vertical axis in which a new and productive relation between depth and surface begins to take shape. Han describes this as follows:

By contrast the specificity of the Archaeology is that it revives the critical question this time through a ‘vertical displacement’ that “questions thought at the level of what made it archaeologically possible”, the opposition between the surface, where continuities and discontinuities are inscribed, and the depth analogically taking up the distinction set up by the critique between founded and founding.⁶³

The difficulties set out for this critical project are as follows. First: to avoid the psychologically reductive explanatory frameworks of Bachelard (Foucault's predecessor)

so that a discursive anonymity can be constituted. Second: to produce a deep history of the sort practiced by the Annales School, but with shifts and regularities in discourse taking the position of shifts and regularities in climatic, economic or geological registers. Third: to avoid the Kantian position in which the intrinsic nature of the faculties form *a priori* limits on the use of reason in order to historicize reason itself. With these speculative limits in place, the ambition of the curious concept Foucault develops is to provide *a priori* conditions for thought that do not lie outside of history.

This concept is critical within the current inquiry in that it furnishes the abbreviated description of a collective topology of problems in a more rigorous manner. The problematic sense in which Foucault understands the historical *a priori* is implicit in *The Archaeology of Knowledge*. Later however, Foucault will refer to it by the expression 'problematique'. In *Fearless Speech*, Foucault expresses the following about this historical approach:

I would like to distinguish between the 'history of ideas' and the 'history of thought'. Most of the time a historian of ideas tries to determine when a specific concept appears, and this moment is often identified by the appearance of a new word. But what I am attempting to do as a historian of thought is something different...The history of thought is the analysis of the way an unproblematic field of experiences or set of practices, which were accepted without question, which were familiar and 'silent', out of discussion, becomes a problem, raises discussion and debate, incites new reactions and induces a crisis in the previously silent behavior, habits, practices, and institutions.⁶⁴

The individuation of the problem and its capacity to orient practices, habits, and behaviors receives various treatments in Foucault's work, beginning with the methodological focus of the early work and moving to a disciplinary focus later. What holds them all together is a unique approach to the status of history, in which facts and

events do not simply accrue, one on top of the other, instead with each epistemic rupture, a new problem emerges - not simply in addition to others - but retroactively transforming them also, each new problem producing a new world and its attendant set of meanings. In the conclusion to *Fearless Speech*, Foucault refers directly to the individuation of the problem as follows:

From the methodological point of view, I would like to underscore the following theme. As you may have noticed, I utilized the word *problematization* frequently in this seminar without providing you with an explanation of its meaning. I told you very briefly that what I intended to analyze in most of my work was neither peoples past behavior (which is something that belongs to the field of social history), nor ideas in their respective values. What I tried to do from the beginning was to analyze the process of "problematization" which means: how and why certain things (behavior, phenomena, processes) became a *problem*?

Though Foucault does not elaborate upon this in direct terms, nor spend much more time attempting to come to a definition, the sense in which a problem individuates, and the sense to which his method can be understood as attending to this genesis is abundantly evident within his work. It may seem that there is some distance between the earlier inquiries into individuation as with Simondon, and its focus on material behaviors, or for that matter Delanda's epistemic model of scientific practice in regards to dynamic systems. The argument being made here is that epistemologies have a history, and these histories emerge in response to the individuation of a new problematic, then it is possible to conceive of epistemological history in something akin to materialist terms. This materialism of thought cannot secure thought with regards to its object. Recalling the introduction to Chapter 1 *The Scale of Matter*, in which both Turing and Longo suggest that that there is something objectively ambiguous in any dynamic system, then following from this, if thought is to be treated in materialist terms, the question that presents itself must be; is there something analogously ambiguous in thought itself? In order to answer this question, it is important to return to Deleuze and ascertain the

relation between the concept of *sense* and Foucault's notion of the historical *a priori*. What is at stake here is more than a conception of history as dynamic and ever changing, instead it is the stronger claim that any epistemic determination carries within it an undetermined charge which literally opens it to multiple actualizations. The idea of the historical *a priori* is very close to what Deleuze will mean by 'sense', in that is an invisible, mobile, sub-representative domain against which any statement or action must rely on order to acquire meaning. In many ways, the Deleuzian critique in *The Image of Thought* resonates with the Foucauldian critique of history as a series of empirical events. What brings their work into proximity is a shared commitment to a depth-surface relationship in which the depth is anonymous, unstable and active, and the job of the critical historian or philosopher then is to play the role of archaeologist and conduct a historical exhumation.⁶⁵ In one of the most powerful passages in *Difference and Repetition*, Deleuze describes this action as follows:

However, instead of something distinguished from something else, imagine something which distinguishes itself - and yet that from which it distinguishes itself does not distinguish itself from it. Lightning, for example, distinguishes itself from the black sky but must also trail it behind, as though it were distinguishing itself from that which does not distinguish itself from it. It is as if the ground rose to the surface, without ceasing to be ground. There is cruelty, even monstrosity, on both sides of this struggle against an elusive adversary, in which the distinguished opposes something, which cannot distinguish itself from it but continues to espouse that which divorces it.⁶⁶

The elusive adversary that Deleuze refers to here is the *aporia* within representation that always works to undermine its security. Instead, there is an immanent relation between the pre-individual background and the individuated element, a background that is always immeasurably in excess of any articulation and therefore ambiguous. More importantly for the aims of this thesis, is the way that this immanence

takes on a specifically scalar form. In order to set this out more clearly, it is important to introduce the work of Alan Garfinkel in more detail.

2.13 Explanatory scale

In *Forms of Explanation* Alan Garfinkel sets out a methodical critique of reductionist explanations in the social sciences and – via negativa ends up positing between the lines a positive theory of irredution, and more importantly, of the structure of scale between a phenomenon and its form of explanation. It is worth quoting Garfinkel's text at a little length since it articulates the specifically scalar form of explanation, or as he describes it the relation between micro and macro:

Suppose we have an ecological system composed of foxes and rabbits. There are periodic fluctuations of in the population levels of the two species, and the explanation turns out that the foxes eat the rabbits to such a point that there are too few rabbits left to sustain the fox population, so the foxes begin dying off. After a while it takes the pressure off the rabbits, who then begin to multiply until there is plenty of food for the foxes, who begin to multiply killing more rabbits, and so forth.⁶⁷

In the pages that follow, Garfinkel tells a short biopolitical fairy tale about explanatory scale - though Garfinkel does not use the word scale – preferring to refer to micro and macro levels of explanation. Two differential equations, one for the fox population level and one for the rabbit population level give the macro level. Explaining rabbit death at a macro level means giving an explanation of a statistical regularity, the chance of any rabbit in the group being killed at a specific time. The micro level explanation occurs at the level of the event of capture, when a specific fox eats a specific rabbit. In this case, the explanation would include more than differential variables of rabbit and fox population, potentially including an infinite list of variables for each of the actors such as the topography, aggression, speed as well a historical information

explaining why this specific rabbit happened to be passing by this specific fox at this specific time. As Garfinkel suggests, the contrast spaces for the two explanations are different, the first asking why: (a rabbit was eaten/was not eaten), the second asking why: (the rabbit was eaten by this fox/ another fox).

Garfinkel has a number of points to make in regard to this. The first is that second explanation has a lot of redundant information making it difficult to use for 'practical reasoning' since in many cases – as he says – the reason for wanting an explanation is to prevent or otherwise change something in the future. Returning to the idea of explanatory stability, the question can be tested by determining how small changes to the initial factors influence the outcome of the explanation. For example, in the case of the macro level explanation of the fox and rabbit population, changing the starting populations within a certain bandwidth will have little impact on the periodic repetition of population numbers, neither will changing the starting point or initial population settings, since the underlying structural relation between the populations is stable. In the case of the second micro-level explanation however, a small shift to one of the variables, say a rabbit deciding to graze somewhere else that day, may well mean the difference between being eaten or not. In this sense the second explanation does not capture the structural regularities in the model, which exist only at the scale of the relation between populations. In a perfectly Foucauldian turn, Garfinkel argues with regards to the idea of explanatory resilience, stability under perturbation, and capture of regularities in a population:

This often happens in the explanations of social phenomena. We may explain why a child has certain attitudes by pointing out that it had certain experiences. This teacher said that to them on such and such a day, they saw such and such a movie, all of which had the effect of engendering a certain attitude. But if the attitude is relatively important to society, the means of generating that attitude will not be left to chance; there will be a multiplicity of, a redundancy, of mechanisms to ensue that the child developed the 'right' attitude. ⁶⁸

In other words, given that this specific formative event may not take place (being eaten by a fox, humiliated by a teacher) it is just as likely that some other equivalent and similarly formative event will. Furthermore, attributing the responsibility for either the meal or the humiliation at the level of the event and the actors involved, obscures their unthinking installation in a larger matrix of structural forces in which their actions are not even their own. Further, Garfinkel argues that explanations seek their own level, or that they cannot be reduced to – and therefore have autonomy from – the level of the substratum. The nature of this autonomy will need to be clarified later, but first it might be worthwhile to try to put this statement a different way, not as a negative statement of critique aimed at reductionist explanations, but as a positive statement of difference between different scales, and thus also the possible incommensurability of the different explanations used to describe them.

Much like Delanda, Garfinkel gives a topological account of the sub-stratum or sub-representative domain upon which these explanations are built. Making cursory references to the work of Rene Thom, Garfinkel argues that the virtual topological space in any explanatory statement is structured so that it is isomorphic with the causal structure of the phenomena in question. In other words the explanation has an objective relationship to the phenomena it is meant to describe. The question however, is exactly where the aforementioned ambiguity lies. Delanda's literalist interpretation of it correlates the ambiguity of complex behavior to the indeterminacy of the phenomena – a point on which Garfinkel would certainly agree. However the Garfinkel makes an additional point, which relates to the broader context in which this specific inquiry is assessed: not according to its truth but to its relevance within a larger discourse.

In other words there is a scale that exists between the level of explanation (individual fox or fox population) and the phenomena (mortality of foxes), but more interestingly another scale pointing in the other direction which is why problem of fox mortality is worth asking. Clearly the fox question is an example, and the work it is

meant to do is to explain a concept of explanatory scale. Nonetheless, the status of the explanatory model exists in two senses, only one of which attracts attention from Delanda. The other sense, in which this specific problem becomes true - not in the trivial sense of being correct rather than being false - but in the larger sense of making intelligible the distribution of what is deemed relevant or not, attracts no attention at all. It is here that the missing political dimension to Delanda's scalar argument makes itself felt, in that this relation to the field of thought should be understood as a complementary individuation, in which a new collective form of subjectivity is oriented around the emergence of a problem.

In the case studies that follow, the idea of collective individuation will be drawn on in order to show that way in which each scalar problem acquires its sense only in regards to an unstable series of background events. This objectively ambiguous ground continually shifts behind the apparent transparency of the problem, making judgments as to its success or failure, relevance or ordinariness entirely dependent on the historical currents it moves within. The idea of history that emerges from this is one that is far from unified, nor can it said to have an end or progress in a total sense. Rather with each drift and break of this indeterminate background, one new set of problems comes to replace the old ones. Because both Simondon and Deleuze can be said to have forward oriented ontologies in that they are mainly concerned with the question of creativity and production, concluding this chapter on a historical note may come as a surprise. And yet, in setting out the case studies that are to follow according to the genesis of scales that they exemplify, the preceding concepts of history become crucial. What would it mean to give an account of the genesis of a scale if not to tell the story of its history? What is unique in the particular mode of historical explication that will follow is that abides by a different set of dictates to conventional historiography, interested neither in a periodization in time or localization in space. Instead the following histories emerge in relation to the scale of a problem. Furthermore, the thesis speaks of scale in the plural since the problems that follow are multiple and there is no ultimate scale in which they reside or that would unify them into a whole.

DISCIPLINARY PROBLEMS

3.0 Introduction

The previous two chapters of this thesis introduced preliminary arguments with the aim of establishing a supportive theoretical context for the idea of scale. These supportive arguments were developed along two fronts; in the first chapter according to a critique of the idea of hylomorphism in philosophy, especially philosophical reflection on science, in the second, according to a critique of the idea of transcendental objectivity and relevance vis-a-vis a problem. The former established a notion of ontological individuation, the second advanced an idea of epistemological individuation. It was argued that this co-individuation of phenomena and the epistemic frame that emerges was a specific kind of relation, one that had previously remained theorized and obscured by conventional use. Far from being pre-supposed then, the formation of a scale – whether ontologically or epistemologically – is subject to a process of genesis. The genesis of the scalar problem takes shape against a background that is indeterminate in both epistemic and ontological registers. Methodologically, this places certain demands on the

writing and explanation within this thesis, demanding not just a history of scale but also historiography of the background against which this history acquires its sense. In order to give a concrete example of this, the present chapter *Disciplinary Conflict* will examine a discipline in which the treatment of scale as a concept in its own right has assumed a singular importance, that of geography. By doing so, a bridge between the explicitly theoretical concerns set out in the first section and the concrete historical events set out in the case studies to follow can be built. Furthermore, by attending to a dispute around scale within a disciplinary setting, the tension between a theoretical explication and a series of practical problems can be elucidated in more precise terms.

At stake within this chapter is the way the scale of socio-political phenomenon provoke, reflect and depend upon a scalar structure of disciplinary inquiry and the scalar division of labour that goes with it. It is not just disciplines such as geography that depend on scalar categories. Institutional jurisdiction, territories of governance and dimensions of political representation are all spatialised at different scales, such that scale is one of the primary forms in which power, as well as knowledge, is organized. As Cox suggests:

Politics-political sociology, political economy, political geography and political science proper-divide up the subject matter of politics is in terms of various spatial qualifiers: local, sometimes regional, national, etc. These ideas are also expressed in the world of politics itself: there is reference, *inter alia*, to *regional* planning or *neighborhood* conflicts. There is, in other words, a scale division of politics.¹

For Cox, scales have a reality independent of the framing of disciplines such as geography at least in so far as they are used to specify the spatialisation of power and knowledge.

The stability of these spatialisations comes increasingly into question. The onset of financial integration and climate degradation, to take two obvious examples, bind

together distant points in space, producing common risks and shared vulnerabilities that no longer obey the certainties of longitudes and latitudes. The concept of scale within geography has reflected this increasing sense of spatial plasticity, more and more being understood as something that it always in the process of re-scaling, stretching and contracting in response to different pressures. This ontological complexity has - an this is the sense that one takes from the literature within geography - raced ahead of its epistemic frame, resulting in an intellectual struggle to invent new scalar frames capable of capturing capitalism's paradoxical and contradictory spatialisations.

3.1 Scale in geography

Beginning with the Marxist inflection in geography in which the capitalist mode of production is said to have produced a distinct form of spatiality, the following chapter will track the contours of the dispute around scale within geography, setting out important stakes within the argument, the contest over key scalar terms such as the 'regional', the 'urban', the 'local', and conclude by examining the conceptual dispute over scale as either an epistemological or ontological category. Geography, more than any other discipline, has recognized the centrality of scale as a way of thinking about the world and its complexity, especially since the 1970s with the intensification of globalization. This sustained interest within geography – taking in almost all of its sub-disciplines – has led to a vigorous dispute over the precise meaning of scale. This dispute has been articulated according to lines of inquiry that will now be familiar: the ontological and the epistemic. Furthermore, geography, again like no other discipline except perhaps biology, is itself organized into a multi-scalar disciplinary structure, with urban, regional and territorial sub-disciplines. The stakes for the conflict within geography then is not just a refinement of the vocabulary and conceptual apparatus of the discipline, but the structure of disciplinary organization itself. The introduction of the concept of scale into geography begins with the work of Lefebvre in two senses; first Lefebvre introduces an idea of space as a plastic agent of social and economic relations,

and second he sets out in prescient terms many of the questions posed by globalization, it is with his work that this chapter will turn to first.

The Production of Space announces in a singular way, the presence of a concept, that of 'space', within the very center of social, political and philosophical speculation.² Drawing on a Marxist-framework and themes formulated during his involvement with the *Situationist Internationale*, Lefebvre's thesis is unique for reconsidering the concept of space as something more than a container for the various events, objects and processes that take place inside it. For Lefebvre, space was not only a stage; it was a theatre of production, something active, continually reproduced through various scales of social and representational practice.³ In this theatre, the script and performance are orchestrated by a capitalist economy. Space is reconceived, no longer as a natural given or an inert background. Instead, in Lefebvre's view, space is both a reflection and driver of social forces. Lefebvre intends to critique the hylomorphic conception of space as transparent, self evident and separate to social activity, instead proposing that life and space dialectically produce and pre-suppose each other. Lefebvre's target is the crushing rationality of capitalism, believing that control over space is control over entrainment to capitalism. He sets out to decompose the material dynamics of capitalist spatialisation and so to uncover a hitherto obscured dimension to capitalist organization: its dependency on, and construction of spaces for social, economic and political relationships. Lefebvre suggests that the exclusion of space as an operational category from the analysis of capitalism is mirrored in a specifically scalar division of labor, whereby different disciplines and the spaces they take as their object become over-coded and stabilized through delimited bodies of knowledge.⁴ Lefebvre calls for an intellectual practice that is able to work across this division of labor such that the complex relation of spatial parts can be reformulated on proper terms. The critique of the way knowledge, and knowledge production, had also become subject to a division along the lines of disciplinary expertise resonated within geographical disciplines.

Though published in France in 1974 and translated into English in 1991, *The Production of Space* nonetheless it had a powerful influence producing a distinctly, spatial and urban turn in geography and political theory, influencing figures like Edward Soja, David Harvey, Manuel Castells and Frederic Jameson and bringing 'space' into the analytic frame in an original way.⁵ It is possible to articulate two divergent intellectual trajectories on the idea of scale from the mid-1970s onward. The first emerges from a neo-Kantian position in which scale is understood as an ideal mental construct used to apprehend phenomena but not an ontological claim about the scalar form of phenomena themselves.⁶ The second trajectory, which can be traced back to Lefebvre, is a Marxist materialist perspective in which scales are taken to be concrete features of the real world. As will be shown this split continues to shape the discourse around scale to the present day.

3.2 Marxist critique of hylomorphic spatiality

The work of Neil Smith can be seen as a development along the latter Marxist line, picking up the work of Lefebvre but also extending it in specific ways in light of the unique pressures emerging in the 1970s and 1980s.⁷ Neil Smith's seminal *Uneven Development* can be read as both a critique and continuation of a hylomorphic conception of capitalist spatiality. Intrinsic to Smith's work is a materialist perspective on social relations, one that would de-naturalize them according to processes of capitalist production. For Smith, it is not that capitalism is structurally pre-disposed to develop space unevenly, but rather that capitalism secures, guarantees and indeed depends upon the spatial differentiation of surplus value, such that it must continually expand its production base in order to stave off the inevitability of a dwindling rate of profit. This makes any possibility of spatial equilibrium – and therefore of *even* development - a strict impossibility, since the drive to competitive advantage will always impel capitalist production to disturb the possibility of economic equalization. This disequilibrium produces a highly differentiated scale of development. The premise that some form of *even* development is possible remains implicit in the work despite Smith's argument that

the book intends to analyze a specific form of unevenness that was brought about by capitalism.

Smith thinks of Marx territorially and so he attends to the operational character of urban space, its generative political and economic dynamic. Smith begins his Marxist critique of capitalist spatialization by pointing to the problems with Newtonian and Cartesian spatiality, where space is misunderstood as a container for social and economic relations but in itself remains immune to their activity. Writing at the end of the 1980s in the midst of a global swing to right-wing politics, Smith attempts to re-politicize geographical thought through Marx and against the positivism still prevalent within the field of geography. This positivism was characterized, according to Smith, by a conceptualization of space as nothing more than a series of coordinates. Against this reading, Smith constructs a materialist conceptualization of space *as geography*, in which nature and society are joined by mutually productive interactions. Smith's critique of the idea of space as the abstract mathematical coordinates of location - as in the Cartesian and Newtonian concepts of absolute space and *res extensa* vs. the real abstraction of human labor relations revealed by Marxist geography - should be understood as a specifically hylomorphic critique of a passive, neutral spatiality. Detecting in capitalist development an array of intrinsic material forces that traverse space, reorganizing its centers of production, sites of labor, transportation and resources, Smith's ambition is nothing less than a theory of capitalism's spatial and geographical underpinnings. In order to accomplish this, Smith attempts to demystify the idea of nature as a 'sacrosanct' and separate from processes of production, since this starting point will furnish the theory of uneven development with a kind of origin myth that must be shattered if the interpenetration between capitalism and space is to become evident. Nature enters into the frame of this newly politicized geography, no longer something from which space could be abstracted into parcels or lots. Rather, nature is re-embedded within an idea of space as a matrix of qualities in excess of any calculus.

The success of the Marxist schema in this case is to reveal a multi-scalar structural dynamic that both conditions and is conditioned by geographical space. Scale and scalar differentiation become linked to economic and political processes in conflicting ways through this dynamic because at its core, the spatialization of competition generates disequilibrium because it works across multiple scales simultaneously. The weakness of the Marxist schema is that the hylomorphic critique of space as a neutral container for the reproduction of economic and social relations is displaced into the register of labor and class struggle.⁸ The displacement of the hylomorphic critique from its Cartesian home onto the register of labour and class struggle reveals that the master-slave hylomorphic binary applies to social relations as much as to literally material ones. In Aristotle's terms, for Smith as for Marx, the social body is a passive potency awaiting the directing force of work to give it shape. In order to actualize this latent potency, labour becomes a form giving operation and not just in the literal sense of repetitively shaping nature into a commodity - but of repetitively shaping itself, shaping itself *as a class*. Smith's contribution is nonetheless significant, not least for the nuanced reading of scale that he introduces into the lexicon of Marxist geography. For the first time specific scales will be given a genetic account - and though they carry the residue of a hylomorphic conception of labour, they are also vividly rendered as individuating from the interplay of capitalist drivers rather than merely being applied as pre-formatted spatial categories.⁹

For example, as nature is absorbed into capitalist production, space is re-organized according to mutually dependent spaces of production: urban space, the nation state and global space. Although such spaces exist prior to capital they are nonetheless radically reshaped by it. In this regard, for Smith, the urban scale is the primary geographical scale within capital; the space where it acquires the most concentrated intensity and its most clear form. The urban scale in this case is defined not by an administrative border or agglomeration of municipal districts, but according to the network topology linking places of residence to places of work. Structured by the labour market, it is spatialised by the matrix of distances that form a daily commute. The urban scale is established around production and labour, reproduction and domesticity,

"leading to the local concentration of specific activities and land uses – industrial, transport, residential, recreation, retail, commercial, financial and so forth."¹⁰ On the other hand, the global scale is produced by the drive to re-integrate separate economies so as to produce a world market for exchange and for the circulation of capital. In order to do this, capital must first convert the *world's* labour power to the status of a commodity. The result of the drive to colonize labor and incorporate it within a single market is a process whereby internal differentials between national labour markets both expand and repeat themselves, but this time at the scale of the planet, expressing themselves in pools of mobile labour and doubling the scale of chronic underdevelopment.

The process of equalization, whereby the proliferation of sites of production leads to a dwindling rate of profit, coupled with the intense differentiation at the scale of the urban as well as underdevelopment at the scale of the global suggests the following: if Smith's Marxist perspective is correct, then geographical, economic and political contradictions cannot be reconciled at the scale at which they are posed. The inconsistency of capitalist development therefore extends across the territory but not along a single register, with relations of production and exchange crossing over and superimposing upon one another at many different scales. Indeed, *Uneven Development* paints a complex picture of scalar genesis that moves beyond a simple mosaic of scalar co-existence, scales now overlap, super-impose and conflict with each other. For example, the national scale is the scale at which the management and regulation of the cyclical nature of enterprise within regional sectors can be coordinated. The region in turn can be defined according to the specialization of specific types of enterprise; bound together by shared resources such as skilled labour and held apart by competitive forces, the dynamic connection of these centripetal and centrifugal forces creates a series of plastic economic units which must be coordinated at a national scale as the economy goes through different periods of intensification and crisis.

Smith reminds his readers that what is important in the discussion of scale is not to assume the existence of each scale, but to account for its process of formation. In

Smith's study, the inheritance of conventional epistemic frames often condition the analysis before it begins.¹¹ This tension between pre-existing scalar categories and the intricate and dispersed networks of globalization has formed much of the impetus behind subsequent disputes over the issue of scale. At stake in the various definitions posed for this concept is a questioning of the status of scalar categories, a means of decomposing spatial complexity into a comprehensible form and finally for opening a space for action and intervention within them.

3.3 Disciplinary confusion

Scholars within geography point to a tension between the proper name of a phenomenon – say 'the urban', 'the local' or 'the regional' – and its reality, asking whether the name captures enough of the real qualities or whether it is nothing more than a spatial shorthand which obscures distinct forces by grouping together unrelated concerns. Inquiring into the definition of scale, Kevin Cox puts it as follows: "It is as if the urban, the regional, the national or whatever, just exist as part of the scene – rather than as expressions of the geographical extents of particular structures of social relations that are continually being reworked and transformed."¹² Do these spatial terms correlate to phenomena in the world given the inconsistency and dynamism of the realities they attempt to describe?

Both within geography and architecture, scale forms an epistemic frame that poses the question of specific phenomena in either extent or hierarchy. Extent refers to a non-hierarchical relation between, say, like bodies (such as two municipalities) and hierarchy refers to a 'vertical' power structure linking unlike but related bodies (such as between a municipality and its regional administration). These scalar categories are already materialized within governmental and institutional structures in that municipal governments attend to local needs within either a regional or national governmental framework. Scales therefore have a territorial reality quite independent of their positing within the discipline. Moreover, these frames begin to organize the production of

knowledge within the disciplines themselves, such that specializations begin to form around specific scales. Even though the realities of these specializations almost always overlap, there is no doubt that the emergence of regional geography, urban geography, environmental geography – in both their names and scope – reflect a certain scalar break up of knowledge production that reflects the apparent distinctions in the problems they address. As Cox suggests this is shown by the titles of journals like: "*The international Journal of Urban and Regional Research, International organization, international Studies Quarterly, the Journal of Urban Affairs* and less 'political' serials like *Urban Studies* and *Regional studies*."¹³

There is considerable dispute as to the value of these disciplinary subdivisions, especially in that they inherit the vertical-horizontal extent-hierarchy scalar scaffold. The organization of scale according to a horizontal plane, whereby non-hierarchical relations of proximity predominate and a vertical axis in which power, force and coercion propagate from top to bottom (or contingency and freedom propagate from bottom to top), still characterizes much writing within the field.¹⁴ At stake within these different metaphors are two questions. Firstly, if the extent of knowledge is potentially infinite, how is it possible to carve appropriate frames of analysis from a continuous condition? Secondly, how can the relationships between elements in the analytic space, such that meaningful contacts are produced between them, be understood? These lines of contact should be able to describe a variety of phenomena such as the force relationships in a domestic space, the coercive relation between the police and a population, the agricultural capacity of a territory, the extent of a nativist rights claim etc. In other words what is necessary is not just a series of cuts that divide a continuous condition into meaningful parts so that a limit is produced, but also the establishment of a network so that the relations between those parts and within those limits become meaningful.¹⁵

This is not a straightforward matter and understandably scholars continue to disagree as to how this might best be achieved. It is worth touching on this disagreement as it is exemplified in the work of Cox, Howitt, Swyngedouw, Paasi and Brenner and

provides a sense of the conceptual confusion. For Cox the aforementioned models of scale need to be augmented with a network like model, Cox suggests this because of the problem that 'extra-local' connections pose. For example, when the effect of remittances on a neighborhood economy are linked to non-local networks, such as when these remittances are being transferred through trans-national bank accounts or credit companies. The resulting model of horizontal plus vertical plus networked has in turn been subject to the critique that each new demand placed on a scalar concept simply adds to the existing repertoire of metaphorical notions, subsequently complicating the concept and making it less and less operational. There are further examples, such as Howitt and Swyngedouw's reference to scale not as a 'discrete object' but more as an event or process subject to continual transformation - the phenomena always being something subjected to contestation by scalar politics. Paasi exemplifies this metaphorical layering when he states that: "Scaling is thus understood as a 'technology of bounding', which renders the division of space possible... Plural meaning refers to the production, reconfiguration or contestation of differentiations, orderings and hierarchies among scales, i.e., to the production of differentiated spatial units, and also to their embeddedness/ positionalities in relation to smaller/larger units 'within a multi-tiered, hierarchically configured geographical scaffolding'."¹⁶

This sense of ambiguity in the concept has been described as 'analytical blunting' by Neil Brenner, who argues that scale has become confused with other concepts such as space and place. Brenner asserts that scale is typically used in two ways, the first is to describe a partitioning or limit, the other is to describe a "production, reconfiguration or contestation of particular differentiations, orderings and hierarchies *among* geographical scales".¹⁷ In this second sense, the measure or unit of space is a second order effect of the process, which forms the scales proper genetic condition. Despite his critique of the blunting of the concept of scale, it is also clear that Brenner repeats the same problem identified and attested to in the above by resorting to a string of adjectives that strive to capture the multiple possibilities contained within the concept. Here scale expands as a

concept, attempting to cover everything but finally covering little at all, as a final example Brenner writes:

Scales evolve relationally within tangled hierarchies and dispersed interscalar networks. The meaning, function, history and dynamics of any one geographical scale can only be grasped relationally, in terms of upwards, downwards and sideward links to other geographical scales situated within tangled scalar hierarchies and dispersed interscalar networks . . . Each geographical scale is constituted through its historically evolving positionality within a larger relations grid of vertically 'stretched' and horizontally 'dispersed' sociospatial processes, relations and interdependencies.¹⁸

Not only is scale a process, plastic, entangled, relational and dispersed but also it is able to constitute connections in all directions, all at once.

In summary, within the work of Cox, Howitt, Swyngedouw, Paasi and Brenner, the metaphors for understanding scale include; vertical hierarchy, horizontal relations, networks, multi-tiered scaffolds, positionalities and embeddedness. Additionally, to these spatial metaphors, a further series of terms that explain their transformations are: event, process, differentiation, plasticity, jumping, and bending. When taken together, this series of terms presents more evidence of a dispute, perhaps a deep intellectual confusion whereby the concept expands in order to take on more and more explanatory work but strains to create any sense of clarity or distinctness. The sheer size, scope and complexity of the processes that scale is called on to explain, demarcate and clarify provokes this continual intellectual tension that continually manifests itself within writing on geography.

The problem with these attempts at defining scale is that they have all attempted to literally transcribe ontological phenomena into conceptual language, with each new explanatory hurdle, a further concept is added to a list that becomes increasingly long

and more conceptually diluted as a result. Rather than attempt to stretch the concept further and further so that it attempts to cover all possible phenomena, this thesis has taken a different approach, proposing a method that proceeds by increasing abstraction rather than addition. The aforementioned scalar distinctions fail to come to terms with the phenomena they are attempting to describe because they have not sufficiently abstracted the problem of scale from its specific manifestations.

By conceiving of scale according to a process of co-individuation across ontological and epistemological registers two things stand to be achieved. Firstly, the processual question is placed before the metaphorical concept. It is not that scale is a scaffold first, and then plastic later, it is that the very structure of the scale as scaffold is only ever a consequence of a process of scalar individuation. This process of individuation may well give rise to multiple organizational diagrams, including scaffold like ones, but these diagrams cannot be presupposed as the unit or frame of analysis, instead they are the very things that must be explained in each concrete case of individuation, as will be shown in the case studies that conclude this thesis. Similarly, with descriptors like 'jumping' or 'bending' in reference to scale, no doubt adequately capture certain phenomena, but they are not abstract enough to think scale as a concept independent of the specificity of this or that case. Plasticity is not something 'added' to a scale afterwards, like a quality that makes something stable into something pliable because plasticity inheres in the idea of scale from the very beginning.

In the second half of this chapter some common scalar descriptors will be examined more closely. As suggested in the introduction to the thesis, there are a number of ways to conceive of scale: as a measure, as a proportion or ration, as an indicator of dimension (large or small), but also as a name given to a common set of questions. In the section that follows, the way in which a proper name is accorded to a set of problems will be investigated. Though it has not been thought through in these terms yet, descriptors such as block, neighborhood, urban, regional, local, national etc. already point to the problematic character of scale in that they all bundle together a series of problems.

Though these problems are organized according to a spatial commonality, closer scrutiny reveals that the imbrication of issues large and small, near and far occurs within each of the descriptors. It makes little sense therefore to say that one of these is either larger, further or more proximate than the other since each of them already binds a highly conflated series of forces and events.

3.4 Regional Scale

In geography, the term region typically refers to a spatial entity located somewhere between the urban and the nation. In terms of scope a region will usually include a number of urban centers, their peripheries and hinterlands. The term has leant its name to a geographical sub-discipline of 'regional geography', not to mention a variety of institutional and administrative apparatuses that work at this scale. There are a number of common characteristics that bind together regionally scaled spaces. Such spaces include *environmental systems*, since these often include entire and unique ecosystems, *economic production*, since according to Marx capitalist production operated at the scale of the region more than that of the city in so far as regions formed a locus for concentration of specialist enterprises and commonly skilled labour pools, and finally *cultural commonality*, since many of the disputes surrounding regionalism counter-pose it to the hegemonic claims of the state, allowing it to become a platform used to support claims for regional independence and autonomy.¹⁹

The push for regionalism on economic grounds has been driven by the belief that enterprises based on clusters or local networks of spatial organization produce economic benefit due to the efficiencies of size and the intensification of communication brought about by spatial proximity. The geographer Ash Amin critiques this idea – one heavily supported by government policies everywhere from Europe, to the United States and Australia - arguing that contemporary supply chains are too complex and highly distributed to effectively be understood or governed at a regional scale. Nor are these regional cluster models able to successfully control the myriad of non-regional, financial

and cultural forces they are enmeshed within (as the legacy of the 2008 financial crisis continues to demonstrate). Moreover the idea that with regionalism, power is localized, or devolved from central state control, does not in itself automatically guarantee more democratic processes at the local level. Amin suggests that decisions “in the new regionalism routinely hold that ‘local’ autonomy is empowering, while ‘external’ control is disabling, that local agglomeration increases local returns while global commodity chains seeps profits away, that home-grown institutions are locally-oriented while distant institutions are predatory or indifferent.”²⁰ Against this assumption, Amin argues that local actors are often unable to make decisions beyond their horizon of local interests, this fact alone poses difficulties for political structures that depend on a re-distribution of social goods.

For Amin, the contemporary public sphere is already so highly diffuse, its multiple actors so caught up in complex networks that extend far beyond the bounds of any spatially defined locale, that only a network model based on interrelation – rather than the positioning of actors - can adequately account for the complex play of forces. This critique would seem to put the very idea of place and the region into doubt, but Amin is careful to maintain that this critique is aimed less at negating the idea of the positionality or regionalism, but rather to expose both of these to forces that begin and end in other places. The question remains however, to what extent can a spatial category like regional survive the removal of its spatially delimited quality, when this quality is almost the definition of the concept itself?

3.5 Urban scale

An analogous argument takes place with regards to the idea of the urban. The term is ubiquitous, more so now than ever given the increasing urbanization of the world’s population. The city has become an important arena for deciding how most of the world’s population will socialize, reproduce and make a living. The term urban itself is commonly taken to refer to human settlement that is located in or around city, that is,

in areas in which the built environment produces effects through its density of inhabitation and intensification of social interaction. Kevin Cox's 2001 paper, 'Politics, Territoriality and the Urban', poses the problem in the following terms:

The question in the 'urban question' is the degree to which cities manifest a behavioral, economic, cultural, or whatever, specificity that can be ascribed to specifically urban processes...²¹

Perhaps another way to pose this question is to ask whether a change in quantity – say the population and density of settlement – produces a change in the quality of that settlement? Does the density and intensification of social interaction produced by urban environments have a kind of surplus effect that is irreducible to the sum of the parts? Writing in *Delirious New York*, the architect Rem Koolhaas describes how Manhattan's grid, the elevator and a rampant climate of real estate speculation, interacted to produce a 'delirious' urban condition.²² And while Manhattan is to some degree a unique and singular example, contemporary claims for knowledge and service orientated economies are based on similar notions, that cities manifest and intensify creative interaction and produce distinct kinds of productivity.²³

Kevin Cox argues that there is another way to enter into the question of the 'urban scale' as a distinct entity with specifically urban qualities. He suggests a genealogical portrait of the emergence of the word urban and attention to the work that it does in reframing discourse and eventually reality. The genesis of the term urban, its force effects and impacts on the way the question of the city and collective life within it is made available for action, mean that the term has by now achieved a durability and traction that reframes social, environmental, and economic questions in particular ways. It is this action that scholarship should be attentive to. He writes:

Rather our critical focus should be at least as much on the particular conditions in which our spatial categories — like the urban or the regional, for that matter —

make their historic entry and assume roles in broader discourses whose ultimate effects, and sometimes their explicit intents, are far from innocent. Like all our spatial categories we should treat the urban with a degree of suspicion. For whom is it a useful category and under what conditions, therefore?²⁴

The inscription of the term ‘urban’ in policy making endeavors, think tanks, educational forums, urban planning, and urban design acknowledges that in some way, the city – in that it stages the contradictory forces of contemporary capitalism in such a bare way, bringing extremes of wealth, diverse socio-economic groups and ethnicities into a space premised on an idea of co-existence and political determination – becomes an important arena for governmentality and political regulation. The difficulty that Cox points to is the sheer myriad of phenomena covered over by the word urban. Understandably, the desire to set out in more specific detail the kinds of things that take place within the frame of the urban can run counter to the slipperiness of the term itself. Cox is right to ask what the ‘urban’ adds as a descriptor, but perhaps overstates his critique. Very few of the practices or institutions that he describes ever remain at this high level of generality or abstraction, but are always engaged in specific projects with their attendant realities.

3.6 Local Scale

If the word ‘urban’ is overburdened by the various kinds of phenomena it is meant to capture, the term ‘local’ is overburdened by meaning and or value. The local has come to be understood as a positive site of resistance to the negative forces of globalization that always threaten to overwhelm it. The valorization of the local as the space in which authentic identity production takes place contra the erosive force of the global plays out in many dimensions of contemporary life, from arguments for local enterprise, local food production, local resource reliance etc. While many of these claims seek to combat what are perceived to be the excesses of globalization, attempting to contract the over-extension of supply chains and their excessive demands for resources, at

other moments, claims for locality and the importance of the local scale often take essentially conservative forms in which the threat of change, whether brought about by demographics, language or other cultural markers, are seen as directly threatening to the existing social and cultural make up.

The concept of the local usually refers to a relation of spatial proximity, including one group of actors as closer in relation to another, but it need not have a spatial dimension at all, and is also used to point to a special kind of bond or affinity in a group.²⁵ Writers such as Amin point to the fact that globalization engenders a specific interweaving between relations that are not always predicated upon questions of proximity, such that what appears as local or proximate, is always bound up in forces that operate at a distance. The constitution of a distinctly local space is bound to the everyday experiences one might go through in order to access the kinds of social, economic, health and commercial services in a neighborhood on a weekly basis. The continual negotiations and contests over these kinds of intimate experiences lend local issues a particular kind of valence, in that they seem to speak very directly to the events that impact on everyday life.²⁶

Is it possible to turn this around and look at it from another perspective, in which the local no longer stands for authenticity, bravely resisting the threat of erasure, but instead becomes a site of withdrawal from the political? This is the argument that this chapter advances – that scale regularly exceeds notions of extension or relations of proximity and always imbricates near and far, strong and weak, small and large. Local politics – the politics of intimacy and proximity – are always enmeshed in forces that begin and end in non-localizable points. The privileging of the local would then be seen as an attempt to amputate the reach of this network, withdrawing from the responsibilities and entanglements that it brings in order to constitute a space without scale. The local according to this view would come to represent something inherently conservative, in that it frames action wholly within a horizon made up of direct contact between proximate actors. In any situation in which politics requires a redistribution of social goods – as is the case in all those nations using taxation or other forms of revenue

to build infrastructure such as roads, schools and hospitals – the claim for a local politics appears more and more as a claim for the contraction of the political horizon.

This is not to dismiss the important nativist and indigenous claims that are made – only to argue that these claims suffer politically when they are made *in the name of locale*, both in terms of their legitimacy, which must be embedded in broader scale questions, but also the efficacy of the claims which depends on a certain pragmatic, multi-scalar negotiation of competing interests.

The aforementioned arguments about scale all imply that real features of the world have a scalar dimension, which is to say that scale has an important ontological basis. It is important to note that this position has received some critique, especially in a landmark article written by Katherine T. Jones in which she suggests that scale is in fact an epistemic rather than ontological concept, used to organize knowledge, thought and action about the world.

3.7 Scale as epistemology

Jones suggests that the ontological position on scale neglects the extent to which scale is an epistemological category, a way of constructing and ordering knowledge and therefore the way these representations begin to literally frame and thus constrain reality in various ways. This is important for Jones because she is attending to the ways in which epistemic frames become exercises in power, especially through the act of naming scalar phenomena. Referring first to the work of Cox, Jones points out the useful ways in which global and local concerns inflect each other through representational practices:

In making these scale jumps or building these networks, local groups practice politics by actively reshaping the discourses within which their struggles are constituted.

They show the commonalities between their political goals and other more pervasive political goals, thus discursively linking their cause to another cause in ways that work to their advantage. In effect, these local groups are practicing a representational

strategy. They discursively re-present their political struggles across scale, and in so doing, they help to recast opposition itself.²⁷

Jones argues that since representational practices are so embedded in struggles over scale, both in real terms through local activism and on a global level through international forums, that scale should be understood as a concept that has a specific history. The claim rests on idea that scale – if it is to become operative within the space of political and social struggle - must enter into that space through discourse and practices that depend on statements in which the stakes of that struggle are set out. Scalar struggle – or perhaps the struggle over scale - therefore depends on knowledge and finally speech, and so it is fair to argue that in many respects this struggle operates in an epistemic register. Jones raises a critical point within the literature on scale, for the first time making an important distinction, or at least calling into question the elision between its ontological and epistemological registers:

If scale is continually contested, then how shall we conceive of the category of scale itself? If scale is a representational practice deployed by participants in struggles, a practice situated within a community of producers and readers who actively negotiate and construct it, then what is its ontological status? Does scale exist beyond that community as a fundamental structure of the world, or is it a mode for apprehending the world that is tied to a particular historical / geographical context? Furthermore, does it make any difference whether we see scale as a fundamental ontological category, or as an epistemology, and if it does make a difference, then what is that difference?²⁸

Jones's question points to the center of the argument within this thesis: the relation between ontological and epistemological conceptions of scale. Through a Foucauldian analysis of discourse, Jones conceives of scale as a projection into reality through activities of dispute and struggle. The shaping of a scale owes its form to the contours of the dispute from which it emerges. This position forms an important

contribution to the field in that it politicizes the projective action of scalar reasoning, the geometry that extends out from the practices described by Jones, conditioning 'real' spaces according to ideologically loaded terms. Jones' argument is useful in that it also points to broader historical drifts and the way they reorganize the truth within these discourses. Turning to the example of urban planning and referring to the work of Soderstrom, Jones argues that the introduction of representational techniques such as 'the geometrical plan, zoning, and social cartography' fundamentally transformed the way the city was understood. She suggests that modern city planning replaced the direct experience of the city as the primary basis for decision making with representational practices, especially cartographic ones, displacing the ontological register into an epistemic one. Recalling Deleuze's discussion about the distribution of relevance in regards to a problem from chapter two of this thesis, *The Scale of Truth*, Jones contends that these epistemic practices began to shape an anonymous discursive background in which certain questions took prominence while others became politically ineffable. Jones puts it as follows:

The creation of scale as a trope for understanding the city did not merely shift politics from one level to another. Rather, it recast what was true or knowable about the city within the frame of scale. Certain questions about the city simply became un-askable. The truth of an 'ordinary gaze' became less 'true', while other questions about zones, for example, became more readily askable.²⁹

Here Jones exemplifies what Deleuze would describe as the distribution of relevance in regards to a problem, whereby *truths* in the plural, rather than *truth* in the singular, emerge through a new distribution of what is visible and therefore what counts as a problem. The example Jones cites however suggests a different distinction to the one between ontological and epistemic scale that she originally makes, since in the case of the gaze and its replacement by cartographic forms of representation, epistemology is being opposed to experience. In terms set out at the beginning of this chapter, Jones' position occupies the trajectory of scalar thinking that is aligned, either implicitly or explicitly

with Kant. This position runs the risk of excessively anthropomorphizing the ontological register by limiting the importance of non-human or non-perceptible actors within scalar individuation, which might occur in examples such as air pollution, water contamination, etc. Further, in emphasizing the role of discursive power at the expense of non-discursive power, Jones comes too close with a kind of social constructivism, not attending enough to the interpenetration between human and non-human actors, such as the role of architecture, say, in the shaping social activity. This is an important distinction and one that Foucault was careful to point out, in that it folds the ontological dimension of scale back into consideration. As this thesis argues, the ontological and the epistemic must be thought together - thought according to a scalar correlation. As the case studies in the conclusion of the thesis will demonstrate, discursive practices shape reality through selection, framing, exclusion, persuasion and rhetoric, but these practices are always accompanied by extra or non-discursive material - for example the form of the built environment, the natural environment, material scarcity and the climate.³⁰

In the conclusion to this chapter, the thesis will turn back to an ontological argument about scale by examining the landmark essay *Human Geography Without Scale* by Marston, Jones III and Woodward.³¹

3.8 Scale as ontology

Writing some ten years after the Jones article, the authors re-examine the ontological status of scale while distancing themselves from previous iterations of argument, especially those emerging from the predominantly Marxist literature of the 1970s and 80s. Instead, their work draws on the thought of Gilles Deleuze, Bruno Latour and Manuel Delanda. The authors attack the metaphorical crutches described earlier in this chapter to discuss questions of scale, especially their reliance on concepts such as nesting, verticality and horizontality. This intervention in the 30-year debate on scale within geography takes as its initial premise in the fact that contemporary social phenomena cannot be easily contained within conventional ontological or

epistemological categories.³² For Marston et al. much of the language used to describe scale is overly reliant on metaphors, and as a result can be said to be excessively reductive of the conditions it is meant to describe. Arguing that 'scholarly positions on scale are divergent in the extreme', the authors dissatisfaction can - in part - be traced back to the predominance of what they describe as a 'vertical imaginary', whereby a conceptual schemata of effects and their scalar relationship resembles a ladder or a similarly multi-levelled structure.³³

In attempting to adapt scalar concepts to these horizontal phenomena, and in line with the critique set out above, the authors accuse scholars of 'grafting' metaphorical models onto each other in order to produce a conceptual scheme that is able to take into account the increasing evidence of complex spatiality. They argue that this model, and the logic of continual conceptual hybridisation, is subject to a number of 'foundational weaknesses' that severely constrain its theoretical efficacy. They conclude that there are in fact three possible alternatives available;

...affirm hierarchical scale and, to the extent that it fails to capture the myriad socio-territorial configurations we encounter augment it with some other concept(s); second...develop... hybrid models that integrate vertical and horizontal understandings of socio-spatial processes; and third... abandon hierarchical scale in its entirety and put in its place some alternative.³⁴

Rather than replace a vertical ontology with a horizontal ontology, the authors propose to do away with any transcendent notion of ordering and instead turn to an immanent idea of scale that does not lean on any existing and externally pre-determined categories for its conceptual labour. In order to accomplish this they propose an "an ontology composed of complex, emergent spatial relations".³⁵ The three conceptual ideas they bring to this ontology are 1) "analytics of composition and decomposition that resist the increasingly popular practice of representing the world as strictly a jumble of unfettered flows", 2) "attention to differential relations that constitute the driving forces

of material composition and that problematize axiomatic tendencies to stratify and classify geographic objects", and 3) "a focus on localized and non-localized emergent events of differential relations actualized as temporary – often mobile – ‘sites’ in which the ‘social’ unfolds."³⁶ These three points might be summarized as follows, the first relates to analytics of composition and decomposition and can be understood very simply as an argument for analyzing individuation as a starting point, secondly, a critique of the formation of conventions, and thirdly, an argument for scalar conflation. Whilst both the first and the third resonate with the aims of this thesis, the second is more questionable. The authors move quickly to a critique of the stabilization of knowledge into categories, not attending to the way any collective form of inquiry demands a common - that is to say conventional - set of terms in order to communicate, to compare and to verify research. Despite this qualification, the paper points to the fundamentally problematic status of scale, inviting readers to wonder exactly "what’s ‘problematic’ about spatiality" and calling for a turn to an immanent model of scalar genesis:

By contrast, beginning from a series of set propositions about the nature of actuality – that is, solutions – serves ‘axiomatic’ ends: ‘covering over’ problems by manipulating them to find an assumed or pre- established solution. Earlier, we mentioned that scalar approaches provide exemplary cases of form determining content; here we note that such cases reveal themselves as axiomatic strategies where researchers ‘solve for scale’, allowing scalar thinking to predetermine the fields of its own solvability. How else to explain the endless noodling with the concept, except as a case of ‘subordinating problems to solutions ‘a practice that effectively hides the virtual, or that promotes the illusion that the actual world is all that must be explained’.³⁷

There is much to appreciate in Marston et al.’s critique of geographical writing on scale and its pervading sense of confusion, especially the practice of intellectual bricolage that only serves to further undermine any operational sharpness the concept may have. The authors gesture to many lines of inquiry but fall short in picking up these

threads, let alone weaving them into a rigorous and conceptual apparatus. Not only this, the authors also repeat many of the issues they discover and critique in the field, often satisfied with pointing to a concept with a series of adjectives such as ‘composition’ or ‘decomposition’, or worse referencing authors such as Delanda, Deleuze and Latour without setting out in clear detail what their different positions would bring to their own work. More fatally perhaps, the rejection of scale as a category – though clearly intended to provoke the discipline out of its lethargy – confuses two different dimensions of critique; the genesis by which specific scales come into being, and the solidification of that process into a fixed and delimited convention. The fixed and conventional nature of the terms that they describe does not point to a desire to hold the world out there as it is in a freeze frame, it emerges out of collective need to form common objects of inquiry through measures that are commensurate across different sites.

3.9 Conclusion

This is not to say that this process is neutral or that epistemic frames do not condition reality in different ways. On the contrary, it is in the very nature of these practices and the types of knowledge that have formed around them to become instrumentalised and to contain both implicit and explicit forms of power. It would be less a matter of yes or no to scale as the authors half-jokingly suggest and more a question of understanding the interrelation between epistemic and ontological notions of scale as simultaneously political. As the dispute in geography in the last 30 years demonstrates, the relation between epistemic and ontological scales is not only one in which the epistemic takes on the role of forming an objective reflection on the ontological. The relation between the two is conditioned, but it is also conditioning, that is to say, it is reciprocal.

The problem of scale that so many of the previously cited authors refer to should not be understood as a limit to be overcome, as a confusion to be clarified, or an error to be rectified. The dispute over scale becomes a dispute over a series of terms: ‘bending vs.

jumping' 'hierarchies vs. networks' 'ladders vs. scaffolds'. Furthermore these terms are always installed in relation to a shifting set of discursive points. The stabilization of the term that seems to be so sought after within geography always rests on an unstable series of pre-suppositions. Nowhere is this more apparent than in the failure of Marxist discourse, where a series of transcendental operators (labour, class, capital) continually form reference points against which every transformation in the world will be measured. In this sense, by understanding scale as the production of a problem – and by retaining the way each problem conditions its solutions, the continual ineffectuality of critique within Marxist geography suggests in some sense at least that the terms described above carry too heavy an ideological burden, and that new entry points into problems should be sought.

Writing in 'The Worldwide and the Planetary', Lefebvre asserts:

Some *propositions* do more than enunciate: they pose and propose. They pose and actual "object" and propose an "objective". This implies the use of classical deduction and induction, but also of transduction, which targets a virtual "object" and its realization on a path heading toward a "pro-posed" horizon. These propositions are abstract, but in the sense of conceptual abstraction, which, more and better than signaling the concrete, incorporates it."³⁸

This object that Lefebvre refers to is a nothing less than the 'problem' as such. The argument being proposed here is that the sense of confusion in geography can be understood not as failure within geography itself, but as a symptom poorly identified, where the problematic describes a fully positive characteristic that animates the transformation of matter and knowledge, not an error or complexity to be nullified by more and more metaphorical gymnastics.

Indeed, Lefebvre himself recognizes this when he writes: "In our societies, there is a "problematic of space" (conceptual and theoretical), and an empirically observable

practice. This "problematic" to employ the language of philosophy, is composed of interrogations of mental and social space, their connections, their link with nature and logic...".³⁹ Even though he does not formalize it completely, Lefebvre implicitly refers to Bachelard's concept of the *problematique*. He does so in two ways, first in regards to the formation of knowledge about space, and secondly in regards to space itself. The preceding confusion over terms within the geographical disciplines is a symptom of an attempt to fix in place a concept, that of scale, which is in-itself problematic and continually differentiating. As the previous two chapters pointed out, this differentiation forms the driver for every scalar individuation. This individuation takes shape and articulates into so many concrete guises and so it is perhaps understandable that the difference between extensive problems is taken as direct evidence of a more complex and deeper process. The ensuing confusion as new evidence piles upon new evidence strains the precision with which the idea of scale can be used, resulting in a notion that has expanded to take in everything, but that finally means very little.

This thesis has attempted to present a contrary and more abstract conception of scale, in which the ambiguity that is evidenced by the plurality of scalar phenomena is no longer papered over by an expansion of adjectives, instead this problematic ambiguity is taken to be a concrete, 'perfectly positive' aspect of any individuation. The problem in this sense is no longer a lack to be rectified, but the motor for the formation of scale.

PART II

INTRODUCTION

4.0 Different truths

Part I of this thesis set out to construct a rigorous concept of scale understood as a sequence of individuations across ontological, epistemic and discursive registers such that the individuation of a problem provoked into being a form of inquiry, which in turn drew its sense from the historical context in which it was installed. In Part II of this thesis, a series of case studies will be examined in light of the terms, concepts and methodologies set out in part I. These cases are: the Fair and Exposition site constructed in 1962 in the Lebanese city of Tripoli, the planning and implementation of a nationwide system of cybernetic management within Chile during the early days of Salvador Allende's regime in 1972, and finally, the collective scientific effort to simulate the earth's climate and its impact during the Copenhagen Climate Summit in 2009. At first glance, these three events seem to occur in a clear temporal and spatial sequence, moving from an urban, to a national/territorial, and finally a planetary scale. While it is correct that each of these terms names a unique constellation of inter-related problems, this should not be directly translated into an extensive property such that one scale is understood as differently dimensioned to the other. As the following case studies will demonstrate, each scalar problem is a complex assemblage of elements large and small, near and far, strong and weak.

The method set out in part I puts in play what will be described as a 'chain of immanence', that is to say the co-individuation of a problem, a form of knowledge and its discursive structure. These three planes of individuation are linked in important ways, such that the objective ambiguity of the problem finds its epistemic correlate in a form of

knowledge. This form of knowledge is in turn always located within a discursive structure that drifts anonymously, conditioning the relevance of a problem and the knowledge that forms around it. The conclusions of this method suggest a number of issues that will be elaborated on in the case studies that follow. Firstly, scale is always a multiplicity and so it is tautological to speak in terms of multi-scalarity. Secondly, the problem is an objective, ontological feature within the world. Thirdly, there is an objectivity, or as shall be shown, a rationality, that works to correlate the relation between these distinct individuations. Fourthly, this objectivity or rationality is historically specified and cannot be said to exist in a space transcendent to the discursive structure it is installed in. The result is less a discrete, nested model of scale; rather it becomes something radically conflated, where disparate features come into proximity. This radical conflation establishes transversal, diagonal linkages across elements (rather than among them).

This is not to say that dimensionality or extensive properties are not important, all conventions emerge in response to an epistemic regularity. In order to avoid naturalising these 'typical' scalar categories, this thesis sets out a conceptual schema with which to understand their genesis. Before the case studies are introduced however, two points require clarification. The first relates to the reasons for selecting these three events. If the relation between the first half and the second half of the thesis is understood according to a conceptual production on one side and an encounter on the other - where the concepts run up against a series of concrete situations - then this implies that the first half of the thesis serves as some sort of proposition, while the second half serves as some sort of test of that proposition. In this encounter, if theory runs aground on an empirical reality, so much the worse for theory. That said, beyond working as test or even as a justification, the question remains, why these three moments and not others?

To begin with, each event embodies a distinct aspect within contemporary architectural thought, the question of modernity and the modern subject, governance and management, and finally the transformation of the climate. The issues raised by these three case studies continue to remain relevant, requiring a re-examination of their

formative moments. In this sense, though each event is dated, there is a continual oscillation between projective and retroactive forces - both past and futurity intermix. Moreover, in selecting three seemingly distinct scales the intensive nature of scale can be rigorously emphasised. The final distinction that must be made, which will take up the remainder of this introduction are the different rationalities evidenced in the case studies. The project in Tripoli is different from both the project in Chile and the question of climate modelling. While both other examples deal with a scientific paradigm, the Fair and Exposition site works through an architectural paradigm and its own unique rationality. Architectural rationality cannot simply be transposed to scientific rationality, and while exploring both allows interesting differences to surface through the course of the case study, it is important to describe as clearly and as briefly as possible the difference between these types of reason, with architecture coming to operate within a Kantian criticality and science composing itself according to the a different set of epistemic virtues, especially objectivity.

4.1 Objectivity and critique

Between the sixteenth and seventeenth century architecture moved from a fusion of architectural code and collective functions to a *general grammar*. Influenced by the great linguistic systems of Blondel and Perrault and, later, of Campbell and Lord Burlington, an inquiry into what makes architecture possible took place.¹ The full history of the formation of an architectural rationality in this period is well beyond the scope of the present project, but some brief points will help to contextualise the important epistemic differences between scientific knowledge and architectural knowledge, especially the central role typology will come to play later.

As the following chapter of the thesis *Spatialising Co-existence* will argue, 'type' occupies a unique position within architectures rationality; it has historically been understood as both an idea and model, represented by Quatremere de'Quincy in the first case and J.N.L Durand in the second. Type has also been understood as both a repository

for reasoned thought *and* the instrument of its action. That is to say, it is simultaneously epistemological and ontological. In order to develop this reading, it is useful to begin with Marc-Antoine Laugier, whose theory of architectural origins allows the discussion of type to be placed in a broader context of transformations in philosophy and the organisation of knowledge, in which a new, *critical* rationality comes to the fore.

In 1753, Marc-Antoine Laugier decisively argued for a return to classicism starting with the myth of the origin of architecture: the primitive hut. His *Essai sur l'Architecture* establishes a rational and systematic set of principals able to guide architecture out of the Rococo phase predominant in France at that time.² Importantly, Laugier locates the source of these principals in nature, seeing in the primitive hut an unadorned model, a repository of truth stripped bare of baroque excess.³ Preceded in important ways by architectural texts from Blondel, Savot, Perrault, Cordemoy - as well as contributions of wider cultural and philosophical import such as Voltaire's *Essai sur les moeurs*, Diderot's *Encyclopédie* and d'Alembert's *Discours préliminaire* - Laugier's *Essai* effectively sets out the terms for the re-evaluation of architecture that will take effect only a few years later.⁴

This period is characterized not just by a search for a rational basis for architecture appropriate to the massive social changes taking place at the end of the eighteenth century, but also in the *form of presentation* appropriate to theories of architecture. Though *Essai* appears as a treatise – a mode of exposition dating back to the Renaissance – it will soon give way to a more systematic attempt to organise knowledge of which the *Encyclopédie* is the pre-eminent example, influencing not only d'Qunicy's *Dictionnaire historique d'architecture* of 1832 but also the *Précis des leçons* by Durand, which preceded it by 30 years.⁵ Despite being oriented toward quite different ends, both texts played a formative role in this regard, establishing - in both their organisation and content – a taxonomic model of architectural knowledge.

Durand's methodical setting out of architectural components, their combinatorial associations, as well as the on-going and continued “interdependence of architecture and

economics” sets out a systematic, rational and most importantly repeatable model of architectural knowledge. His taxonomy is a decisive moment, a pre-cursor to the standardised systems and data sets that are commonly found in today’s architectural offices.⁶ The legacy of this work extends into the pedagogy of architecture, as much as to its economic and practical basis, in that it speaks to the mass production - not only of buildings, but also of architects. The present education of architects exist within this historical legacy, in that it operates through a model in which knowledge is standardised such that it can be systematically transmitted outside of the atelier system. While acknowledging Laugier’s influential theory of the origins of architecture in the primitive hut, Quatremere’s essay, *Dictionnaire historique d’architecture (Historical Dictionary of Architecture)*, nonetheless constitutes a significant transformation of Laugier’s text, in that he no longer locates the origin of architecture in nature, but in society. Architecture’s rationality emerged wholly through the exercise of man’s critical faculties and a collective capacity for reasoned reflection.⁷ The idealism of the Kantian position, not to mention its paradoxical framing of freedom as a reciprocal submission to law maintained the centrality of the subject as both free actor and tribunal.⁸

4.3 Rationalities

The epistemic differences between architecture and science hinge around this moment, architecture continuing to operate within a critical framework in which the centrality of the subject is a given, science gradually coming to see the role of the subject as a threat to be eliminated in the name of impartiality, neutrality and finally, objectivity.⁹ In their history of objectivity, historians of science Lorraine Daston and Peter Galison track, from the beginning of the eighteenth century, an epistemic shift in the concept of objectivity away from one paradigm - truth vs. illusion - towards another: subjectivity vs. objectivity¹⁰. This shift introduces the seeing, observing subject into the epistemic space. The modalities of this subject are conceived in different ways according to different periods – thus the ‘history’ of different ‘epistemic virtues’ that come to guide scientific inquiry. During the end of the nineteenth and the beginning of the twentieth

century, the advent of mechanical forms of seeing and reproduction led to a significant shift toward repeatable forms of experiment and collective approaches to inquiry, whereby knowledge – in order for it to be verified or falsified – had to be repeated by others. Importantly, this shift marks a break from the rationality that will continue to predominate through architecture in that its basic premise is no longer the proper exercise of subjective faculties. Instead, the “temptations of the imagination” must now be resisted and the subject removed from potential interference with the object of study. Within science, the reasons for this are in part quite pragmatic. As Daston and Galison suggest, the objects of study had grown too small or too large to be distinguished by the naked eye and had come to depend on technical instruments and experimental apparatus to be made visible. Unlike architecture, which would remain deeply indebted to the seeing, perceiving, experiencing subject to constitute its rationality, science would come to depend on techniques of falsification and verification, in order to produce a repeatable and collective form of inquiry. The corollary construction of an epistemic virtue around objectivity constitutes the core differences between scientific and architectural forms of rationality. If architecture and science construct their own immanent truths and these truths and their epistemic frames are not commensurable, this will be of little surprise. Perhaps obviously, the epistemic models for forming these truths will also operate differently.

In architecture, the typological model – if it is taken to be a repository of disciplinary knowledge as figures like Argan or Rossi would suggest – simultaneously reflects upon *and* transforms its condition.¹¹ If there were an ‘epistemic virtue’ or model here, it would be one based on learning by disturbance or by iteration of provocations, rather than through distanced reflection. In this regard, type is both diagnostic and projective, as an epistemic frame used to pose spatial problems according to its own terms, type is able to redraw, embody and propose a constellation of broader social and political forces.¹² This is important in order to contextualize the rest of the thesis such that the terms used (epistemic, critical, objective) do not cover differences in rationality between the disciplines. Further, these cautious distinctions point to a final important conclusion; that the idea of scale within architecture is specific to the discipline and cannot be easily

conflated with the way scale has been described in other fields. This is primarily because the idea of adequation or correlation between the epistemic and the ontological is not structured in the same way.

Knowledge within architecture and within science do not form in the same way, nor are they directed to the same ends. Scientific knowledge, which formed the focus of the first part of the thesis is subject to processes of verification and falsification that lend scientific epistemic history a different truth-value, as will be shown in the concluding case study on the politics of climate change. Nor does seventeenth century medicine bear upon twenty first century medicine in the same way seventeenth century architecture is able to bear upon contemporary architecture. Nonetheless, there is – if not an objectivity proper to architecture – a critical rationality, against which different kinds of truth, and therefore different kinds of history can be produced. Perhaps the distance between the two is only the difference between *objectivity* and *critique* – but this would be a great distance already. Since the early eighteenth century architecture has located itself within a tradition drawn from the philosophy of the enlightenment, which – if it is not able to constitute a scientific rationality, comes into close proximity with one, with a specifically architectural rationality being the outcome.

What implications do these different forms of rationality have and more importantly how will they come to affect the idea of scale within the case studies that are to follow? The preceding argument suggested that ontological and epistemic individuation were objectively linked by a scalar correlation, such that there was a verifiable explanatory resolution of phenomena. This claim will not hold in the case of architecture, since the principle of verification does not pertain to it in the way it does to science. Within architecture at least since the eighteenth century, rather than a link between these two forms of individuation based on objectivity, there is a link based on a critical form of reasoning. The relation between this epistemic model and the phenomena it wishes to describe is nonetheless structured according to a series of values, which set out the instrumentality of the model in question. This is particularly important in the case study that is to follow, *Spatialising Co-existence* in that the rationality of the

typological operation will be seen to result from the reasoned judgment of an architect in accordance with the prevailing discourse on modernism - in this case Oscar Niemeyer, and not from a field of inquiry structured according to ideas of falsification and verification such as science.

SPATIALISING CO-EXISTENCE

5.0 The idea of unity

This case study examines a high modern project in the north of Lebanon, using the idea of scale in to unravel the idea of unity suggested by the work. Unity is understood as the attempt to refine and synthesise parts so that they express a common aspiration in a consistent way. Implicit in the idea of synthesis is mereology, or the theory of parts, and how discrete elements can be brought together, held and oriented towards a consistent purpose. The premise of unity being that all parts act in harmony and functions operate in concert, or that unity makes possible commensurability at all scales. This recursivity of scale in which the microcosm mirrors the macrocosm implies a continuity of architectural expression at each level within the work, a recursive line of reasoning which when taken further suggests that the problem posed by the very small and the very large must differ only by a matter of degree, else, how would it be possible to find a common measure between them?

Of relevance here is how the individuation of scale relates to the possibility of unity within both architecture and urbanism, an important question within modernism

in which universality of scope and unity of expression formed mutually symbiotic ideals. An important (albeit lesser known) example of plastic unity within high modernism is the Rachid Karame Fair and Exposition project in Tripoli by Oscar Niemeyer.¹ In line with the universality of scope and unity of expression expressed within his body of work, Niemeyer attempts to orchestrate the parts of the Tripoli project into a coherent and unified ensemble. But this coherence extends only as far as the elliptical boundary of the site, which marks a line of difference with the existing city of Tripoli and its mixture of Modern, Post-Modern, Mamluk and Ottoman architecture. This *discontinuity* between site and context marks the ground upon which the *unity* of Niemeyer's project rests: giving life to the possibility of constituting a new, internal unity dependent on a tabula rasa and the positioning of the historical city as an 'outside'. Both the critics and the defenders of modern architecture overemphasise the importance of this issue, seeing in this moment of discontinuity not a specific part within a larger ensemble of other parts, but instead a paradigmatic break that 'reveals the intelligibility of the set to which it belongs'.² If the recursivity of the project is based on a consistent synthesis of parts both large and small, is it any surprise that a critique need only point to one problem, either large or small, in order to put in question the entire whole?³

What does it mean then to describe something as a whole, except to say that it has a unity? Furthermore, would it be the same unity that binds together the parts of an element, a building, an urban plan, and a city? Is the domain of that which can be unified in a work, *equally* amenable to unification? To answer yes would be to imply that the problems posed across each one of these parts are commensurable, which is to say the environment that conditions each part, conditions them in an analogous way. Against this idea, this case study will argue that there is no environment in this consistent and unified sense, only an environment *for* the part in question. In other words, each part of the project constitutes its own set of relationships, but there is no universal and ultimate set to which all relations belong. Instead, parts can be understood as a specific response to a problem, including the problem of relations to other parts. In this way, each part is conditioned by a specific scalar problem and there is no unity or sum of all the problems

taken together. The aim of this line of argument is to expose the unity of the object to the action of scale. In order to accomplish this, a unique method of reading the Rachid Karame Fair and Exposition site is called for, one that refuses a mono-scalar critique and instead finds within the project a complex, often contradictory collection of parts. Reflexive, all too simplistic objections that Niemeyer failed, both in Tripoli and Brasilia need not be repeated, let alone by an opposing assertion of success. The aim here is to neither bury nor exonerate the architect or the project, rather to problematize the very idea of success or failure by showing its wholly contingent dependency on the idea of scale.

This method will examine a series of scales within the project in order to determine the relationship between the problem and the part it conditions. Rather than begin with the assumption that the aims of the project and its authors are unified - an inference seemingly reinforced by the aesthetic consistency of the work - this case study will allow for conflict between these authors, paradoxes behind their ambitions, and incommensurability between the problems posed to the project. In order to pursue this, the case study will develop a multi-scalar line of inquiry in which each part is understood as a differential event installed within a shifting network of meanings. This is done with the aim of breaking open the possibility of a unified reading of the project, such that specific judgments at one scale will not simply translate to judgments at another.

This case study will explore three scalar problems - the geopolitical attempt to form a nation state, the urban drive to intensify productivity, and the governmental techniques used to shape a new political subject. Either implicitly or explicitly, as each scalar problem individuates, a specific epistemic model will guide the spatial reasoning of the project, beginning with Brasilia as an idea of a city, followed by infrastructure as a conduit for capital growth, and finishing with the exposition type as a civilizing mold for civic society. As a final coda to these three scalar questions, the typological displacement of dome from a theological to secular function will be discussed because it most clearly reveals the temporal fragility that links ontological and epistemological individuation. In

conclusion, this chapter will return to the question of unity, this time by examining its most well known critique within urban discourse, *Collage City*, by Fred Koetter and Colin Rowe. As the following argument will demonstrate, *Collage City* and its promotion of bricolage as a counter strategy to the apparently totalizing impulse of modernism, amputates the issue of form from scale, the consequence of which is to neutralize history and frustrate the emergence of new kinds of spatial and political rationality.

5.1 A new synthesis

Measuring over 600,000 m², Niemeyer's Rachid Karame Fair and Exposition site was conceived as more than just a recreational or commercial space for the city of Tripoli.⁴ Intended to present a new 'idea of the city', the project was to kindle a synthesis of work, life and culture, functioning together in an open civic landscape. With construction interrupted by the Lebanese civil war all the primary structures were completed, yet none were fitted out. Therefore, what remains is a bare, unadorned yet almost complete representation of all the main elements of the original Niemeyer plan. Looking at Tripoli from the air today the elliptical area of the park recalls a petri dish. Stamped into the urban tissue, a 1.1km long ellipse is filled with prototypical architectural forms, such as parabolic arches and faceted cones, with a vast plane of concrete seemingly afloat in its amniotic landscape. Intended programs for the buildings were to include an exhibition hall, national pavillion, outdoor concert stage and a helipad. The sense that this project constituted a type of urban laboratory is far from metaphorical.⁵ Niemeyer envisioned these parts growing, becoming populated and informing the surrounding city. Indeed, the original plan indicates rows of collective housing around the western perimeter of the site - an initial proposition for a new residential district in Tripoli, in the expectation of a burgeoning urban hub.

The project forms part of a broader, well documented history of high modernist work in Africa and Asia, including Le Corbusier's work in Chandigarh, India, Kahn's work in Bangladesh, and Niemeyer's later campus project in North Africa.⁶ Unlike the

former examples, little is known about the project in Lebanon. Niemeyer's own references to the project are scant: a two-page report in the journal *Modulo* that he established to document Brazilian architecture, and a passing reference to it in his autobiographical notes.⁷ The reasons for this may well be due to his dissatisfaction with the procurement process, which he decried for being rushed and excessively beholden to commercial interests, with little in the way of research into the historical urbanization of the city. Furthermore, Niemeyer was unhappy with the choice of site, preferring a site closer to the coastline.⁸

Dissatisfied architect aside, the lack of scholarly attention for the project can also be explained by the dangers – either perceived or inherent – within Tripoli itself. This seems particularly relevant given the inaccessibility of the site during the years of the civil war between 1975 and 1990, when it was often used as a barracks for the Syrian Military. Moreover, for a long period of time after the war the site remained inaccessible to the public, only recently being re-opened for regular access.⁹ Still, it is interesting that in the major surveys of Niemeyer's work the project is mentioned twice, and only to recount a few well-known details such as the extent of its commission.¹⁰ A few articles have appeared in the popular press and online since the cessation of hostilities in 1990, appearing around 2010, but these are mainly in response to a proposal for turning the site into a theme park. Only one English language article directly addressing the project has appeared in academic press. In comparison to the work Niemeyer completed during his years of exile from Brazil, such as the University of Constantine project in Algeria, the Rachid Karame Exposition Site is something of a forgotten project. Drawings exist in the Niemeyer archive but all other documentation, including the drawings of the site's structural engineering, having since been lost.¹¹

5.2 The Geo-political scale

In 1962 Architecture is called into geopolitical service in Lebanon when Bolivar de Freitas, the Brazilian Ambassador to Lebanon, writes a letter to the architect of Brasilia

on behalf of the Lebanese government, inviting Oscar Niemeyer to propose a new fair and exposition center in the northern Lebanese city of Tripoli. By this stage Niemeyer had become well known, both through the commission for Brasilia and his collaboration with Le Corbusier on the UN Headquarters in New York.¹² Yet this alone does not explain his selection, nor the long-standing migration to Brazil by the Lebanese diaspora. In order to more fully explain this selection, the decision must be put in the context of the formation of the Lebanese state in the post-independence period, and the country's brief embrace of a social welfare state.¹³ The selection of a Brazilian architect, as well as an avowed communist, can also be understood within the history of the 'non-aligned movement' that played an important role in the geopolitics of the Middle East, Latin America, Asia and Africa during this period.¹⁴ A Brazilian architect would be compatible with the post-independence ethos characterized by the National Pact (al Mithaq al Watani) of 1943, an unwritten power sharing agreement formed between Maronite and Sunni leaders.¹⁵ Further, this would allow the project to benefit from an important symbol and convention of modernity: modern architecture. With one important difference: by nominating a non-European architect, all colonial burdens identified with the aesthetic could be avoided.

In the decades leading up to the commission Lebanese President Camille Chamoun initiated a process of institution building, modernizing the bureaucracy and establishing a ministry of planning. This era - from the mid 1950s through to the early 1970s - is characterized by several attempts at nation building through the renovation of the civil service, large-scale projects and electoral reform.¹⁶ For example, in 1958 a 5-year planning report was published. This represented the first attempt to conceive of national territory according to a Westphalian model in which sovereignty and territory coincided. However, the report was interrupted by the hostilities of that year and subsequently never referred to again. This would have been the first of two major planning reports commissioned before the outbreak of the civil war in 1975, the other being a report developed by the French company IFRED at the behest of President Chehab in 1965. This second report concluded by proposing a series of large-scale infrastructural projects

throughout the country.¹⁷ This process should be viewed in relation to, and in competition with, emerging regional powers (such as the Gulf States).¹⁸ The problem that begins to form here is how to conceive the state according to the model of a unified national territory.

Endeavors by the Lebanese government at the time, such as the planning reports and infrastructure proposals are manifestations of a geopolitical calculus which aims to quell the intermittent instability of the previous decade, such as the 6 months of fighting in 1958, the attempted coup d'état by the SSNP (Syrian Socialist Nationalist Party) in 1961, but also to form a bulwark against broader regional tensions expressed in the rise of Nasserism in Egypt, or the transformations that would take place within the PLO after 1967 and the subsequent impact on Lebanese stability.¹⁹ Farid El-Khazen writes:

In the mid-1960's, Lebanon was certainly a more reformed, united and stable country than at any other time since independence. Furthermore, in comparison with other Third World countries, Lebanon scored better on almost all the indicators of modernization. But again one question remains: how could the 'loads' on the system be prevented from increasing faster than its 'capabilities'.²⁰

Khazen points to an important factor in this process where integration or state formation does not simply proceed from one stage to the next in a step-by-step progression. Rather, at each stage a field of instabilities need to be managed; coalitions need to be held in balance and tensions allowed a certain elasticity, even though they perpetually threaten to break.

On a geopolitical scale, the Tripoli commission would not have existed without this impetus for nation building and the central importance it would accord to future large-scale projects. Nor would it have emerged without the desire to contain, stabilize and unify the fragile state of the nation in a turbulent and antagonised region.²¹ The problem Chehab faced was how to give shape and fasten this newly emerging, and

somewhat precarious situation. Opposing forces, both internal and external needed to be balanced, at the same time this balance needed to acquire a shape that could signal the entrance of a newly independent nation attempting to leave behind a colonial identity. The need to find a language or grammar to communicate the universality of this ambition, together with the practical requirements of an exposition site, had to take form within the barely formulated outline of a national imagination. In addition, this problem was exacerbated in a state with only a nominal form of a representative democracy and nascent public institutions, both with very little in the way of public legitimacy. In fact if one were to characterize the popular perception of the state during this period, significant levels of distrust and suspicion would color it.²²

An important point to draw from this is that the geopolitical problem to which this project responded had no specific dimension. It was an intensive problem before it received extensive articulation, taking in a wide spectrum of political disputes, drawing together global ambitions for recognition and economic stimulus, regional fears about the ascendancy of competition in the gulf states and - closer to home - the perpetual instability of the Levantine context.²³ Thus, the very idea of 'geopolitical scale' is not tied to a specific measure - in fact it makes no sense to say that it is larger than urban scale. Though the era of geopolitics is inaugurated with the treaty of Westphalia and the territorial state form, it has always involved the imbrication of elements large and small, tangible and intangible. This diverse set of elements is produced and held together through a specific model, of which the nation state is the political exemplar. Nonetheless, a great variety of practices take place within this geopolitical space and each epistemic model used to understand it will redraw the geopolitical problem in its own way. In the following examples, the epistemic model is understood as a type, a form of rationality specific to architecture. The typological idea that would be drawn on to accomplish this Herculean task and carry this geopolitical burden was still in its formative stage. Only eight years before de Freitas would deliver his commissioning letter for Tripoli to Niemeyer, an experimental idea of the city was emerging in the new Latin capital of Brasilia.

5.3 Brasilia

“It is strange how the power of beauty makes us forget so much injustice.”²⁴

Brasilia was an attempt by President Juscelino Kubitschek to construct a new and geopolitically integrated Brazil, to “reverse Brazil’s colonial orientation toward Europe and inaugurate a permanent pattern of modern settlement in the vast hinterland.”²⁵ Like the later project in Tripoli, which was meant to create a new locus of activity outside of Beirut, Brasilia was planned, in part, to shift the economic focus away from Brazil’s major coastal cities, creating a new vector of development. Furthermore, beyond practical concerns, both projects trade in symbolism: Tripoli as a commercial exposition project and Brasilia as a new center of political and administrative power. In this case, the typological idea operates an epistemic model by laying a grid of intelligibility over the problem, posing the nascent geopolitical ambition in terms of a symbolic expression and a common formal grammar. The model reflects back an image of the problem formed in its own liking; according to an idea of unity which would act like an adhesive able to bind a disputed and disparate entity, according to the scope of modernity and the universal extent of its horizon, and finally according to the abstract and essential character of the forms themselves in whose reduction the idea of truth was seen to reside. Both Costa’s pilot plan and Niemeyer’s architecture along the capital’s primary axis attempt to formalize and unify, through spatial and material means, a complex and often paradoxical national ambition. The project is at once grounded in the colonial past and renaissance ideals expressed through clear geometries, monumentality and a distinctly baroque orchestration of perspective, yet it is also distinctly forward looking, gazing ahead to a newly modernized and independent nation embarking on a process of industrialization and reform.

Despite its declared emancipatory ambitions, in retrospect, Brasilia would seem to confirm Manfredo Tafuri’s oft repeated paraphrase of Marx that “just as there can be

no such thing as a political economics of class, but only a class critique of political economics, likewise there can never be an aesthetics, art or architecture of class, but only a class critique of aesthetics, art, architecture and the city.”²⁶ In other words, Brasilia would never be able to transform the class disparity in Brazil, only further actualize and exemplify the paradoxical and contradictory forces within Brazilian society. Writing about the project, David Underwood suggests:

Brasilia’s development reflects the dichotomies of the larger Brazilian dilemma, primary among them the modernist utopian ideal that a new society could be created through a new architecture promoted by the country’s governing and artistic elite... ..The city thus expresses the contradictions between a political reality of absolute authority and a dream of democratic freedom... ..The city thus reflects Brazil’s endemic double standard. While seeking to architecturally neutralize class distinctions in the housing blocks of the *superquadras* (large blocks of apartments), Niemeyer actually reinforced the social hierarchies of the new city through a deliberate play of oppositions that privileges a clear architectural and social elite.²⁷

These comments are illustrative of many of the critiques leveled at Brasilia, critiques that began even prior to its construction. All seem united by a single point: the impossibility of the symbolic register coinciding with the practical one. Brasilia functioned as an idea of unity – but harmony in an aesthetic and spatial register could only ever spatialise the social distinctions present in its development. It is not necessary to repeat these conclusions here. Of more interest in regards to the later project in Tripoli is the way Brasilia functioned as both a typological idea of the city and therefore also as an epistemic model, and the way in which this idea and model could be detached from one context and its attendant set of cultural, economic and functional requirements, and re-oriented forward to act in another.

5.4 The end of the modern project

By the 1970s the idea of pan-Arabism, which first came to prominence with Nasser's regime in Egypt and Gadhafi's proposal for a Federation of Arab Republics, is a project on the decline. This was indicative of a shift in the regional context away from secular and socialist principals. Military defeats and economic stagnation contributed to a widespread sense of malaise in the Arabic speaking world.²⁸ In Lebanon the contraction of the state, the withdrawal of government from social services, its inability to implement electoral reforms or build stable institutions coincided with the extreme regional destabilizations occurring as a result of the conflict between Israel and the Palestine Liberation Organization (PLO), who were now operating from Lebanese bases.²⁹

Post-World War II Lebanon was marked by the conviction that government should intervene in the national economy. Though articulated differently in developed and developing countries, internationally, this period was characterized by state ownership and intervention, strategically using policy and finances to stimulate the economy, promote growth and generate employment. The shift in this period, from ambitions for social welfare and a strong state, to one in which the state has almost disappeared, provides an important context for understanding both the initial optimism of the Niemeyer commission but also its perceived failure. The national imagination went from being something that could be consciously shaped by political and popular will, to one that would be abandoned to the 'free and natural' expression of the market and fractious group of political actors. While Lebanon is perhaps the purest example of a laissez-faire market economy, the period from the 1950s to the 1970s represents an attempt to institute a more structured plan for economic management based on an idea – however partial – of the redistribution of social goods.³⁰ The ferocious return to an unfettered laissez-faire system, with its privileging of the individual as the basic social unit occurs less out of political or ideological conviction and more out of a kind of strategic incompetence - a withdrawal from governance that characterizes the Lebanese state to this day. Toufic Gaspard writes:

Laissez-faire is a moral program, and the market is its instrument. A product of the Enlightenment, it was conceived as the way to unleash human potential through the restoration of a natural system, a system unhindered by the restrictions of government.³¹

In this context of a laissez-faire economic model the infrastructural spending and government intervention required for a project such as the Rachid Karame Fair and Exposition site becomes increasingly unlikely because a project on this scale would represent a disturbance of the 'natural' state of the market. That the subsequent abandonment of the site is intrinsically linked to the economic stagnation of the city of Tripoli is undeniable, more interesting perhaps is the question this decline poses for the 'idea of the city', proposed by Niemeyer for Tripoli. On a national scale and within a larger geopolitical context, to what extent is a project like this dependent on a specific model of the state, not just for its procurement but also for its continued survival?³² The geopolitical project of modernization within the developing world and the centrality of architecture to it remains important, not only because it points to a moment of optimism precious for having been so short lived, but because it continues along increasingly privatized lines.

Examining the individuation of the geopolitical scale, it is clear that the Rachid Karame Fair and Exposition project works as both instrument and node. As instrument, it aspires to bind, on a symbolic register, a series of pre-individual national tensions. As a node it is but one element in a much larger relay of nation building efforts and attempts at institutional reform. Thus, the disparate forces the project aims to reconcile lie far beyond the scope of the project itself. Its attempt to bind these tensions and make them resonate together is wholly contingent on a network of forces that exist outside the architectural domain. The geo-political scale that finally emerges with this impetus to modernize comes into existence through a specific problem: the formation of the modern nation state. So too with the Tripoli project that both redraws and responds to this problem, existing within a scale of action only newly conceived and soon to be abandoned. As with Brasilia, what this project embodies is a specific scalar diagram in

which a strongly interventionist state is coupled with a bureaucratic and technocratic form of rationality. The stability of this diagram guarantees the spatiality of the urban plan; it does so by continually reserving the right and the means to intervene into national space at geopolitical scale.³³ In this regard, this specific manifestation of the geopolitical scale can be understood as a phenomenon that emerges with, belongs to, and finally depends upon a particular kind of state apparatus, one that conceives of the national space and its geopolitical context as plastic, one ready to identify itself as the architect of this plasticity, one able to redistribute social goods and aggressively intervene in the spatial articulation of the national imaginary. When this condition changed, when the nascent ambition for on model of statehood was aborted in the name of an even more aggressive return to *laissez-faire*, what takes place is not just a shift in political orientation, but also the death of a specific scale of intervention within the territory. In this regard, the geopolitical scale that the Niemeyer project embodies was born with this state form and wholly contingent on it for support, when the civil war began and this life-support apparatus was removed, the project was abandoned. In the following section, the conflict between the economic scale of the nation and the economic scale of the neighborhood will be used to explain the dispute over the status of infrastructure in relation to the Rachid Karame Fair and Exposition Site.

5.5 Economic scale

The city of Tripoli dates back to the 12th Century BC, with a history of settlement that includes Assyrian, Phoenician, Persian, Roman, Byzantine, Caliphate, Crusader, Mamluk, Ottoman and French Empires.³⁴ As the major seaport to Damascus until Lebanese independence, the city was a vital trade artery to the Mediterranean for centuries. The development of the city proceeded according to two poles, a port on the small headland and a fortification further inland. This typical Phoenician spatial pattern reconciled the need for trade with the need for security. The street pattern around the El Mina port area and the fortification are based on a medieval street pattern. The main axis

linking the port to fortification orients a grid that forms the basis of much of the development in the city in the post-independence period.³⁵

The Rachid Karame Fair and Exposition site is located to the south of the main axis linking the fort to El-Mina. Its elliptical form is defined by a four-lane freeway that circles the site, reinforcing its separation from the city and turning the project into a vast roundabout. The following argument explores the relationship of the site edge and its road network in regards to the infrastructural spine that connects Tripoli to Beirut and the rest of Lebanon, asking how the rhetoric of speed as able to unlock arrested economic potential is transcribed from its origin in the critique of the nineteenth century city to a regional and national scale. In the individuation of this scale of economic problem, a shift in historical attitudes toward the idea of continuity within the historical city can be found; especially the way ideas relating to circulation would come to figure so prominently in the project. The question then, relates to the individuation of two potentially conflicting or irreconcilable spatial problems, an economic actualization of potential at the scale of the nation, or an economic actualization of potential at the scale of the neighborhood. Which scale does the project address, which scale will it draw its meanings from, draw its successes or suffer its failures? In order to answer this question, a small piece of evidence in Niemeyer's sketch plan of the project is suggestive.

A comparison of the satellite photograph of the project in its current state (see fig.3) with the sketch design published by Niemeyer (see fig.4) reveals a significant detail that has passed without comment in any literature. The sketch plan clearly shows an intended road artery passing through the center of the elliptical site, penetrating under the boundary at the southern end and passing over the boundary at the northern end. Furthermore, two roads extend from the street grid planned between the coast and the project in the proposed residential district, puncturing the edge with two intersections. Significantly, this new urban district was to contain the collective housing that was never completed and most likely never seriously considered. These small details in the sketch plan indicate an attempt by Niemeyer to mediate the different regimes of speed announced by the context and its transformation: the Medieval street pattern of El Mina

and the Port, the 1950s development grid stretching between the two, and the high-speed freeway model accommodated by Niemeyer's curving freeways. The existing limit of the site, both in its articulation as a multi-lane road and its shape as a vast ellipse, surely the most foreign geometry that might be imposed on this site, was always intended to be punctured by two further access points. The scalar analysis of the Niemeyer's relationship to the city hinges on these details and whether they are understood in the context of the polemic against congestion that characterized the formative moments of modern planning or the later critique of the road and its annihilation of street life that emerged in response to it. Is it possible to read the puncturing of the limit as a concession to the context and its pre-existing circulation patterns? To what degree is the re-appropriation of the polemic on speed, not just in Tripoli but also in other Niemeyer projects, indicative not so much of a specific artistic attitude but a broader, discursive shift that would come to pose the problem of the city in terms of movement? In order to understand the epistemic model that Niemeyer draws on to re-organize movement around (or through) the Tripoli project, it is necessary to reflect on the work of Ildefons Cerda.

Cerda's 1859 Plan for Barcelona's *Eixample* is notable for its assertion that a city is based on the principals of efficient circulation of vehicles, pedestrians, goods as well as its emphasis on ventilation and access to sunlight.³⁶ This project proposes, in the form of a grid layout and building typology, a maximally efficient arrangement of parts in which the basic unit of the block is able to be repeated, allowing for maximum flexibility in the growth of the city. This geometric consistency also marks a profound philosophical reorientation in the conceptualization of the city, which will no longer be understood as a centralized seat of symbolic power and civic space but as a flexible spatial module whose logic is drawn from an empirical problem - circulation.³⁷ Both in terms of its ability to unlock stagnant economic forces and improve the health and vitality of the citizens, the question of efficiency and circulation take on a primary importance in the formulation of modern planning, finding in the question of circulation its *raison d'être*.

At the International Conference on Traffic held in 1923 in Seville, Spain, M. Massard suggests, “speed is the very epitome of modern society”, the smooth flow of automobile circulation taken as the *sin qua non* of the soon to be modern city, by the time Niemeyer would be commissioned in Tripoli, the economic and social rationality of speed would have acquired the status of dogma by the proponents of modern planning.³⁸ Reading the infrastructural dimension of the Rachid Karame Fair and Exposition site against this history makes two things apparent. Firstly, in line with the ascendant principals of planning at the time, the integration with the existing built fabric is premised on major arterial roads, thus privileging vehicular traffic over pedestrian traffic. More interestingly, the original plan shows the freeway from the south entering into the middle of the site, thus connecting it directly to Niemeyer’s project in Beirut. This infrastructural umbilical clearly links the commercial viability of the exposition site to its capacity to maintain a healthy (high-speed) link to the rest of the country. The failure of this strategy, its attempt to make an argument at the scale of the nation and not at the scale of the neighborhoods immediately adjoining the site is undisputed, but it is undisputed from the perspective of subsequent critiques of modern planning and their willingness to sacrifice pedestrian amenity and the virtues of ‘street life’.

A year prior to Niemeyer’s commissioned work in Lebanon, Jane Jacobs, writing in *The Death and Life of Great American Cities* (1961), lamented the wholesale erasure of urban fabric as part of what she took to be an ideological marriage between the principals of modernism and the private interests of developers, primarily in New York.³⁹ Jacobs takes aim at the modernist tower block typology, especially the empty datum that characterizes the ground plane, suggesting that much of the vibrancy and activity of the city was nullified by drawing people away from an active participation with the street. The success of Jacobs critique is evident; town planning has, since the period of the 1970s, incorporated into its basic presuppositions this expanded view of the street as not just a vector of movement but a locus for interaction.

The question here is to what extent the idea of ‘street life’ in the terms Jacobs conceives of it, can be said to have existed prior to its nullification? Did street life exist

before 1961? Or, is street life a retroactive projection of something that only became visible at the moment of its potential disappearance? Certainly there was already a tradition of literary and artistic reflection on the delirium of the new metropolis in Zola, Baudelaire, Kracauer and Benjamin. However, Jacobs' critique is entirely different, uninterested in the alienation, disinterest and delirium of the crowds or the inexorability of industrialization. Instead, Jacobs turns to the spatial dependency of small interactions and weak social bonds that glue together communities in an urban space. The solvent applied to these bonds - the modernist tower type - should instead be understood to have made these bonds visible, precisely because it threatened to dissolve them. If the scalar problem of circulation was immanent to the rise of modern planning, the scalar problem of street life was similarly immanent to its period of critique. Both problems evolve in response to different perceptions of the city, the squalor of the 19th century city in one case, the sterilization of the 20th Century city in the other, furthermore, both arguments take different scales of economic activity as their object, the nation state or region in the first case, the neighborhood and its community in the second.⁴⁰

Architecture's rationality is a critical one in that critique binds a problem to a proposition through a spatialised form of argument. In this regard, the specific scale being described here, the freeway encircling the Tripoli project and severing it from its adjoining city, is ideologically motivated, as Jacobs suggests. Furthermore, the ideology of speed and efficiency works both at the level of declared rhetoric and implicit content, but this content is no less present in Jacob's critique than in Niemeyer's proposal only that each conceives of critique with regards to a different problem. The problem that is so powerfully individuated during the later part of the 19th and early part of the 20th Century occurs at a historically specific and contingent scale – the vitality of the entire urban population. What takes place with the critique of modern planning, of which Jacobs is but one example, is that this distribution of problems begins to shift toward another scale – the neighborhood. With this new scale comes a new distribution of relevant and irrelevant questions, such as the emphasis on 'character' and heterogeneity, the importance of the street frontage and its activity, or the amelioration of traffic from

residential streets. Each individuating problem is retroactively declared a failure in response to a problem made retroactively visible.

5.6 The scale of the subject

The need which consumption feels for the object is created by the perception of it. The object of art – like every other product – creates a public which is sensitive to art and enjoys beauty. Production thus not only creates an object for the subject, but also a subject for the object.⁴¹

The following section turns to another scale of problem in the Tripoli project; the kind of political subject implied by its architecture. This argument will be made through a reading of the internal planning, organization and orchestration of movement through the work. It is a narrative that will be told against the movement from secular to sectarian politics in Lebanon that reached its apotheosis with the civil war, since this shift signaled the major break with the way a political subject is conceived and formed. In a Lebanese context, the question of identity must be situated in relation to the tension between urban and rural centers, the tradition of rural power being inseparable from its feudal structure and history of *asabiyah*, or group feeling.⁴² The dominance of communal bonds as the fundamental coupler of the social system undergoes a significant transformation with the urbanisation of the rural population that begins to take place as early as the 18th Century, articulated initially through a series of peasant protests and reaching a turning point in the early 20th Century with the perceived threat posed by the state.⁴³ As Michael Johnson has argued, the retreat into communal affiliation must be understood as a reaction to the erosion of secure social structures brought about by an increasingly urbanized and capitalist economy.⁴⁴ Sectarian tensions exist with the first wave of urbanized migrants arriving from rural areas into the cities. Communal politics can be understood as a response to a newly urbanized context and the inability to gain

access to networks of patronage that characterize Lebanese society.⁴⁵ In a 1998 article, Samir Khalaf and Guilain Denoeux put the issue in the following terms:

When the cruelties of the public world become more menacing, threatened and traumatized groups seek refuge in their tested and secure primordial ties and affiliations. Hence the family, locality, and confessional communities allay some of their vulnerabilities and provide needed psychic, social and economic supports and cushions. They do so however only by eroding civility, increasing distance between groups, and sharpening further the segmented character of society. In short, what enables at one level disables at another.⁴⁶

For Khalaf and Denoeux, urbanisation in Lebanon has always been marked by a disparity; the physical fact of increased metropolitan populations, density and activity was never accompanied by ‘urbanism’ as a way of life’. By this the authors refer to the stubborn persistence of feudal organization and communal bonds that translate into a neighborhood scale, and where urbanism as a practice would signify the anonymous social contract of civil society in a city. It would be tempting to dismiss the Rachid Karame Fair and Exposition site in light of the preceding argument, for appearing hopelessly optimistic in its invocation of a neutral, urban subject. Paradoxically, its commission by Rachid Karame the *za'im* of Tripoli can be understood as an example of the clientism and patronage that – as Khalaf and Denoeux argue – undermines the legitimacy of public institutions, those same institutions that the project would aim to symbolise.⁴⁷ While hindsight provides a certain critical reassurance, an analysis of the how the Tripoli project was organised reveals an ambition that, even if flawed, attempts to assert a model of spatial co-existence that is worth reflecting on, especially in the current context of continual anxiety and the threat of renewed conflict.

5.7 Spatialising co-existence

Entrance to the Rachid Karame Fair and Exposition project occurs at the southern end of the site through a trapezoidal concrete plane that funnels visitors away from its elliptical edge toward the entry pavillion that marks the beginning of the main axis. Flagless poles stand neatly to one side pointing at the sky. The initial impression is of a vast grey datum and grid of straw-colored weeds vainly working their way through the concrete. The scale of the entry plaza is vast. At the far end the datum is broken by a ramp where visitors can ascend to enter the site. Occasionally the obscure profile of beguiling shapes will come into view, but from a distance there are very few clues as to the contents of the project. Ascending the ramp, the interior of the project comes into focus. A panorama of isolated concrete figures in a landscape, to the left, an impossibly long plane forming the expo hall sweeps across the horizon in a broad arc, originally the 750m long exposition shed is oriented such that its concave side faces the Mediterranean, when eventually built later it will be flipped 180 degrees. The elbow form, two long straight sections connected in the middle by a curve, which orients the arms at around 140 degrees, is a Niemeyer trope, one deployed in previous projects such as the University of Brasilia (1960), the University of Constantine in Algeria (1969 -1972), and the Pavillion of Creativity in the Memorial to Latin America in Sao Paulo (1986-1988). Niemeyer usually uses this figure in larger urban plans in order to produce an asymmetry in the axial organization of the site and to act as a frame for free standing pavillions, which typically sit on the concave side (with the exception of the project in Algeria in which it sits on the convex side). The effect of this is a curving accompaniment to the promenade so that attention is gradually redirected across the site while also functioning as a continuous structure able to unify very large sites.

According to Niemeyer, the expo hall was intended to ‘discipline’ the ‘disagreeable confusion’ typical of exposition sites in which a large number of unique pavillions jostle. In response, Niemeyer’s proposal generates a simple concrete shelter open to the Mediterranean breeze arriving from the west. To the east of the expo canopy is a series of pavillions carefully sequenced to produce an ordered perspectival framing as one moves through the site. Referring to the project, Niemeyer suggests the pavillions were intended to display “the great themes that impassion the contemporary world:

spatial experience imbued with beauty and mystery; the evolution of nature and its perspectives; theater, music, cinema etc."⁴⁸ The first of these pavillions is the Lebanese National Pavillion, a square plan surrounded by a colonnade of subtly faceted arches that recall the Ottoman architecture of the region. To the right is a dome for experimental music, after that a restaurant, a tower and an open-air theatre capped by a parabolic arch. Interestingly, at the conclusion of this promenade, Niemeyer proposes two housing typologies; a freestanding, detached dwelling and a collective housing unit loosely based on a repetition of the typology of Le Corbusier's *Pavillion de l'Esprit Nouveau*. These types are complemented by a museum of housing in which a series of experimental approaches to modern dwellings were to be displayed.

There are two critical points that the project makes at this scale. The first is the organization of separate elements united by a ground plane datum and set in a park-like landscape, the primary element of which being the exposition hall. Niemeyer's idea of the ensemble attempts to deploy a number of different, though simple forms to produce an emergent spatial complexity. This ensemble form of organisation freed the individual buildings from the burdens of expressing needless differentiation, allowing Niemeyer to reconcile spatial richness at the scale of the site with simplicity at the scale of the pavillions. The second critical point is Niemeyer's decision to conclude the axis through the site on a pedagogical note, in which housing comes to occupy the prominent and symbolic role.

There are two main forms of movement through the site, the curvilinear progression towards the culmination of the axis and the Brownian motion between and through the pavillions. The gentle deformation of the baroque axis that re-orient attention as visitors progress through the site would typically conclude with a ceremonial or symbolic building. Here, Niemeyer locates these pavillions to the side, free standing in the park where guests can meander around them. Instead, the culmination of all Niemeyer's efforts at spatial organization and orchestrating both movement and views through the site results in a block of flats.

These forms of organization invert Costa's pilot plan for Brasilia, where the main axis terminates in a municipal plaza and is accompanied on either side by public service buildings, entertainment, banking and commercial sectors, with the residential zones relegated to the cross-axis or wings. Here the market place or exhibition hall accompanies a curving promenade on one side as a continuous plastic form with unique pavillions on the other, with the axis terminating with the proposed collective housing. The decision to conclude the ceremonial axis through the site with a row of typologically identical apartments based on a Le Corbusian model is a relatively unambiguous statement about the centrality of the dwelling and importance of domestic space within the modern city, but it is equally important to ask what sort of subject was being called into existence by this proposal.

The elements, programs and organization of the Rachid Karame Fair and Exposition site should be located in the context of the history of the national fair and exhibition projects, a history that is intimately linked to an attempt by the state to marshal culture in the effort of producing a new kind of public. Beginning with the Great Exhibition in London's Crystal Palace, such projects set out to shape, reform and regulate a large undifferentiated, newly urban population. This new subject had to be made governable, taught how to dress and act appropriately in public, to appreciate culture and their location within a new kind of national identity. As Uslenghi suggests, these exhibitions and the national pavillions they contained formed a 'technology of nationhood' in which culture and consumerism were instrumentalised.⁴⁹ Being shaped here was not just architecture but an audience that could, in the vastness of its own spectacle, become self-aware. In the mass orchestration of this public spectacle, the crowds would *see themselves seeing, and see themselves being seen*. This self-reflectivity, in line with the anthropological and ethnographic artifacts housed in the national pavillions, would form the primary pedagogical ambition behind such projects.⁵⁰

The Rachid Karame Fair and Exposition site carries with it the civilizing burden of the expo type's history. At the scale of the interior and its elements, this project was an aborted attempt to enlist the public into the project of its own reform. What sets this

project apart from its historical predecessors was an emphasis not just on exhibition, but also on cultural production and performance. In the plastic, concrete forms of the pavillions and theatre there is a concerted attempt to produce a surplus of cultural and symbolic capital that cannot be simply explained through recourse to historical precedent. The prominent location of the collective housing unit and museum at the end of the primary axis, but more so in the theatre for experimental performance, Niemeyer exemplifies a specifically humanist attitude towards the imagined subject. On one hand, the symbol of collectivity and on the other, a space reserved for the artistic free expression of the individual. This tension is the marker *par-excellence* of the modern project, the impossibility of reconciling technocratic rationality with individual freedoms.⁵¹

The individuation of the three problems considered so far - the geopolitical problem of nation building, the actualization of economic potential within the region and finally the constitution of a new public - cannot be considered to form a single, coherent impetus behind the parts of the project. Each scale places paradoxical demands on the project, which the form and organisation of Niemeyer's site attempts to mediate and hold in a stable state. In the genesis of the plan, the project attempts to mold the image of an embryonic state and in the same gesture ties itself to the viability of that state for its survival. In the formation of a blank ground plane and the discontinuity from the city around it, the project attempts to form a limited, though open and neutral stage for a civic promenade. In doing so it severs itself from the context and interrupts the neighborhoods that surround it. In the final stage of this case study the interior of the dome (for experimental performance) is examined in relation to the ineliminable conflicts that characterize the rest of the project, forming one last poignant expression of scalar conflict.

5.8 The dome of the park

Wherever the power of illusion is at its most intense; wherever the inversions, deceptions, and confluences occur, that is where the difficulties are likely to be most desperate beyond the borders of illusion.⁵²

To the right of the exposition hall is a dome measuring 62 meters in diameter and almost hemispherical in shape. From the outside, the dome gives little away, a squat partially curved shell with straight sides broken by short doorways. Made entirely of concrete and filled with detritus like broken bottles, small rocks and empty water bottles, the structure - intended, as a venue for experimental theatre and music - is little more than a curiosity to residents who stroll through the area. Entering at ground level, visitors gradually descend toward the center, the floor terracing to a sunken orchestra pit. Much is unknown about this structure, except for its startling acoustic behavior in which sounds ricochet wildly across the room. Did Niemeyer intend to retain this strange acoustic signature? Is the building an instrument designed to accompany the performances that were to take place inside? Would the complex time signatures produced by the excessive reflections force artists to both compose and rehearse inside the space? Some have speculated that the steel bars suspended from the roof were intended to fix acoustic battens or ceiling treatments that might have modulated the intensity of the acoustic reflections.⁵³ While one can only speculate as to Niemeyer's intent, one thing is certain; the overwhelming sensation of sound in the dome does not accord with any previous acoustic experience.⁵⁴

The dome is the paradigmatic figure of centrality and platonic perfection, a seemingly recalcitrant geometry resistant to innovation (Buckminster Fuller's experimentation with geodesics being a notable exception) and so suited to reflect both sacred and profane images of the cosmos. One thinks not just of mosques and churches but also observatories and planetariums. Perhaps the most well known typological example is the dome of a centralized church; an exemplary type which historians like Rudolf Wittkower and Heinrich Wolfflin took to embody the serene perfection of the Renaissance. The architectural critic Robin Evans has suggested that these structures - and especially the frescoes painted on the inside of them - are evidence that architectural

and artistic practice struggled to reconcile an ambiguous relationship between man and heavens.⁵⁵ After all, how is it possible to marry the Ptolemaic view of the cosmos, with the earth occupying the center and surrounded by concentric orbits of various celestial bodies with the sense that power must always radiate outward from a single point?

The dispute, as Evans puts it, is between envelopment and emanation and there is more than mere spatial or pictorial resolution at stake. Each position embodied distinct and sometimes antagonistic social, theological and political claims about the location of man with respect to God. According to Evans, the achievements of Brunelleschi or Raphael lay in their ability to literally give form to the contours of the dispute by bringing these differences into proximity and holding them in a space of co-existence. Uncharacteristically, Evan's text leaves out one important aspect: sound. Any account of centralized churches that does not account for the experiential effects of the liturgy and choir is incomplete, for what remains unresolved in the spatial registers is answered definitively in the acoustic one. The effect is one of complete envelopment.

Though it is possible to see the dome as a platonic element afloat in the green datum constructed for it, the experience of the room challenges this reading. This confusion leads one to think that Niemeyer had one final typological displacement in mind when selecting the recognizable form of a dome, shifting the conventional and local reading of it as a sacred space and transforming it into a secular one. The choice of program for this room - a site for experimental theatre and performance - only serves to confirm this suspicion. The Lebanese Civil War, which began in 1975, aborted the completion of the project. It has operated, since the cessation of hostilities in 1990, as a kind of abandoned park for residents.

Niemeyer's attempt to enroll architecture in the project of building a new state was directed to an imagined humanist, secular subject. This subject that was never realistically on the horizon. In the symbolic typological displacement of the dome, from its religious or sacred context into a new experimental and cultural one, it is possible to see exactly how far Niemeyer's ambition for the project stretched. In the distance between the theological context of today and the secular one it was conceived within, one

can measure the precise distance between 1962 and 2012. Like the other buildings on the site the dome was never used. It sits as an abandoned acoustic chamber capturing the sound of the surrounding city, such as the accumulated noise of traffic as it makes its way around the site in a clockwise circle, or, five times a day when a clamoring recitation of the call to prayer can be heard from two opposing minarets.

5.9 Fragmented utopias

In conclusion, this case study will reflect on the idea of unity in light of the aforementioned analysis of the project in Tripoli. It will do so by comparing the question of scale as it has been presented here with a canonical critical text on modern architecture and its proposition of 'bricolage' as a dis-unifying strategy. In *Collage City* Fred Koetter and Colin Rowe critique what they perceive to be a totalizing excess in the modern movement and its idea of the city, seeing in the utopian impulse a hubristic desire to suppress history, eliminate contingency and annihilate difference. Looking back on this critique, in light of continued reassessment and the decline of modernism, *Collage City* reads more like a critique of modern rhetoric than a critique of modern building. Contingency, history and difference care as little for architectural rhetoric as they do for building; they have, and always will, make their claims on architecture, whether modern or otherwise. Taking the idea of contingency seriously, neither success nor failure can be secured in the face of it, regardless of style, form or ideological commitment. As this thesis argues, both success and failure are always dependent on the distribution of relevant points within a field. There is no ultimate tribunal that can decide in favor of one moment over another; instead, one set of singular problems is replaced by another. With each shift a reorientation of attention and a retroactive re-assessment of history and its pre-cursors takes place.

Both Koetter and Rowe claim that utopia can never be conclusive. With this truism out of the way, they inaugurate a critique of 'total design', beginning with a

comparative discussion of Villa Hadriana and Versailles. It is worth returning to *Collage City* here. The text signals a departure from modern architecture that proceeds via a critique of unity. But as this conclusion will demonstrate, both Koetter and Rowe formulate the *problem* of unity, and by implication modern architecture, on the wrong terms, connecting the question of difference to a series of bourgeoisie values such as taste and discernment. The action of scale in *Collage City* is implicit in the title with its references to multiplicities and difference, but scale here is overburdened by nostalgia existing primarily within a semantic and picturesque register. The effect of this is twofold: 1) to neutralize history, which now appears as simultaneity - a repertoire of available forms to be drawn upon, and 2) to neutralize politics, reduced to the ironic play of differences. Against this position, the present case study will conclude by explicating the implicit scalar argument in Koetter and Rowe in order to detach it from any necessary relation to picturesque values.

Describing the Palace at Versailles, Koetter and Rowe noted:

The moral is declared to the world and the advertisement can scarcely be refused. This is total control and the glaring illumination of it. It is the triumph of generality, the prevalence of the overwhelming idea, the suppression of exception.⁵⁶

Versailles is a paragon for everything the authors set out to negate, they will counter pose it to another project, which will come to exemplify everything they will try to assert: the Villa Hadriana at Tivoli: "The one of the them is all unity and convergence: the other all disparity and divergence: the one supposes itself to be an organism, entire and complete: the other presents itself as an animated dialectic of parts."⁵⁷ The rhetoric here is quite clear, on one side, the reductive simplification of totalizing architecture, on the other the conflicting, dialectical complexity of Hadriana. The authors set up a series of clear oppositions: abstraction vs. reality, large-scale ambition vs. small set piece, unity vs. conflict, general vs. specific, homogeneity vs. heterogeneity. Railing against total

design and arguing that it is the 'psychological sub-stratum' of urban thought they argue that rational, systematic methods will always run aground on the contingent shore of the city.⁵⁸

There is much to agree with here. Gesturing to an idea of the city as resistant to unified expression, the authors hold a deep conviction in the role of difference. However, the conclusions they draw from this premise should be challenged for the following reasons. Koetter and Rowe champion the idea of 'bricolage' as a counter strategy to the purported totalizing impulse of modernism. Through bricolage, different historical forms are allowed to co-exist, related to each other in 'set pieces'. The theatrical or cinematic analogy should not be passed over too quickly; the city is literally *a staging* of different, sometimes conflicting meanings. There is a strange self-reflexivity at work here, where the structural position of difference is no longer something that occurs as an automatic consequence of the plurality of actors, instead difference should be consciously deployed as a marker by those actors in the service of an 'idea of the city as heterogeneous'. Heterogeneity appears therefore, but it appears as a sign.

Koetter and Rowe move from an existing condition, the historical city, to its concept, the collage city, bypassing the operational moment that occupies the gap. This hasty leap from a catalogue of pre-existing forms to their eventual staged redeployment misses the operative moment of individuation, ignoring the creative space and time of architectures reasoning. If there is a creative act within their concept of the collage city, it only emerges out of the arrangement of pre-existing elements. The heterogeneity that both Koetter and Rowe focus on is primarily compositional, working only as an illustration to stage difference and stimulate the interest of the passers-by. The error that Koetter and Rowe make is to treat the idea of heterogeneity and multiplicity in purely actualized, already individuated terms. By treating difference and conflict as existing signs able to be transplanted from their context and re-organized according to will, they repeat a hylomorphic conception of matter, denuding the sign of its intensity and disconnecting it from the background conditions that lend it sense.

It is worth returning to the different scales within the case study so that the difference between bricolage and scale can be made more precisely. In the genesis of the geopolitical scale a typological idea, Brasilia, was drawn on in order to give shape to a newly emerging state.⁵⁹ The geopolitical scale of the project was in turn tied to a specific formation of the state willing to conceive of this scale in plastic terms. As long as the state apparatus adopted this composition, it was able to marshal together and hold in place the necessary forces required to maintain this scale of operation, and by implication the project. In this regard, there is a specific problem being posed: how is an emerging nation *given* shape? How is it attributed a specific epistemic model? Brasilia, and the discursive background that lends its elements meaning, was imagined as a stable social welfare model of the state. The chain of immanence that connects each one of these distinct individuations (ontological, epistemological, discursive) forms a scale; in this case a geopolitical one.

As this thesis has argued, this multiplicity of forces should be understood as immanent to the terms of the problem, the actualization of the multiplicity, its gradual specification and concretization into parts can only take place through the co-individuation of an epistemic frame. In each case, the concrete parts emerges out of a specific scalar problem, the problem is dragged forward by the part as its background, stabilizes - if only momentarily - before being plunged back into a new set of conditions. In this regard, the individuated forms that make up the Niemeyer project always carry a reserve of pre-individual excess able to actualize in different ways depending on the network of conditions in which they are located.

5.10 Conclusion

Returning to Koetter and Rowe in conclusion, it is one thing to grant complexity and difference ontological status, as they seem to imply, but it is another to presume that any symmetry exists between this ontological difference and its actualized manifestation. Should difference translate into diversity of forms or should it be understood as the differentiation of problems as they gradually specify themselves?⁶⁰ There is much at stake in the answer to this question. In ignoring the process of individuation of the problem-model-discourse plane, Koetter and Rowe give no weight to the importance of the epistemic individuation that is the necessary counterpart to the individuation of the problem. In doing so, they abdicate any instrumentality for architecture beyond the curatorial arrangement of pleasing artifacts. Thus, their position perfectly coincides with the disavowal of belief that is endemic to late capitalism:

...a collage technique, by accommodating a whole range of *axis mundi* (all of them vest pocket Utopias – Swiss canton, Dome of the Rock, Place Vendome, Campidoglio, etc.) might be a means of permitting us the enjoyment of Utopian poetics without our being obliged to suffer the embarrassment of Utopian politics. Which is to say that, because collage is a method of deriving its virtue from its irony, because it seems to be a technique for using things and simultaneously disbelieving in them, it is also a strategy which can allow Utopia to be dealt with as an image, to be dealt with in *fragments* without our having to accept it *in toto*, which is further to suggest that collage could even be a strategy which, by supporting the utopian illusion of changelessness and finality, might even fuel a reality of change, motion, action, history.⁶¹

As Slavoj Žižek has pointed out, the function of irony here is to announce a separation between belief and action.⁶² The public disavowal of explicit belief in utopia sustains an unannounced implicit one - in this case paving the way for a return to a mythical community. Nothing could be more ideological than this disavowal of ideology. Nonetheless, it is possible to see a clear oscillation in the above. On one side a political

disavowal in which ironic distance comes in to stand for the undeclared presence of an ideological position. On the other side, a nascent scalar argument dealing with parts, inconsistency and fragments. A more generous and alternative reading can be imagined. To what extent can the conservative dimensions within Koetter and Rowe's argument be amputated? Can the latent scalar argument be unfolded from what remains?

This all depends on how the idea of the part is conceived. The critique of unity for both Koetter and Rowe exists at the scale of the city, the intention in the remainder of this chapter is to radicalize it such that it applies to all elements regardless of size, and where the idea of the part expresses neither the ultimately dialectical nature of the city nor a sign of difference denuded of context, but rather the concretization of a problem through a model. A process that takes place within a limited horizon of action and for this reason manifests as partial. The instrumentality of these parts can no less be reduced to *inconsistency* of appearance, style or character, than they can to *consistency* of appearance, style or character. This would direct the objects instrumentality at the wrong level and over burden specificity within appearance, style or character with an ambition it can no longer fulfill.

For these reasons, the critique of unity is always operative in any work, whether it purports to be unified (Niemeyer), or purports to be differentiated (Villa Hadriana). The test in this sense cannot operate in a stylistic register alone since this register emerges as a consequence of the collective forms of knowledge that individuate around a problem, it is more a question of epistemology and reasoning and the way they both allow for an instrumentalisation of form. The alternative conception of urban design as found in Koetter and Rowe's text resembles nothing more than a sensibility guiding the cultivated arrangement of conversation pieces in a Bourgeois household. If the continuity of the city cannot be spoken of in the singular, and it is difficult (if not impossible) to be faithful to more than one continuity, to which continuity do Rowe and Koetter refer? Pierre Bourdieu's analysis of the class basis of taste is worth recalling here in that it clearly

expresses the congealed cultural capital and class stratification latent in seemingly neutral aesthetic judgments.⁶³

The account given of Tripoli in this case study could have been expressed in a number of different methods, the most conventional of which would be to narrate the itineraries of different actors and the individuation of their unique perspectives on the project - each pedestrian actualizing a partial if overlapping image of the whole. This perspectival approach is implicit in the work of Koetter and Rowe. In departing from it here there is a desire not to anthropomorphize architecture within a phenomenological framework, nor to equate it with the experience of a specific human subject. The 'geopolitical', the 'city' and even the 'subject' scales are riven by an anonymous play of forces in which an idea, a planning charter, a road, and a building are just as likely to be protagonists as the architect or the inhabitant - each of them both installed within and adrift upon problems they have limited agency over. Architecture is contextualized here, not in order to secure its meaning once and for all, but rather to open it so that multiple forces might traverse it. In this continual assembly and disassembly, typological thought is the epistemic glue that binds the part to a context *and* to a history, knowing full well that these bonds will represent only a temporary coming together, a partial unity limited to the scale at which the connection is posed.

THE CYBERNETIC ETHOS

6.0 Zero latency

The following case study explores a little known episode in the history of Latin American socialism. A great deal of time has been spent investigating, documenting and disputing an eleven year period in Chile from 1970-1981, encompassing the presidency of Salvador Allende and the dictatorship of Augusto Pinochet. Between the rise of the Unidad Popular and its overthrow by the military junta, brutal and notorious events took hold of Chile.¹ Though many of these events have remained ambiguous, obscured by trauma or lost in official dissimulation, over time the contours of history have become less confused. Beyond the coup, the involvement of the United States or even the subsequent transformation of the economy, a more comprehensive story of radical experimentation on the Chilean social body has emerged. Within this story, attention has understandably focused on Allende's rise and the capitulation of his government, followed by years of brutal reprisal and repression meted out by the junta.

What has attracted less scrutiny is an experiment in economic management during the formative moments of socialist reign. Allende's attempt to implement an experimental system of nation wide governance based on cybernetic principals is as remarkable as it is obscure. So far it has merited a single book: *Cybernetic Revolutionaries: Technology and Politics in Allende's Chile* by Edin Medina, a chapter in Andrew Pickering's *The Cybernetic Brain: Sketches of Another Future*, plus a small number of journal articles and references.² However, the principal cybernetician and mastermind of the project, Stafford Beer, did publish prolifically, and some of his own writings reflect on the Chilean experience. Almost all of these efforts attempt to establish a historical record of events, before, during and after this particularly tumultuous period of Chilean history. Similarly, almost all are swept along by the audacity of the project, caught up in an attempt to describe what was, in retrospect, an unprecedented and prescient experiment with a form of governance, decades before similar ideas would be tested in the rest of the world. There has been no reflection as yet on the broader implications of this project, neither in terms of its relation to wider, global issues of governance, which it surely raises, nor to political histories which go far beyond the histories of technologies.

At stake in the years of Allende's ascension to power and those that followed was a Latin laboratory for social experimentation. This laboratory was at once optimistic, sincere, naïve, hubristic and finally brutal. Few experiments were as audacious or prophetic as Allende's cybernetic programs. In this ambitious venture that lasted only two short years, a number of issues that carry continued importance were raised: first, an attempt by a national government to govern in real time at the scale of the entire national territory; second, the development of technical infrastructure that could track and shape fluctuations and changes in the Chilean economy; third, the conceptualization of a national political space along the lines of a business regulated by ideals drawn from corporate management; fourth, the invention of a scale and technique of government that begins on one end of the political spectrum but finds its ultimate conclusion at the very other.

The Chilean cybernetic experiment emerged in response to an urgent problem; the nationalization of the Chilean economy, especially the gathering together of disparate sites of productivity, resource extraction and manufacturing, in addition to their re-integration within a state controlled economy. Allende had no desire to model Chile on the centrally planned economy of the Soviet Union, whose rigid hierarchical structure and lack of adaptive flexibility led to human and political crises.³ In line with the mandate of a constitutionally elected Socialist leader, Allende intended to devolve some central control to factories and grant workers increasing autonomy over their own labour. In doing so he hoped to hold in balance a series of opposing forces. On the one hand, the burden of redistribution that always falls to a centralized state, on the other, liberating the auto-poetic force of the workers in their specialized sites of work. This complicated political calculus was made all the more difficult because the stage upon which it took place introduced a further set of variables. Chile is on average only 175km wide, however it stretches for 4,300km in length. Moreover this elongated sliver of a nation is draped over an almost entirely mountainous terrain. If this engendered topographical complications, geologically Chile was abundantly rich. Breaking apart the monopolistic control of these resources would be critical to the viability of the new socialist economy. The problem that was posed to this young and idealistic government was how to create a new territorial scale of governance, one able to reform and eventually stabilize this complex spatial, economic and social landscape without relying on the precedents set by Soviet-style economies. In other words: how to reduce the adaptive threshold of political decision-making from the five-year model to something more immediate. This ambition would require developing an infrastructure for the exchange of information and transferring some of the decision-making capacity from the state to local actors.

The land surface of Chile had long acquired clear boundaries, fixed since the indigenous Mapuche uprisings.⁴ Communication systems throughout the territory were principally based on human operated telegraph, radio and microwave transmission. These two factors, the scale of the territory and the extent of the communication network

would prove critical for Allende's government. As the following case study illustrates, the Chilean cybernetic experiment made a technical promise to make the entire territory knowable *in real time*. Sites in the far south in Puerto Montt or the far north in Antofagasta would now be in continual and reciprocal exchange with Santiago, the capital. The orchestration of this new scale of governance both in time and space was without precedent in the 1970s. For example, the military predecessor to the Internet, Arpanet, was still in its infancy, while Soviet experiments in controlling the economy with computers was only just beginning. As such, the project provides a unique examination of the attempt to build an epistemic structure around a complex ontological situation, unique because at the very basis of cybernetics lies a belief that these two registers are wholly commensurable, the difference being only a matter of latency. The complex non-linear behavior of an economy or a social system might not make itself wholly predictable, but it could be tracked, made present, and therefore available to action in real time. This promised to shrink the gap between a dynamic material condition and the kinds of knowledge that made decision-making on this condition possible. Furthermore, the individuation of the problem of the territory and the individuation of a new epistemic structure sheds light on many contemporary questions relating to the form of governance under what is described as neo-liberalism. These aspects of the story continue to be of importance today, and will thus be referred to throughout this study. Of particular relevance is the way in which government begins to operate through the contingency of this condition rather than in despite of it. Finally seeing in the contingency of the territory both a natural resource to be cultivated, and because of this, a constraint meant to minimize the intervention of government.

It has been a central part of the argument in this thesis that the relation between the epistemic and ontological registers emerge in response to the objectivity of a problem, and that the correlation between these registers form the genetic moments of scale. In the Chilean case, the scale is territorial. Importantly, the objectivity of this correlation always takes place against a shifting background of conditions which have the potential to fortify, disrupt or weaken the network of associations that radiate out from the problem, making

it deeply contingent. Moreover, the historical context in which this new scale forms is – in turn – subject to its own transformations and contingencies. History retroactively shapes a new distribution of problems and with time the problems can become more or less relevant. In effect, this means that the objectivity of the problem is immanent to the contingency of the field in which it enters. If the field starts to shift, then the problem inevitably installs itself into a new set of points within this network, lending it a new and different sense. In this regard, the Chilean cybernetic experiment is paradigmatic, an experiment in emancipatory politics from the left, interrupted and quickly transformed into an experiment in neo-classical economics by the right, a transformation that mirrors the shifting historical background against which this particular cybernetic experiment takes shape. Beginning as a paragon of socialist virtue it culminates as a paradigmatic technique of neo-liberal government.

6.1 Error correction

On 4 September 1970, in an election awash with KGB and CIA money, the Popular Unity (UP Unidad Popular) coalition of leftist parties headed by Salvador Allende won 32% of the popular vote in Chile. At this point, the Allende government believes it has six years to reform the Chilean economy.⁵ In line with its socialist democratic agenda, the government sets out to nationalize its resource and finance sectors, and increase the efficiency of poorly performing industries.⁶ Allende faces challenges on a number of fronts. The modernization of the economy demands integration at the scale of the entire territory, in this case a tortured topography formed by the subduction of the Nazca and South American plates, riddled with fault lines, the scars of glaciation, active volcanoes and rich seams of copper and other valuable mineral deposits. The infrastructural demands of orchestrating production along this mountainous seam of a territory had to be met if, in line with Allende's anti-monopolistic stance, the country was to gain control of the mining industries that the Chilean economy had come to depend upon.

On 12 November 1971, little over a year since his government had come to power, President Salvador Allende receives an unlikely guest. Stafford Beer is a cybernetician interested in the application of cybernetics to social systems. Beer has been invited to meet Allende by some Chilean scientists who are interested in using his expertise on cybernetics to manage the newly nationalized industries.⁷ Cybernetic research evolved out of a problem: how to hit a fast moving plane with a weapon, or, in the parlance of the military; making the ballistic and the target 'reach the same point in space at the same time'. In response, researchers during World War II developed systems that were able to track an enemy target by continually recalibrating a weapon around its anticipated position, labeled a 'feedback loop'.

At MIT, on a miniscule military budget, Norbert Wiener led research into the mathematics and circuit boards that would eventually help to automate anti-aircraft fire. The achievement was as conceptual as it was technical, a re-imagining of the method by which a highly manoeuvrable fighter and its pilot could be fired at, with the projectile anticipating the future position of the target. The design of the mechanism had to reconcile meteorological factors such as wind with human cunning and be able to outsmart both. Wiener's urgent desire to develop these systems emerged in response to the carnage caused by the German bombing of London, and though he was unable to complete the device before the conclusion of World War II, he clearly perceived and predicted the horizons that this technology would open. Horizons far beyond anti-aircraft weapons, and moreover, far beyond any military use per se. Wiener "came to see it as the articulated prototype for a new understanding of the human-machine relation... His two thousand-odd dollars would be conceptually stretched to blanket the earth."⁸ Wiener's research arrived at a time in which the idea of large-scale computational modelling had begun to take hold across many areas, almost all evolving from the war effort and the attempt to build a systematic basis for strategic decision-making. Soon urbanists and planners would also begin to extol the virtues of this research into game theory, operational research, and systems analysis. For example, researchers at "RAND

sought to quantify complex social and political phenomena into equations whose variables could be fed into a computer. These equations formed the backbone of mathematical models that, once transformed into software code, were said to predict behaviour in uncertain systems".⁹

The problem of uncertainty, treated in Chapter 1, *The Scale of Matter*, returns here and acquires a unique sense. If the temporality of science was characterized by the reliability of its predictive capacity, this is because an ability to render laws out of experiments formed a specific kind of scientific virtue. As the object of scientific inquiry became increasingly complex, uncertainty began to frustrate the constitution of laws on which this predictive capacity was based. In response to this, models began to acquire a central role in scientific research.¹⁰ While both laws and models are composed of symbolic statements, their functions could not be more different. Laws transmit information mechanically from a general rule to a particular instance, while models form general behaviors out of particular interactions.¹¹ In the final case study on climate conflict, it will be possible to find a paradigmatic example of this difference.

Uncertainty is as ineliminable from a climate model as it is from the climate. The predictive capacity of the model always exists within a bandwidth of statistical reliability. The response of cybernetic systems to this condition of uncertainty was an attempt to track the dynamism of a complex condition in real time. Though the predictive cast of a climate model stretches to years and usually decades, the systems that will be described in the following case study occur in the present - or as close to the present as the latency of the system will allow. This emphasis on the present and the immediacy of the detection-calibration-action circuit within cybernetic thought produces a unique temporal contraction that is as conceptual as it is literal. In effect, the cybernetic circuit attempts to bind itself to the problem at hand, welding epistemic and ontological registers in a unified plane. The Chilean cybernetic experiment is also unique in that its object of inquiry was a human population, not an enemy aircraft or a weather system. The natural expression of contingency in nature exemplified in climate science or Darwin's theory of

random mutation for that matter, finds a mirror here in the natural expression of freedom within a human population.¹² Cybernetics would play on this history.

Though Wiener set the incalculability of nature against the calculus of man, what held the two together and ties cybernetics to the 18th Century is the fundamental commitment to understanding human populations as unknowable in ways that resonated with the unknowability of nature, and thus to open the possibility of re-inscribing human interaction either socially or economically within a specific kind of calculus. In this case, the mathematics of error correction.¹³ The cybernetic black box operated at the very limits of the known, the very idea of a cybernetic control mechanism – in that it posed the correlation between the behaviour of an open system and the tracking of that system in terms of error correction – attempted to collapse the ontological *into* the epistemological with only the latency of the feedback loop to separate them.¹⁴

6.2 Organizational biology

In the only comprehensive history of Project Cybersyn, Edin Medina accounts for Chilean experiments with cybernetics in terms of the deep affinity between cyberneticians like Beer and the reformists around Allende, especially engineer and political ally Fernando Flores, who would be instrumental in inviting Beer to Chile.¹⁵ Beer's interest in cybernetics emerged out of his work in organizational management, especially what he perceived to be limitations in the adaptive potential of organizations dominated by rigid divisions of labour, poor channels of communication and constrained spaces for decision-making. In response to this, Beer experimented with organizational reforms that aimed to inject flexibility and a level of autonomy into decision-making, believing this would encourage employees to respond to a shifting work environment.¹⁶ Looking back, Beer's commitment to a radical flexibility within the workforce is only one of a number of prophetic resonances that early cybernetic research has with neo-liberalism. At the time, the promise of granting more autonomy to workers in terms of

control and organization of factory productivity neatly coincided with the aims and aspirations of Allende's leftist government. A core concept in the implementation of this ambition was something Beer called the Viable Systems Model (VSM). This model attempted to capitalize on the unique ability of cybernetic systems to respond to contingency. In order to accomplish this, Beer envisaged a technical system as open and as adaptive as the society it set out to manage.¹⁷ For Beer, organizing bodies into groups, establishing protocols for decision-making, setting up channels for communication and allowing thresholds for change were all qualities embedded in the material of the organization in the same way developmental pathways were embedded in the organism. The plasticity of the organism with respect to its environment served as a model for the plasticity of the business in regards to its market and competitors, both being problems of adaptation to an external force field. Indeed, Beer originally viewed cybernetics as a hylomorphic critique of the *matter* of 'business organization', a faith in the *agency* of (organizational) matter whose adaptive, auto-poetic potential needed to be unlocked. Much like a biological system, for Beer, the organisation was made of matter that was alive with possibility, animated by internal drives, regulated by environmental constraints.

In an attempt to mirror a certain conception of the firm, the diagram of the VSM broke down its structure into a series of linked parts hierarchically nested within each other. *Like* parts, say the accounts departments for different geographical regions, were linked by horizontal relations of information exchange, allowing them to share data. *Unlike* parts, say the relation between the management board and the accounts departments were linked by separate circuits allowing for feedback and control. Organized according to a biological metaphor replete with nervous system, organs and sensory apparatus, the VSM was envisaged as a complex interlinking of perceptual and responsive mechanisms. These mechanisms could ensure that changes in the information environment would efficiently reach the appropriate decision making node within the organizational structure. This sensitivity would encourage rapid and responsive decision-making and thus adaptation. Not that Beer conceived of all decisions as being equal, there would be no point burdening management with decisions that were not strategic in

nature, therefore the autonomy on which the firms adaptation drew was not equally distributed. As one moved up the hierarchy of systems, the amount of overall strategic information about the entire firm expanded till the brain-like command structure was reached, which Beer imagined should look like a World War II operations room. Significantly, the structure of the VSM was recursive, the same logic of feedback and response that structured each part also structured the larger part that these sub-parts were contained within, *ad infinitum*:

Beer felt that such recursivity was a necessary property of viable systems—they had to be nested inside one another “like so many Russian dolls or Chinese boxes” in a chain of embeddings which descends to cells and molecules and ascends to the planet and its universe.¹⁸

For Beer, the question of scale was wholly commensurable across different problems, from a small cellular organism to an entire ecosystem, just as from a clerk's office to a production line. This crude characterization of the biological metaphor and its over application would cause difficulties later when techniques that were successful in a business environment were drawn into the management of an entire nation's territory and its economic productivity. The reason for this recursive approach to scale in management clearly stems from a recursive understanding of scale within the organism - one serving as the rule and the model for the other. Moreover, it is possible to speculate that what permitted Beer to extend this diagram of organisation into non-biological domains was a sense that each part of this system operated like a black box. According to this idea, first formulated by Weiner, the inner workings of the thing being modelled did not matter, all one had to do was to track the inputs and outputs.¹⁹ The VSM was simply a diagram for relating inputs and outputs among variously scaled black boxes, this seeming neutrality with respect to 'specified content' may have further allowed beer to generalise its applicability across different situations. In fact, Beer was a staunch critic of the idea that the VSM could 'contain' information the way a box could contain goods, this would be tantamount to splitting form from content, reverting to a hylomorphic conception of organisational matter. As Pickering states:

In Beer's vision, viable systems do contain knowledge representations of their own inner workings and of their environment—principally enshrined in the OR models at level 3 of the VSM and the projective models at system.²⁰

What Beer misses, ironically, is that the representations may not have been held or contained *within* his system as a kind of cargo or payload; instead they were embodied in the system's very structure. Though there were no 'symbolic or representational elements' or internal models in the black boxes that made up the VSM, it was not possible to say that the VSM was wholly plastic and adaptable. It had parts – and though these parts were indeed black boxes, the diagram of information flow that linked the various inputs and outputs together was quite immune from the adaptive process. There was a clear model at work, just not at the scale Beer was focused on. It is possible to see why this was successful within a business environment. While it was subject to fluctuations in demand, price, manufacturing etc. it nonetheless had to have a relatively stable set of parts given that marketing, accounts, production and management were regular features of the mode of production the business existed within.²¹

6.3 The national nervous system

The eventual deployment of a socialized cybernetic network in Chile exceeds any precedent by orders of magnitude. Known variously as 'Proyecto Synco', 'el Sistema Synco' or Cybersyn, the fruition of Allende's control fantasy and Beer's techno-optimism was a nationwide system of monitoring, reporting and feedback based on cybernetic principals. Hundreds of telex machines installed in newly nationalized factories all over Chile were utilized for sending data on everything from production volumes to employee absence rates back to the central command room in Santiago. The backbone was Jay Forester's DYNAMO compiler, fresh from use in the Club of Rome Report titled *The*

Limits of Growth, where it had also been used to model large-scale economic and demographic tendencies.

For Beer and enthusiastic colleagues like the biologist Francisco Varela, who would go on to put forward a theory of auto-poiesis with Humberto Maturana, a cybernetic model of socio-economic management equaled national stability. Provided inputs could reliably be fed into the control center, social and economic effects could be generated in response to any circumstance. The nation could be tuned, and Beer knew how to turn the dials. Sitting on molded plastic chairs in the Cybersyn control center, technicians took live signals from Chilean factories up and down the coast and in return used them to manipulate and adjust the Chilean economy in real time. Like stimulated nerve endings firing electrical charges, information from hundreds of small social and economic events across the nation flowed down telegraph wires into the central control room; the national nervous system had been re-scaled to cover the territory, and had seemingly acquired a cybernetic brain.

In the hexagonal control room in Santiago, television screens would present real time information to a planning committee. This organization of information spatialised the real-time data processing system, collapsing the vast distances of Chile's topography and its widely distributed centers of production to a single point in space. From this position, it would be possible to literally *see through* the walls of the room such that the entire scale of the territory would be co-present and available for action simultaneously. The ontological and the epistemic promised to merge on the surface of the screen. This control room scenario is now commonplace, indeed contemporary logistics, shipping and freight systems would be unthinkable without it, and though it had certain precedents during World War II, especially in the spread of war rooms built across the world, the televisual nature of the system together with its peace-time operation and economic domain make it unique.

Additionally, what made Cybersyn more unique however was that each node in the network would be granted a certain operational autonomy. Factories could communicate with each other as well as with the central command room. This image of freely flowing information able to traffic horizontally between like nodes and vertically through a command structure was absolutely central to Beer's conception of Cybersyn. It was what, he and Allende believed, would lend it its curious powers of adaptive strength. By re-empowering local decision makers, Cybersyn took Beer's interest in organizational management and socialized it. In a moment of incredible optimism, the core group of researchers working with Beer seemed on the cusp of securing the shifting coordinates of Chile's social and economic environment. Ironically, the major success of Cybersyn was the thwarting of a CIA-financed truck strike that threatened to paralyze the Chilean economy – ironic because in order to do this, Cybersyn switched into a mass surveillance command and control infrastructure that could be manipulated from the central command room in Santiago.²² This monitoring function was always latent within the system. Deep ideological convictions on the part of its architects however always maintained that this information flow would be put at the service of the people and not only the central command. Replete in both Beer's own writing and that of the historians who take up the Cybersyn project is a conception of so-called 'bottom up' decision-making as inherently democratic, in contradistinction to top down decision-making processes which are seen as coercive.

An important anecdote is worth repeating here since it reveals the naivety of the political position behind this equation of upward traffic and democracy, which both Medina and Pickering take up without qualification. Invited to the Presidential Palace on 12 November 1971, Beer is tasked with explaining his proposal for the nationwide cybernetic system to the newly elected president. Beer slowly takes Allende through the nested structure of the Viable System Model, carefully explaining the equivalence between the factories and limbs, between the feedback loops and the sensory apparatus. Step by step it is elucidated, moving through the hierarchy of levels and explicating the autonomy granted to decision makers at each point, as well as the flexibility this system

could guarantee. Finally Beer reaches the apex of his metaphorical diagram, the brain or control center. Just as he is about to explain this point as the seat of the President, Beer is interrupted by Allende, who declaims: 'at last... el pueblo' - the people.

6.4 Blind spot

Allende implicitly understood the difference between representative democracy and business management. For Beer the ability to make decisions had a simple and direct correlation to freedom regardless of the decision being made, a freedom that only ever trafficked in a literal register: either democratically bottom to top, or autocratically from top to bottom. Furthermore, in committing to a wholly rational idea of decision-making in which an actor is presumed to make the best decision if they are provided with the right information, Beer aligns himself with a technocratic vision of society, in which decision-making is reduced to a question of expertise. Indeed this has been one of the major criticisms leveled at Cybersyn, as Andrew Pickering notes:

The VSM undoubtedly was a technocratic approach to organization, in- as much as it was an invention of technical experts which accorded technical experts key positions—on the brain stem of the organization at levels 3 and 4. No one had asked the Chilean workers what sort of a subpolitical arrangement they would like. Nor, I believe, did Beer ever envisage the basic form of the VSM changing and adapting once it had been implemented in Chile. There is not a lot one can say in reply to this, except to note that, on the one hand, the fixity of the overall form of the VSM can be seen as a noncybernetic aspect of Beer's cybernetic management. As ontology in action, the critics seized here on a nonexemplary feature of Beer's work. But we might note, too, that expert solutions are not necessarily bad.

What Pickering misses perhaps in his defence of Beer is that the problem with technocracy is that it cannot be argued under a moral code of good or bad, nor should the argument be posed as expertise vs. non-expertise, since clearly expertise is of value. However, the foregrounding of expertise as a principal of decision-making mystifies the

political dimension of decision-making. In this sense it is not a question of moral value, but of the proper structural position of expertise vis-à-vis representation in democracy. Though many states are run along corporate lines, Singapore and the United Arab Emirates for example, the redistribution of social goods and the viability of a company cannot be easily reconciled without sacrificing certain political freedoms. Less ironically then, Beer's precedent to the VSM was titled Liberty Machine, which;

...modelled a sociotechnical system that functioned as a disseminated network, not a hierarchy; it treated information, not authority, as the basis for action, and operated in close to real time to facilitate instant decision making and eschew bureaucratic protocols... Beer posited that such a Liberty Machine could create a government where "competent information is free to act," meaning that once government officials become aware of a problem, they could address it quickly; expert knowledge, not bureaucratic politics, would guide policy.²³

Furthermore, Beer's dream of real time policy in which live-feedback from constituents could be fed into governmental decision making on the fly finds its ultimate conclusion in another political obsession: polling and focus groups. This leads one to think that 'liberal machine' would have been a more apt title for the project. Though Beer would have argued against this comparison (what he had in mind was more of a happiness dial that registered feedback) the resonance with contemporary politics is undeniable, as is the now quite refined ability of polling and focus groups to detect and respond to shifts in affective tonality.²⁴ This concept of continual feedback, combined with the idea of political decision-making as a Pavlovian exercise in stimulus and response, left no space for real conflict, dissensus or deliberation.

Just like any organism, Cybersyn's life world was shaped by its sensory apparatus. In order for something to count as an input, the system had to *see* it in order to *recognise* it. This recalls Jakob von Uexküll's concept of the *umwelt*, in which each organism has a world of its own comprised only of the dimensions present to its sensory apparatus. Despite the abundant and profuse continuity of the natural environment, each organism gives birth to a world by selecting only a few important markers within this space. For

the organism everything else simply does not exist. Deleuze and Guattari, and also later Agamben's often cited use of the tick, is drawn from von Uexküll and serves as an extreme example of the point. The tick's life world is contracted down to three stimuli: light, smell, touch.²⁵ Light draws the tick to the tip of a tree branch, smell allows it to detect the passage of a host below and drop onto its back, touch to locate bare skin so that it could burrow. As Canguilhem writes:

A meaning, from the biological and psychological point of view, is an appreciation of values in relation to a need. And a need is, for whoever feels it and lives it, an irreducible system of reference, and for that reason it is absolute.²⁶

If the world is an accumulation of signals, inputs and outputs than Beer and Uexküll are in close proximity. Each cybernetic apparatus, whether the anti-aircraft battery or the Viable System Model individuates a specific mesh through which the continuity of the world passes. The individuation of the epistemic and the ontological - in that it is a co-individuation - binds certain features of the world to knowledge apparatus in a partial and limited way, in other words at a specific scale. Gilbert Simondon's critique of cybernetics is worth repeating here. What matters in a system is not the communication between pre-given receivers and whether one or another node in the relay of communication is sensitive enough to register a change in its environment.²⁷ Instead, it is the genesis of the senders and receivers themselves that is of importance, since this forms the genetic condition of possibility for communication *to exist as communication*. In the genesis of the communicators perceptual apparatus is the genesis of a specific life world. In this regard, what matters is the individuation of Cybersyn and the VSM diagram that it carries inside - not the modulation of the signals between the parts, or their adaptation within a functional bandwidth. At precisely the same moment that the abstract diagram of the system is articulated and the parts have been prescribed their range of functionalities and sensitivities, two things are produced. Firstly, a life world. This contains all the things that can be recognized and detected by the system. Secondly, a contrast space or blind spot, a remainder, which - from the point of view of the life world, has no existence whatsoever. Cybersyn had an *umwelt* all of its own, and

this *umwelt* was wholly determined by those things Allende's economists and Beer's cyberneticians took to be of value between 1972-1973.

Imagine, for example, an exceedingly complex system such as a national economy. It has many component parts, including factories, suppliers of energy and raw materials, and a labour force, all of which are intricately configured and mutually dependent. Each component can assume a range of states... .. Controlling an exceedingly complex system with high variety therefore requires a regulator that can react to and govern every one of these potential states, or, to put it another way, respond to the variety of the system.²⁸

By attempting to equate an economic and social formation with a series of indicators in a feedback loop, Chile's cybernetic experiment over-extended quantitative techniques into a qualitative domain. The equations, diagrams, circuit boards, telex machines and screens that made up the 'body' of this national cybernetic system, attempted to make a society and its economy knowable through calculus, a series of variable quantities that could be tuned and calibrated. As Rose says, democracy is always a form of calculus:

Democratic power is calculated power, and numbers are intrinsic to the forms of justification that give legitimacy to political power in democracies. Democratic power is calculating power, and numbers are integral to the technologies that seek to give effect to democracy as a particular set of mechanisms of rule. Democratic power requires citizens who calculate about power, and numeracy and a numericized space of public discourse are essential for making up self-controlling democratic citizens.²⁹

The question that arises for any such system is how to count. Where is one to draw the line between the calculable and the incalculable, the field of vision and the blind spot? This question would become paramount for the Allende government on 11 September 1973 . Entering the field of vision from an incalculable blind spot was General Augusto Pinochet.

6.5 Complexity and feedback

Cybersyn was never designed to halt a coup attempt, nor can the overthrow of Allende's government be said to have eventuated by a failure in this unique experiment. Instead, the line followed here is that the ethos hardwired into the telex machines, control rooms and software encapsulated an idea of homeostatic social equilibrium – and the coup in all its murderous force represented another kind of politics, one that would never be content to operate within an exiting set of rules. Rather, it demanded that the rules themselves - the very structure of decision-making - enter into the stakes of the political bargain. That this was articulated by a military junta in this case is coincidental, since what is at stake is not the adaptation of the parts in the system, it the possibility of radically transforming the abstract diagram holding the social parts in their place.

In the final chapter of *The Death and Life of Great American Cities*, Jane Jacobs concludes with a rather long reflection on a quote by Warren Weaver, whose *Mathematical Theory of Communication* co-authored by Claude Shannon is one of the canonical and yet widely unread texts on cybernetics.³⁰ Weaver's essay is drawn from a speech given at the time of his retirement as vice-president of the Rockefeller Foundation of the Natural and Medical Sciences. Weaver uses the occasion to reflect upon the possibilities opened up by research into complexity. He tells the story of a transition in science, from a regime of disorganized complexity dominated by statistical techniques and probabilities, to a phase of organised complexity, focusing on interactions that were characteristic of biological systems.

Jacobs' interest in Weaver is obvious; she wants to tie modern planning to its reductionist ballast and sink it. Cybernetics will offer an alternative empirical frame through which to understand the urban territory, not as a static distribution of quantities but instead as a dynamic feedback network of locally interacting agents. In cybernetics, a

population of actors is analyzed in terms of its communication or connectivity. Individual elements are no longer simply aggregated as with the previous regime of planning or zoning, but now installed within networks of neighboring elements, which they either depended on or competed with. Positive and negative feedback loops could either strengthen or weaken alliances within these systems, lending them curious, bottom-up powers of production.³¹ For Jacobs, Weaver's work thus signals an alternative spatial possibility, a scientific regime that is able to recognize complexity without reducing it to a series of "mathematical averages". Jacobs goes on to say:

Cities happen to be problems in organized complexity, like the life sciences. They present 'situations in which half a dozen or even several dozen quantities are all varying simultaneously and in subtly interconnected ways'. Cities, again like the life sciences, do not exhibit *one* problem in organized complexity which if understood explains all. They can be analyzed into many such problems or segments, which, as in the case of the life sciences are also related with one another. The variables are many, but they are not helter skelter; "they are interrelated into an organic whole"³²

Echoing the biological metaphor that was to obsess Beer throughout his career, Jacobs represents only one moment in enthusiastic urban uptake of cybernetic theories. Though politically over-burdened in retrospect - this promising science of connectivity seemed perfectly suited to understanding the networked metropolitan territory. Suddenly linkages mattered, suddenly communication between nodes mattered, suddenly phenomena that could only be described statistically through their outward effects could be described analytically through their internal mechanisms. Though the dream of a feedback loop in which society can be tuned by modulating its inputs had a real-time debut in the political arena of South American socialism, its history extends back to the 1950s.³³ These recent periods are already consistent with a general historical ambition that predates both cybernetics and the writings of Jacobs, stretching back as Foucault notes, to a 'transformation in the object and the practice of government' when the truth of the city first appears through the frame of an empirical project.³⁴

6.6 Sleeping dogs

In the introduction to his lecture at the College de France on 10 January 1979, Michel Foucault opens with a joke. He abbreviates Freud's quotation of Virgil's *Aeneid* which reads, '*flectere si nequeo superos, Acheronta movebo*' or '*if I cannot deflect the will of Heaven, I shall move Hell*' which Foucault renders simply as, '*Acheronta movebo*'.³⁵ Freud uses the line as the epigraph to the *Interpretation of Dreams*, where it is meant to refer to the upward movement of repressed content within the psyche.³⁶ Foucault humorously counterposes Freud's dictum with a quote from Britain's first Prime Minister, Robert Walpole, who once stated: "*Quieta non movere*" which Foucault translates idiomatically as "*Let sleeping dogs lie*".³⁷ It is certain that the distance between the two quotes is not as great as Foucault implies, and though Foucault does not propose a psychoanalytic reading of the history of the eighteenth century – the extent to which subterranean problems rise up to lend sense to the details of history is a methodological given within his work.

'Let sleeping dogs lie', what is intended with this statement? What is its value here? Undoubtedly, it is a council of 'prudence', a description of government as a game of minimal contact. Foucault traces the evolution of liberalism as a specific refinement of the *raison d'état*, especially through the period in which the market moves from being a site of redistributive justice in which buyers must be protected against fraud to a site of verification, and thus the production of a kind of truth. The market can only operate as a site of truth production once it expresses a natural or true price. For this reason, any intervention by government threatens to jeopardize this natural state of affairs. Thus, government must adopt a continual reflective stance formed between the twin limits of a minimum and maximum contact: As Foucault states:

When you allow the market to function by itself according to its nature, according to its natural truth, if you like, it permits the formation of a certain price which will be called metaphorically, the true price, but which no longer has any

connotations of justice. It is a price that fluctuates around the value of the product.³⁸ The genesis of liberalism as a specific technique of governance can be traced to the problem posed by populations of a certain scale. At its core, liberalism attempts to establish a naturalized state of interaction between individuals, especially with regards to economic transactions and the idea that within the emergent sum of these interactions exists a wholly natural value – price. Only by *securing* the contingent interplay of these actors within the population – and here the term security is meant in its regulatory, policing sense since this freedom depends on certain limits – can the natural tendency of this system be expressed. This rationality accords to a complex interacting system – in this case the market, a privileged status as a site against which the principals of control and rectification can be measured.

For Foucault, the art of liberal governance is essentially self-reflective, a continual recalibration of techniques addressed to the milieu of a population in response to the various problems posed to it. The epistemic dimension to this project takes different forms that are united by the same reflective gesture in which truth appears through the frame of an empirical project measured against the truth supplied by the market. A number of deep affinities between the cybernetic dream in Latin America and the liberalism become apparent at this stage, especially the inscription of the social body within the calculus of a complex emergent system. Later, it will be possible to say that in the case of the neo-liberal experiments that begin in Chile and eventually make their way to Eastern Europe and other parts of Latin America, this reflective gesture gives way to something more aggressive. This mutation does not faithfully reflect a reality that exists within an empirical project, instead it violently brings a new market-oriented site of verification into being.³⁹

The convergence of cybernetic theory's game of epistemic capture with contemporary neo-liberalism thus forms one chapter in the historical attempt to establish a rational basis for managing a population. It begins with naturalisation of the market and takes up a wide range of empirical strategies whereby government begins to address itself to an "indefinite series of mobile elements", such as individuals, vehicles, goods or

dwellings. In other words, strategies where a quantifiable matrix of co-ordinates and trajectories become isolated, tracked and regulated in time and space. The circulation of these elements will continually constitute new problems to which government must respond. It will do so by adopting a 'transformable framework' that recalibrates around the provocations these problems pose.⁴⁰

Because characteristics such as health, crime and poverty emerge from a terrain that is necessarily contingent and open, the practices of government take on a reflective form. Though populations exhibit tendencies that cannot be simply be directed at a goal, they can nonetheless be tracked and modulated within a bandwidth of possible variation. In some sense this marks the critical point of transformation; power will no longer touch its object directly, instead it will address the space in which the object exists as a possibility.⁴¹ Phrased differently, it will begin to address the life world or milieu.

Under this cybernetic ethos, transformation is not directed towards a distant goal that is known in advance. Instead, it follows immanent tendencies, guiding them forward - but also giving them space to evolve. The city or territory is here understood as a contingent, self-regulating resource that requires ongoing management. The goal of this management is to secure a natural equilibrium and keep emergent forces in balance. In one way, the Latin American experiment in cybernetics is the first moment when this liberal diagram goes live, the moment when “the medium of an action and the element in which it circulates” promises to come under real-time control.⁴² However, as Pinochet would eventually show in the case of Chile, the properly political question is not how the system operates (i.e. how can we refine it, make more integrated, more complete, more coextensive with the world?) but rather what *counts* as part of the system. The political dimension of any system is its blind spot, the part it cannot recognize, as Rancière writes in different context: ‘the part with no part’.⁴³

6.9 The complexity surplus

Jacobs' displacement of modern planning is premised upon a specific critique: that cities are highly complex. However, the very idea that the truth of the city can be formed through a scientific and rational analysis of certain *facts*, remains securely in place. For Jacobs, it is rather that these facts were too coarsely scaled, too reductive and too static to capture the urban territory in all its richness. It is not that the city cannot be produced by facts, but more that these facts needed to be sufficiently fine grained, sufficiently alive and active in order to produce a faithful rendering. Modernist planning had draped too coarse an explanatory mesh over the city, allowing human interactions at the scale of the neighborhood and the street to pass through unnoticed. What was needed then was a more finely calibrated adaptive explanation that could make visible the endlessly 'small points' of social interaction. Latent within this ambition is the unstated dream of omniscience - a map that would drape over the territory at one to one, making it knowable in all its complex depths. Complexity is what ontology provokes epistemology with. A provocation that drives a continual game of epistemological cat and mouse in which the complexity of the city races ahead of the forms of knowledge that attempts to keep up with it. The possibility of closing the gap looming over the horizon, a promise of control always just out of reach. Both the Cybernetic experiment in Chile and the extension of the cybernetic ethos into the biopolitical governance of the urban territory can be seen as responses to this specific way of thinking about complexity, a problem posed such that this complexity is always *excessive*.

In Beer's opinion, traditional science did a good job of handling simple and complex systems but fell short in its ability to describe, let alone regulate, exceedingly complex systems. Cybernetics, Beer argued, could provide tools for understanding and controlling these exceedingly complex systems and help these systems adapt to problems yet unknown.⁴⁴

This ethos continues to into the present. It poses the problem of contemporary governance in terms of an informational deficit. The territory must be made to appear through a form of knowledge that is able to recalibrate around its object in a game of epistemic cat and mouse; always trying to absorb more information, mapped more

dynamically across more scales. Geographic Information Systems (GIS), real-time data analysis, sensor-based data collection and other forms of aggregation and mapping provide increasingly high-resolution and 'live' representations in order to close this deficit and manage the complexity of the condition. The implied reasoning behind the drive towards urban modeling and simulation being that more information translates into better decision making, though it is equally likely that the existence of more information solicits responses that attempt to respond to this information, a potentially conservative way of privileging the existing condition. It is important to bear in mind that the control of this process does not operate by touching its object directly, and that the idea of cybernetics is not a dystopic, Orwellian image of society. Rather, it is an ethos, a set of implicit ideals that guide the techniques and practices of government. As Rose, Essin and Osborne suggest, Cybernetics is

...symptomatic of a certain way of imagining cities, government and spaces in the present. We do not live in cybernetic societies but in societies that are governed in ways that have certain points of alignment with the dream of cybernetics. The cybernetic metaphor is a kind of image of thought for grasping what is specific to modern styles of governing.⁴⁵

Though cybernetics is marked by a series of failures, subsequent scientific developments on complexity theory and emergence support the basic continuation of its ethos. Though it would be well beyond the scope of the present analysis, the shift to notions of cognitive capitalism/knowledge economies within contemporary urban discourse would provide an illuminating example of precisely the same questions playing out in different terms, this time according to the calculability of immaterial labour within the city.⁴⁶ Similarly, certain tendencies within contemporary architectural practice pose the problem of urban complexity according to cybernetic terms, seeing in the contemporary city a dynamic material condition, with its own innate tendencies and ability to self-organize, a condition that demands a re-conceptualization of the architectural intervention, which

must now meet the plasticity of the city with an adequate plasticity of form. Patrik Schumacher puts it as follows:

...the same theoretical resources and computational techniques that allow meteorologists to reconstruct and predict the global weather system and scientists to speculate about the earth's evolving climate are available to contemporary urbanists and architects in their effort to meet the challenges posed by the ongoing Post-fordist socio-economic restructuring. The task is to project the growth and transformation of cities as a rule-based, largely self-regulating morphogenetic process.⁴⁷

The contemporary reliance on terms like ecology, the importance of creativity within the current city, the privileging of nature as the paradigmatic model of equilibrium, the elision between the fluctuations of the market and that of the weather, the myth of balance and natural equilibrium or homeostasis, and the projection of all these ideas into a political and social space recasts a debate that has been taking place since at least the 1930s. When Fabian Socialist Arthur G. Tansley accused the British Empire Field Marshall Jan Smuts of *The Abuse of Vegetational Concepts* in the 1934 issue of the journal *Ecology* he had in his sights the doctrine of holism and the exponents within the study that applied the model of the single organism to communities of organisms, seeing causality within the cell and the solar system possessing a single drive toward the formation of a 'whole'.⁴⁸ Tansley critiqued the foregrounding of the organism as the unit of evolution, arguing that the organism is meshed within a complex yet open environmental assemblage composed of organic and non-organic parts, operating differently at different scales and whose equilibria was always contingent.

Following from this, it is possible to see exactly how the cybernetic ethos and its historical antecedents found in the idea of 'fit' or the adequation of something that is well adapted or properly suited to its purpose like the naturally expressed price in a market a welcome scalar expression. 'Fit' is a regulative idea that sits between form and function, between ontology and epistemology. As it approaches its ideal point, it tends to become isomorphic with its object, as in the space between clothing and the skin. It

becomes cybernetic when it is asked to regulate a mobile correlation between an object and dynamic condition.⁴⁹ In the case of cybernetics being described above, there is a condition in which the object of explanation is continually changing and so the resolution of the explanation, or perhaps the fineness of the mesh used to capture it, must take on a continually adaptive form, modulating in response to the condition it is meant to capture. Returning to the naturalization of the idea of politics, whilst there is no positive or negative value, in this plasticity as such, its installation within a discourse on the complexity of governance binds government to a conservative agenda in which the job of politics is to passively receive and manage the imprint of the forces around it.⁵⁰ As Beer himself states: “Instead of using science to dominate the outside world, scientists should focus on identifying the equilibrium conditions among subsystems and developing regulators to help the overall system reach its natural state of stability.”⁵¹ The issue is that complexity is neutralized as a concept and becomes recast as a mere excess of variables in which only the corresponding management of variation in the art of government can be adequate. The scale of the territory that emerges from these practices is highly interconnected and contingent, but it is a contingency that is primarily presented as a problem of environmental management and not of politics.

6.10 Socialist Neo-liberalism / Neo-liberal Socialism

Freud’s dictum regarding the return of the repressed suggests a subconscious that never sleeps. In the Chilean episode, the historical subconscious underwent many movements of its own; socialist dreams were soon replaced by neo-liberal ones. Just as in dreams, where unrelated facts can suddenly become juxtaposed without logical relation, three times in short succession Chile became a space of extreme experiment: first with constitutional socialism, second with cybernetic management, and finally with the Chicago school of economics. For decades, this Latin American laboratory painfully rehearsed social and economic ideas years before they became accepted in the rest of the world. If the socialist origin of cybernetic management is a source of pride for many

advocates, its ultimate conclusion as the deep structure of neo-liberalism is not. Petras writes:

From 1970-1973, the Allende government implemented its “anti-imperialist, anti-oligarchical and anti-monopolistic” program, deciding to nationalize the financial and productive sectors of Chile, to expropriate large chunks of rural property, and to replace the market with far-reaching price control. From 1974-1978, the military regime of General Pinochet developed a radical economic liberalization program based on the indiscriminate use of market mechanisms, the dismantling and reduction of the state, regulation of the financial sector, and a discourse that ascribed to market forces the ability to solve practically any problem in society. One extreme of radical ideology was followed by its opposite. Chilean society was twice called upon to begin its history from scratch.⁵²

Though their means and purposes point in opposite directions, and while it would be ridiculous to equate Allende’s constitutional socialism and its wholly legitimate rise to government with Pinochet’s violent coup and years of terror, is there not – despite the aforementioned differences – a deep affinity between the two? In the fervor to shape a new Chilean subject, to disavow the past, to pursue growth and set in place “irreversible change” both the military junta and the left-wing socialists share surprising similarities. As such: “the coup cannot be reduced to a particular time-bound event but must be seen as a *process*, i.e., as a particular constellation of social and political forces moving together and apart over historical time.”⁵³ The Cybersyn experiment only makes sense against this changing historical background. In the very attempt to constitute an environment as a resource *for* adaptation, this techno-social assemblage was disposed to draw on its context. As soon as it was activated, as soon as it began to work, as soon as it was plugged into a concrete historical situation it began to inflect that situation’s politics, to redraw the contours of the problem in its own image. For this reason, the technology could never embody a specific ideological payload, its status as emancipatory, its surveillance function, its left or right orientation was always contingent to the environmental input it drew upon. This environment made for an unstable ground, always threatening to give way beneath the cybernetic ethos, moving from one political spectrum to the other and then

back again. The relay into which the cybernetic diagram was installed was never stable. Called on to regulate economic activity, manage workers' disputes and form an affective loop between government and governed means that the question of freedom is itself tangled in a network of resistances wholly immanent to the field in which it takes shape. Meanwhile the diagram kept working - switching one set of points in a relay for another, so that the same technique of management was able to take on two radically different meanings according to two distinct historical junctures.

Not only did those involved in the experiment believe that an emancipatory program was hard-wired into the structure of Cybersyn, and that this structure was itself inviolable and not subject to the same rules of contingency as the condition it attempted to control, but that at each scale of the system, the very same logics that applied to the whole, would also apply to the parts. As Beer writes: "The whole is always encapsulated in each part... This is a lesson learned from biology where we find the genetic blue-print of the whole organism in every cell."⁵⁴ Beer begins with a diagrammatic model of an organism. In this organism, the function of the cell, the organ and the organism observe a deep structural similarity - a similarity of such universal importance that it could be found within any number of non-biological phenomena, just as the VSM could be successfully applied to a business as much as a nation. In this way Beer holds to a belief in the commensurability between different problems, believing that a common measure not only exists between radically different problems, but that this common measure could be applied in order to control and transform them.

The desire to see the same platonic circuits lurking behind matter can be seen, not just as political naivety, but also as evidence of disbelief in difference. If difference had been taken seriously Beer might have acknowledged that a wholly recursive epistemic model might not have translated between separate domains so easily. Regardless, the contingency of the situation was such that difference would soon make its uncontrollable presence felt, the short socialist cybernetic experiment in Latin America eventually becoming solidified as a norm and a convention in the west, but only some ten years later

during the ascendancy of Reagan in the United States and Thatcher in the United Kingdom. By the time the era of Blair and Clinton had arrived, the genesis of this unique techno-social assemblage had finally become a central platform for 'third way' labour, it had finally come full circle. From the left to the right to the pseudo-left again, encapsulated in the obsession with continual polling and focus groups that continues to dominate contemporary political life.

CLIMATE CONFLICT

7.0 The chain of immanence

The opening chapter of this thesis, *The Scales of Matter*, explored a history of scientific ideas on nature as they coalesced with philosophical debate. In order to frame this debate a critique of the Aristotelian doctrine ofhylomorphism was introduced. This doctrine of passive materiality on one side and an active force on the other, announced a split in the philosophical engagement with science that would be taken up by Descartes, Kant and Newton. To varying degrees of success, an alternate line of thinkers struggled to reconcile this split and re-embedded a creative impetus within matter, from the Vitalists to Darwin, Lucretius to Serres, this other tradition looked to the variable, differentiating qualities within matter itself for clues as to its own morphogenetic capacity. In turn, acknowledgement of the unique ability of matter to self-organise was exemplified in a matrix of related ideas on complexity, non-linear behaviour and emergence. In the conclusion to the first chapter of the thesis, Gilbert Simondon's notion of individuation was said to embody an important moment of philosophical reflection on these systems, especially their capacity to self-generate stability and

regularity. The present case study on climate conflict will draw on many of these concepts so some points require recapitulation.

In science the tension between immanent and transcendent accounts of material production has acknowledge the ability of material systems to self-organize. This is not to say that metaphor plays no role, or that transcendent principals have been extinguished entirely, as the on-going debate on adaptation within biology demonstrates.¹ This acknowledgement has been secured in many areas including chemistry, physics, biological and earth sciences, but in no place has the uncertainty that characterizes self-organization come to occupy a more problematic role than in the project of modelling the climate. The epistemic counterpart to this philosophical tension continues to persist within discourse on and around science, even if it is less and less apparent in scientific practice. In many ways the Cartesian account of change in the natural world has been relegated to an important footnote in the history of the natural sciences. The Cartesian structure of inquiry however still imbues the way this discourse is perceived and often practiced.

In his reading of topology and mathematical models, Manuel Delanda presents what purports to be an alternative account of scientific epistemology in a critique of essentialist and hylomorphic frameworks. On the basis of a suspicion that Delanda had failed to adequately specify and historicize the relation between philosophy and science, the second chapter of this thesis, *The Scales of Truth*, drew on Deleuze, Foucault and Garfinkel to test his claim. This investigation suggested that while Delanda's positing of an objective scalar link between an event and its explanation was an important move, it failed to go far enough because it overlooked the position of an explanation with respect to its discursive field. Delanda neglects important presuppositions in his own argument. While he convincingly historicizes knowledge and the method by which this knowledge is known, he fails to explore its historical status as relevant or ordinary within the field of discourse around it. The historical status of the problem within its field is overlooked by Delanda in so far as he posits, either implicitly or explicitly, an idea of scientific progress

in which truths are gradually (and impartially) accumulated, one on top the other. As the argument in this preceding chapter noted, the exhumation of the presupposition by Deleuze ungrounds this transcendent sense of progress and critiques the purported natural inclination to truth shared by thinking beings – a point that is lost in Delanda’s argument.

From the perspective of a historian constructing an immanent critique of Kant’s transcendental *a priori*, Foucault approaches this question through another opening, via the concept of the historical *a priori*, the *episteme* and finally the *problematique*. Bearing in mind the importance of extending Delanda’s argument so that it incorporates both the discursive field and the problems that structure it, a method that draws on the aforementioned concepts can be formulated. This method, which might warrant the name ‘chain of immanence’, suggesting a sequential reaction of linked events or the individuation of problems across ontological, epistemic and discursive registers. This case study centres on climate change, specifically the way climate models attempt to individuate phenomena like weather patterns or ocean currents. The example of climate modelling demonstrates the notion of ontological individuation - its epistemic and its discursive correlation. It also shows how all three are linked through scale.

7.1 Climate scale

The question of scale is perhaps one of the greatest challenges to face climate modelling.² The periodic scales effecting climate change fall between 433,000 years and 1 nanosecond. This is the difference between one astronomical season and the time it takes for a wave of infrared light to complete a single oscillation.³ The spatial scales are no less vast and complicated, encompassing dust particles in the atmosphere and polar jet streams. Moreover, these phenomena interact in a myriad ways depending on their spatio-temporal scale.⁴ Coupling non-linear models of deep ocean currents to dynamic models of major weather systems, terrestrial radiation, hydrological cycles, volcanic

activity, aerosol dispersion, ice sheets and ecosystems - not to mention anthropogenic factors across multiple scales and at very different resolutions - poses conceptual, scientific, philosophical and political difficulties.⁵ Making sense of these difficulties currently animates what is the largest collective endeavour in the history of science, modelling the earth's climate.

This endeavour can be described according to the terms set out in chapters 1 and 2 of this thesis, *The Scale of Matter* and *The Scale of Truth*, where the individuation of climate phenomena, say the contraction of the ice caps or the desertification of arable land, is doubled by an epistemic individuation in which a climate model attempts to reproduce the important causal features in the phenomena. Drawing on both of the aforementioned chapters, this case study will bring both ontological and epistemic lines of inquiry into contact. The individuation of *climate phenomena* will draw on *The Scale of Matter*, dealing with the notion of change in nature. The individuation of *the model* and *the discursive field* will draw on the account of epistemology in *The Scale of Truth*. The argument here will be that the point of contact between the two individuations is structured by an objective conception of scale. It will conclude by proposing that this ontological and epistemic co-individuation further individuates a field or polity. Moreover, this field or polity is governed by a rationality that is historical, a rationality that conceals a form of power in its scalar presuppositions, which in the case of a climate model is the idea of average temperature increase.

The idea of an average temperature increase frames much public debate around climate. What it mystifies is the fact that temperature rises differentially across the planet, increasing by more than the average in some cases, less than the average in others. To state this seems obvious, an average is after all an abstraction, but as this case study will show, the political calculus, obscured by this seemingly obvious fact, has powerful and long lasting implications. What is presented as a dispute over 'a number' is in reality a calculus of conflict in which millions of people will be directly affected. The biopolitics of climate, as this case study will argue, must attend to the question of scale in order to

frame not only the calculus of the climate model, but the forms of dispute or consensus that emerge around it, since this polity individuates through the shared perception of a problem. As Simondon suggests, there is a collective individuation of subjectivity that is the psychic counterpart to ontological individuation. By turning to a specific moment in the Copenhagen Climate Summit of 2009, this chapter concludes by exploring an example of this individuation - the eruption of a new public around the dispute of the earth's temperature.

7.2 Forums for climate conflict

Copenhagen, as well as Kyoto before it, was a unique historical event. Despite its failure, it is worth reflecting on the unprecedented strangeness of a forum in which world leaders gather to discuss the level of the earth's temperature. Once a feature of the 'natural world', the temperature of the planet now emerges from its ambient background, modified and put at risk by human action, it gains a calculable existence.⁶ The political dimension to the climate change dispute takes on many varied forms. Primarily it is seen as a question of policy, whereby climate models are presented as impartial tools by the Intergovernmental Panel on Climate Change (IPCC) - currently the leading international authority on climate policy.⁷ There are alternative lineages of political reflection on climate change that appear through military and security analysis, lineages that are in many ways much clearer about potential social and political impacts than current policy disputes. Indeed, prior to Copenhagen, as far back as the 1970s, the United States Central Intelligence Agency had already commissioned a report framing climate change as an issue for geopolitical security.⁸ This was especially important as some of the most effected parts of the world such as the Sahel and sub-Saharan Africa were already experiencing political disruptions connected to environmental forces.⁹

A unanimous resolution of the UN General Assembly in December of 1988 signalled the first international recognition of the effects of climate change. Some four years later in 1992, the UN Framework Convention on Climate Change (FCCC) led to the creation of the Intergovernmental Panel of Climate Change (IPCC), inaugurating the current international regime for guiding climate policy. The first binding agreement to stabilize atmospheric carbon levels was initiated in 1997 through the Kyoto Protocol, to which commitments terminate in 2012. The conclusion of the much-maligned Kyoto regime and the failure of the 2009 Copenhagen summit means that the post-2012 era begins in the absence of any binding international framework.¹⁰ The intractability of the consensus-based Kyoto model and the trans-boundary impact of anthropogenic climate change has led to calls for the delegation of national sovereignty to a new body with an international mandate and planetary jurisdiction to negotiate the status of a historical contribution to emissions and future emission potential.

Forums charged with allocating global carbon capacity will become paradigmatic spaces of national conflict in the coming century for two interlinked reasons. Firstly, economic activity is highly carbon dependent. Industrial and agricultural production as well as consumption link GDP to emission.¹¹ Secondly, the impacts of anthropogenic climate change manifest themselves in an environmental milieu. The environment diffuses the chain that binds cause to effect. In diffusing this bond, it diffuses the attribution of responsibility and the possibility of justice. The unique scalar politics of climate change separates the event, say carbon emission, from the space of its repercussion, the mechanics of the earth's climate forming a complicated transport system, redistributing the effects of pollution according to a trans-boundary, non-linear logic. For example, as recognized by the Group of 77 developing nations (G77) and the Alliance of Small Island Nation States (AOSIS), changes to agricultural yields, disease vectors, water stress and sea levels will strike those parts of the world least responsible for carbon emission.¹²

The political difficulties raised by climate negotiations can be traced, in part, to a separation positing the problem in terms of a scientific paradigm addressing pollution and environmental damage on the one hand.¹³ On the other, an economic paradigm posed as a problem of sustainable development and economic adaptation.¹⁴ Characterizing the latter is the idea of emissions trading, a new post-colonial playing field in which an atmospheric pollutant - carbon - is transformed into a universal currency subject to trading caps and abstracted within a liberalized market.¹⁵ Characterizing the latter are the satellites, radars, ground stations, forecast centres, researchers, institutions and protocols that make up the planetary scale infrastructure of climate science.¹⁶ Re-connecting the two is a dangerous task, foregrounding the biopolitical calculus of policy and threatening the impartiality of scientific research. Prior to this, the two views were imbricated, and in some ways they share a common moment of origin. After all, the scientific impact on climate policy continues a history of post-war atmospheric-politics whose first phase ended with the limited test ban treaty of 1963, before being spurred forward by post-Vietnam interests in climate modification and aforementioned concerns over environmental damage.¹⁷ Further iterations such as the landmark publication of *The Limits to Growth* by the Club of Rome in 1972 and subsequent debates on ozone depletion throughout the 1980s set the stage for atmospheric policy, finally adopted by the UN General Assembly through Resolution 45/43 titled *Protection of the Atmosphere for Present and Future Generations of Mankind* in 1988.¹⁸ In 1979, the United States Office of Science and Technology Policy (OSTP) released a report commissioned by the administration of President Jimmy Carter investigating the impact of CO₂ levels in the atmosphere.¹⁹ Drawing on computer models at the Geophysical Fluid Dynamics Laboratory and the Goddard Institute for Space Studies, the report is the first quantitative assessment of potential temperature increase to be used as a tool for shaping government policy. Concluding that average global temperature increases of 3 degrees were likely, from this point forward, government policy would begin to systematically incorporate information from computers running simulations of complex open systems.

7.3 Individuating models

Climate science remains in a unique position. Much like astronomy it is unable to experiment on its object of inquiry, a position that poses difficulties for a form of objectivity premised on the processes of verification and falsification that experimentation requires. Out of this constraint climate science has come to exemplify the epistemic relation between models, concepts and observation, with the IPCC in turn establishing itself as the principal scientific authority on anthropogenic change. The legitimacy of the IPCC is founded on a comprehensive scientific review process and the presentation of impartial reports to be used as the basis for future climate policy. Nonetheless, the distance between scientific and politico-economic questions becomes more difficult to maintain in the face of projected loss of life due to temperature increase. By some estimates this will reach tens of millions in Africa.²⁰ In this regard, fossilized within every scientific model and dispute over average temperature increase is a non-scientific ethico-political paradigm. Inside every single degree Celsius - a new calculus of life and death is disguised.

Unpacking this ethico-political payload is the work of security and defense analysts. This work is found in more direct and certain terms within documents like the OSTP report from 1979 than in contemporary public debates on energy and sustainability. The OSTP report is also notable for another reason, since it introduced the idea of a global average temperature increase, which has become the most common and prevalent frame for the public presentation of climate research. There are reasons for relying on a global temperature increase, it is memorable, easy to understand and effective for describing planetary scaled effects.²¹ Furthermore, in many ways it is more difficult to make predictions at smaller spatial and temporal scales – which is why predicating the climate is more accurate than predicating the weather. Nonetheless, it is important to remember that the idea of an average temperature increase is an abstraction, concealing an uneven distribution of temperature, and therefore an uneven scale of effect.

Earth science modeling can be said to proceed according to two ‘technically linked’ but divergent lines of inquiry, the detection of statistical regularities and the construction of causal models explaining and attributing those regularities.²² This chapter will concern itself with the second of these, since it exemplifies the difficulty of simulating a population of related, non-linear phenomena. As a 2007 IPCC paper points out, this complexity is leading to a re-conceptualization of climate models in which a unique idea of scale plays a central role.²³ The term ‘conceptualization’ is used in a very precise sense here, in that the problem posed to climate science by climate phenomena requires a conceptual diagram of how the various phenomena interact. The vast spatial and temporal scales at stake make this endeavor particularly difficult. In order to make better sense of this complication, climate scientists are turning to a concept of modeling based on the idea of a population. Rather than create a model of the system as an integrated and dynamic whole from the outset, recent approaches have favored disaggregating the model into a population of sub-models that individuate specific scales of climate phenomena. This population of sub-models is subsequently tested in order to determine how well they capture the relevant features of the scale in question. The outputs from this population of sub-models are then used as input for a General Circulation Model (GCM), which re-integrates them.²⁴

Two questions arise. How to decide what counts as ‘a’ phenomena within an open system? More importantly, how to develop a conceptual model in which these individual parts might be re-integrated? Turning to the former question first, the difficulty is where to begin dissecting something as interlinked and continuous as the climate? What aspects of the phenomena count as important? What aspects should be left out? How to divide entangled planetary wide phenomena into manageable, calculable parts? According to Plato’s advice, one should always divide things by carving at the natural joints.²⁵ But where Plato had classes in the animal kingdom in mind, climate scientists carve around areas of negative feedback and borders between physico-chemical processes. The drawing doesn’t take place in the phenomenal world; instead, the dividing lines carve through the topological contours of a mathematical model, isolating

singularities and basins of attraction, each part attempting to frame specific features of the earth's climate such as cloud reflectance or albedo effects.

The study into non-linear effects by American meteorologist Edward Lorenz forms the basis for much contemporary earth science, especially the attractors and other topological structures of dynamic systems that will be mathematically modeled.²⁶ The Fourth Assessment Report of the IPCC puts it as follows:

There are many feedback mechanisms in the climate system that can either amplify ('positive feedback') or diminish ('negative feedback') the effects of a change in climate forcing. For example, as rising concentrations of greenhouse gases warm Earth's climate, snow and ice begin to melt. This melting reveals darker land and water surfaces that were beneath the snow and ice, and these darker surfaces absorb more of the Sun's heat, causing more warming, which causes more melting, and so on, in a self-reinforcing cycle. This feedback loop, known as the 'ice-albedo feedback', amplifies the initial warming caused by rising levels of greenhouse gases.²⁷

Topological zones of negative feedback dampen the propagation of effects from one phenomenon to the next. Along with physico-chemical processes these zones form convenient brackets around which sub-models can be built. At the coarsest scale this is why models are divided into atmospheric, cryospheric, biospheric and earth systems, but also into component models that model solar radiation, aerosols, terrestrial radiation, precipitation and land use. This first division of the climate into parts suggests that the question of scale is related to that of mereology, where each part forms a unique scalar individuation of a climate phenomenon. The question then, is how to ascertain the correlation between the model and the phenomenon? On what grounds can an objective assessment of the part be established without necessarily re-connecting it to entire system? The answer to this question repeats the answer given by Alan Garfinkel and Manuel Delanda. The reliability of the model (a model being an explanation that attempts to capture the causal features of phenomenal event) is a question of stability,

and that a process of methodically de-stabilizing the model can test its reliability. This method works by transforming different aspects of the model, for example by firing a range of parameters as inputs and correlating outputs to observations. In a now landmark test within climate science:

The strong effect of cloud processes on climate model sensitivities to greenhouse gases was emphasized further through a now-classic set of General Circulation Model (GCM) experiments, carried out by Senior and Mitchell (1993). They produced global average surface temperature changes (due to doubled atmospheric CO₂ concentration) ranging from 1.9°C to 5.4°C, simply by altering the way that cloud radiative properties were treated in the model. It is somewhat unsettling that the results of a complex climate model can be so drastically altered by substituting one reasonable cloud parametrization for another, thereby approximately replicating the overall inter-model range of sensitivities.²⁸

The mathematical simulation of clouds captures them at a certain resolution. That is to say that the model breaks up the cloud volume into a three dimensional grid and interpolates the information, in the same way a compression ratio such as JPEG interpolates an image into a series of two dimensional pixels. This division of the cloud into a computable grid is important since climate science is always operating within the limits of available computational resources and so approximation is always necessary.²⁹ In order to discover whether this resolution captures the relevant features of the cloud, in this case the impact of cloud cover on temperature, a series of tests need to be undertaken. These tests attempt to destabilize the model by inserting a bandwidth of potential properties – in this case the radiative properties of the cloud. Importantly, the bandwidth fell within the normal range of properties that clouds could be expected to exhibit in a real world setting. The test of reliability occurs by determining whether this ‘normal’ variation in cloud properties produces a ‘normal’ shift in average temperature. If the variation in the model does not correlate to the variation in observable temperatures, something is amiss. The experiment showed that the resolution of the cloud model was

in fact too coarse to capture the relevant causal information – in this case the impact of cloud cover on temperature sensitivity – because the normal range of inputs to the model produced abnormal ranges of output with respect to observable temperature change.³⁰ The scale of the ontological condition and the epistemic model failed to coincide.

The idea of explanatory resolution or parameterization can be understood as a kind of sieve whose openings must be calibrated with respect to the phenomena in question. If the mesh is too fine then the model will include redundant information, in which case the problem is over-determined. For example, in the cloud model, if the model attempted to capture every water droplet in the cloud, this would generate an excess of un-useful information. On the other hand, if the mesh is too coarse relevant information will pass through, in which case the problem will be under-determined.³¹ The individuation of the model proceeds according to a progressive specification of the explanatory mesh, trialing and testing each scale against observable transformations until a durable link between the two can be established. The challenge for earth science is to establish exactly which kind of phenomena are important in effecting temperature increase and then to model these phenomena and their relationships in a robust way, a challenge that demands working across radically different scales. Referring to the relation between terrestrial and atmospheric sciences in a 1992 overview of climate modeling, Kevin Trenberth wrote:

In no other pairing of disciplines are the temporal and spatial scales at which research is conducted at so tremendously mismatched. Current GCMs operate at time steps of minutes to hours while dividing the earth into blocks, which are hundreds of kilometers on a side. In contrast, most terrestrial ecosystem models operate at monthly to annual time steps on a spatial scale measured in tens of meters.³²

As Trenberth suggests, the complexity of modeling the earth's climate occurs twice, first in an ontological register - understanding the physical and chemical interactions of matter - and second in an epistemic register, relating the various fields of

inquiry shape climate research. The bodies of scientific knowledge that bear upon earth science operate within a relatively stable bandwidth of scales, much like many other scientific fields such as biology. A difficulty in the case of climate modeling is to bring these diverse scales together and to form a common measure such that information from one scientific discipline can communicate with another. At a meta-level, the integration of these diverse areas of study poses its own conceptual problems, especially in terms of the relation between the various parts and their interaction within a single framework. It is not just the parts of the model that must be coordinated, diverse scientific practices with their own protocols and methods must also be coordinated and directed toward a common horizon of inquiry.

7.4 Deep inconsistency

It is worth comparing the complexity of climate science to other fields in order to emphasize how the level of complexity within this collective empirical effort is unprecedented. Returning to the question of the re-integration of parts, it is important to note that both the part-part and part-whole relationship in a climate model does not have the same stable diagrammatic organization as in a biological model. In biological individuation each scale is linked to another in an overall structure that maintains roughly the same relationship between parts, for example, photoreceptor cells in the retina of the eye cannot migrate and take up a position in a different part of the body. Though certain kinds of cells are pluripotent during embryogenesis and can therefore actualize specific kinds of cells, this differentiation is governed by the interaction of genes with enzyme gradients in a relatively stable and predictable way. Except for evolutionary time scales, the diagram that holds, directs and integrates these separate individuations is stable within a probabilistic bandwidth. In the case of climate systems, it is not only that the distinct individuations change, but also the structure that holds them together. In other words, distinct, disparate and distant phenomena can be brought into contact in new ways by virtue of the system's diagrammatic openness. For instance, this occurs

when an ocean current changes direction, or more obviously when anthropogenic forcing makes weather patterns change. This deep re-organization of both the parts and their relationship establishes new transversal linkages between phenomena, and unlike biological systems separated by reproductive isolation, their only rule of hierarchy or organization – that is to say the scale of the parts and their relation - is that they must obey the laws of physical and chemical interaction. This is why scalar metaphors drawn from biology should be applied to biology only, such as describing the earth as an organism, since what is at stake are two radically different types of organization.

This radical openness of climate phenomena poses further questions for the project of re-integrating a population of sub-models into a General Circulation Model (GCM).³³ As Assessment Report 4 (AR4) of the IPCC states:

Many of the processes that control climate sensitivity or abrupt climate changes (e.g. clouds, vegetation, oceanic convection) depend on very small spatial scales. They cannot be represented in full detail in the context of global models, and scientific understanding of them is still notably incomplete...

...With the development of computer capacities, simpler models have not disappeared; on the contrary a stronger emphasis has been given to the concept of a 'hierarchy of models' as the only way to provide a linkage between theoretical understanding and the complexity of the realistic models.³⁴

There are two important points to draw from this quote. First, the processes and information used to model them is not the same at large and small scales. There is a link between the two, but large-scale information cannot be easily subdivided to give small-scale information, nor can small-scale information be easily multiplied to give large-scale information, though there is nonetheless a link between them. The most accurate process to date is to model each scale, for example an RCM and a GCM, and then to couple the models together.³⁵ Second, the relation between scales, that is to say the coupling, is in

itself another order of complexity in the model since the historical diagram of the relationship between parts is itself variable. History becomes a less reliable test for the future, as The Hadley Centre report states: "we cannot assume that relationships developed in the climate of the recent past will be applicable to the altered climate of the future."³⁶

The critical calibration here is the alignment of the explanatory mesh in each model (usually a grid with different interpolations) to the conditions being studied. Certain topographies, say those close to bodies of water or mountain ranges, will experience significant fine-grained effects that cannot be captured by using a low-resolution mesh.³⁷ These different problems posed by the diversity of scales in operation within the earth's climate pose challenges for modeling.³⁸ Even if a GCM is now understood as a population of coupled models linked in an overall diagram, the question of how to make the different parts of the model (and the scientific disciplines that they draw on) commensurable with each other remains a challenge. In order to address this problem, a standardization of the part-part (or component model relationship) has been established; it is called the Earth Systems Model Framework (ESMF).³⁹

7.5 Explanatory traffic

The diagrammatic relationship between parts is another explanatory problem. At stake in this problem is the protocol that determines the direction of causal information. Operating like a roadway upon which information traffics, either from small-scaled regional phenomena to large-scale global phenomena or visa-versa, this diagram regulates the direction of causality between small and large events. Though this is often referred to as 'top-down' or 'bottom-up', it makes no sense to use this terminology since what is at stake has little to do with metaphors about verticality. Nonetheless, the way in which this diagram regulates explanatory traffic in the model can be objectively determined in a similar way to the idea of an explanatory mesh described earlier. In both cases, the risk is

to over-emphasize, or over-determine one direction over another. The philosopher Graham Harman has further refined this idea of over-determination in a way that is useful here. Graham distinguishes two types of over-determination: 'undermining' and 'overmining'. Undermining places too much emphasis on causal traffic in which small interactions drive large interactions, while overmining places too much emphasis on explanatory traffic that passes in the other direction such that large interactions excessively determine interactions at a smaller scale. In both cases, interactions of members at one scale are granted too much agency over another. This can be seen in the dispute over approaches to economic models of emission based on either disaggregated (bottom-up) or aggregated (top-down) data.⁴⁰

As stated, both 'top-down' and 'bottom-up' are unfortunate metaphors for describing different forms of traffic between the parts in a model, since they suggest an axial organization (higher and lower). Nonetheless, there is a clear sense that the different problems and the spatio-temporal scales at which they are posed and held together are objectively if ambiguously linked. That is to say that the behavior of the system in question will always be open to multiple actualizations that cannot be predicted. All that is possible is a probabilistic distribution of potential outcomes.

Thus far, this case study has addressed the co-individuation of climate phenomena and climate models. As was articulated in chapters *The Scale of Matter* and *The Scale of Truth*, both individuations are marked by a fundamental ambiguity or uncertainty. Despite the uncertainty operating at different scales within each open-system: "simulations show that the projections tend to form clusters around a number of attractors as a function of their initial state."⁴¹ In other words, there are real and determinable tendencies within the system. These tendencies and the probability of their actualization can be described mathematically, even if their existence will always be uncertain. This is why this ambiguity can be described as objective. This objective ambiguity in the phenomena correlates to the epistemic ambiguity in the explanation. So far, this has been treated in terms of both ontological and epistemological individuations.

The false impression that might be gained if the analysis were stop here is one of science progressively inching toward a multiplicity of models that capture (however statistically) an increasingly refined causal picture of the climate phenomena across multiple scales. According to this premature view, science marches onward, collectively oriented by the promise of reliably modeling the earth's climate. This view certainly carries an element of truth; indeed, the marshaling of so much intellectual energy and human resource into a common project has little precedent in history, save the attempt to map the genome. Nonetheless, the security of this path to a progressively clear and distinct image of the climate is not without its own instabilities. These instabilities make the relevance of scientific claims contingent, even if they do not make their claims for truth less objective. The question of relevance is directly related to the way in which scientific claims re-organize a series of bodies around a problem. In this re-organization, the ambiguity of the scientific claim begins to resonate in two ways, first with regards to the uncertainty within the phenomena and its correlate within the model, second with regards to the discursive field in which scientific practice is installed. Both Alan Garfinkel and Manuel Delanda argue that epistemic ambiguity is determined in an analogous way to ontological stability. In order to return to the question of ambiguity within discourse, and thus return to the events in Copenhagen in 2009, it is worth recapitulating some salient points from the second chapter of this thesis and the work on both Garfinkel and Delanda.

As stated previously, problems have an internal structure composed of important and less important parts, different tenses, scales, contrasting spaces and background presuppositions. The stability of the problem thus resides in the ability of these parts to resist transformation.⁴² Any explanation always carries a background pre-supposition. The explication of any event is potentially infinite in time and in space, making it strictly impossible to give a full account of every causal factor. Instead, all that is possible is the gradual pruning back of causal links, carefully discerning between relevant and irrelevant linkages, for example, negative feedback in the climate model and structural coherence in

the nested organic model. The elimination of these linkages produces a space of pre-supposition that works as an invisible and implicit armature. This armature makes any explanation indeterminate, in that the explanation *implies* but cannot *contain* it. For example, each climate sub-model will include a range of input pre-suppositions or placeholders for the amputated web of relations that connect the discrete phenomena to all others on the planet. The standardization of these linkages and their points of amputation is exactly what allows for the inter-operability of the ESMF, so that different component models can be coupled together in numerous ways, but also as a way of checking and verifying the reliability of the different pre-suppositions - called 'parametrization' in climate literature.

An implicit presupposition is understood by testing what counts as a relevant or irrelevant difference with regards to the event in question. The decision to *suppress* one or another of an event's causal antecedent is always a question of value in two senses. Firstly, what is the best way of capturing *this specific* causal feature? Secondly, *why is this specific causal feature* worth capturing? This puts forward two different kinds of pre-supposition; the objective correlation to the phenomena, and the degree of relevance to the field in which the inquiry takes place. These different spaces are often taken for granted and so the values that structure the inquiry remain implicit. Garfinkel cites the example of employment statistics in which the presupposition is always "given that people are going to be unemployed..."⁴³. The presupposition in this case carries a specific political charge that is obscured. In the mechanical recitation of the statistic, the presupposition is naturalized. The justification for these kinds of explanations is to fall back on an idea of realism or common sense. The critique of them however is purely political. Alan Garfinkel foregrounds the relation between implicit sets of values when he writes:

The problem is that what is "realistic" to one may look myopic to another. There may be genuine disagreement as to whether an alternate economic system is "possible" not in the abstract sense of possibility, but in the practical sense: a possibility that must be taken into account in practical reasoning, whereas another

denies that it is practically possible. What shall we say about the nature of this disagreement between two such people? Is it a "factual" disagreement or a "value" disagreement? There does not seem to be a clear separation between the two.⁴⁴

Garfinkel raises a critical point here with regards to the idea of 'realism', seeing in it a naturalized pre-contraction of the space of possibility in which the mis-alignment of the implicit space becomes the very terrain on which the dispute occurs. This implicit type of objective ambiguity in the explanation is what Deleuze means by sense: a shifting non-linguistic landscape that lends the explanation a degree of relevance. The indeterminate aspect to the explanation resides in this space, and though he neglects the second form of the pre-supposition, Delanda makes this point in regards to the first:

Despite the fact that questions and answers are, indeed linguistic entities, 'Why' questions involve as part of the conditions that make them answerable, or well-posed, a non-linguistic or extra-propositional aspect which is properly problematic: a distribution of the relevant and irrelevant.⁴⁵

The rest of this case study will draw on Delanda's comment, but rather than orient it back towards the veracity of an epistemic model, it will expand it to explain the individuation of a political space. One way of entering into this is through Garfinkel's work on contrast spaces, which provide a theory for thinking about the non-, or extra-propositional nature of explanations. The contrast space is the list of implicit alternative answers in any question. The structure of these contrast spaces is as follows: why did X happen (as opposed to Y or Z)? Here, the letters in the brackets list implicit alternatives and compare it to the realised space. This was clearly seen in the cloud model cited above, where a different set of radiative properties were used to test the stability of the model's causal explanation with respect to various observations. In order to test the second kind of presupposition where the relation is between the proposition and a field of discourse, the thesis will turn to the Copenhagen Summit of 2009.

7.6 We have been asked to sign a suicide pact

The public debate during the Copenhagen Climate Summit was framed by two simple questions: 1) Will an accord be signed or not? 2) What was the acceptable temperature increase - would it be 1.5 degrees as opposed to 2 degrees, or 2.5 degrees etc.? In the midst of the negotiations a Rancièrian moment occurred. On December 8, 2009, during a hastily convened private press conference, the Sudanese negotiator representing the G77 group of 130 developing nations, Lumumba Di-Aping, broke down and uttered a distinctly un-diplomatic phrase: 'We have been asked to sign a suicide pact' in reference to the so called 'Dutch text' and a proposed 2 degree global average increase. ⁴⁶

This brief irruption carries into speech within a public forum the reality of a private calculus and its implicit presupposition, a calculus linking the historic responsibility for climate change, proposals for technological transfer, industrial output, global carbon capacity, rising sea levels, forced climate migration, economic activity, and most importantly the unequal distribution of anthropogenic impact. 2-degrees was a global average; it would mean 3.5 degrees in many of the African nations Di-Aping was there to represent

The contrast space of the argument is the list of implicit alternatives to the proposal: 2.5 degrees, or 3 degrees, or 3.5 degrees. The question is a vector of power that conditions the cases that form its solution, in this case the question is directed toward a purely abstract series of numbers, abstract because the 'average' is not regional but planetary - a global sum rather than a localized one which would allow for an assessment of impact according to specific populations. In this sense, the presentation of the global average complicates scientific claims. It is not that the average scale is not objective but that its objectivity operates at a scale, which mystifies the real and uneven distribution of an increase.

If the scale of argument is shifted from a planetary one to a regional one, different pictures emerge. In Northern and Southern Africa, a global average temperature increase of two degrees has been shown to translate into a 3.5-4 degree increase and widespread desertification and extreme drought – though some parts of the continent may also experience a smaller increase and more rather than less rainfall.⁴⁷ As some reports have pointed out, the impact of water stress, reduced crop yield and new disease vectors could lead to an additional 300,000 deaths on the continent per year in the immediate term, with double that amount in the coming decades.⁴⁸ This does not include the exacerbation of existing conflicts and refugee movements due to war and famine. Di-Apping's claim of 'climate genocide' during the Copenhagen summit should be contextualized in this situation. Indeed, the militarization of climate instability is already underway, with a 2006 US report titled *National Security and the Threat of Climate Change* calling for greater integration of climate concerns into national security issues, the report suggested that it posed a "serious threat to America's national security" while also acting as:

...a threat multiplier for instability in some of the most volatile regions of the world. Projected climate change will seriously exacerbate already marginal living standards in many Asian, African, and Middle Eastern nations, causing widespread political instability and the likelihood of failed states. Unlike most conventional security threats that involve a single entity acting in specific ways and points in time, climate change has the potential to result in multiple chronic conditions, occurring globally within the same time frame.⁴⁹

A fundamental reorganization of cause and effect due to climate change is evident in the concerns of this security report. The unconventional nature of a threat that does not act as a 'single entity' in a specific point in space and time but instead manifests in multiple and diffuse spatio-temporal scales forces a re-conceptualization of risk assessment and management. The entangled action of climate brings near and far, small and large, weak

and strong into contact in new and unforeseen ways. The political impact of this situation relies on pre-existing scalar models with which to frame its argument, the consequence of which is that dispute never poses the problem according its proper terms. The entangled action of trans-boundary impact and mitigation establishes unique difficulties for a model of negotiation premised on the scale of the nation state. The conceptualization of impact as a global average does little to clarify the extent of potential impacts on specific populations, on the contrary it only serves to further mystify what is at present a poorly posed debate. Part of the reason for this is that scientific research has been directed toward global models, both out of a necessity for understanding the climate system in comprehensive terms, but also because this is where funding has been directed. Further, there are real technical limits on existing capacities to model impact at a smaller resolution, as would be needed to describe specific impacts on populations. This insecurity in the epistemic model is reflected by a general anxiety as to the intensification of existing conflicts due to heat stress. The relation between climate and conflict is already well established in Africa, as a prescient report by the Guardian suggested in 2007, on the eve of renewed hostilities in Darfur:

With rainfall down by up to 30% over 40 years and the Sahara advancing by well over a mile every year, tensions between farmers and herders over disappearing pasture and evaporating water holes threaten to reignite the half-century war between north and south Sudan, held at bay by a precarious 2005 peace accord.⁵⁰

As the UN Secretary General Ban Ki-Moon pointed out, the Darfur crisis was not only ethnic but also *ecological*. This categorical porosity, in which ethnic, ecological and economic concerns become increasingly difficult to distinguish will characterize future forms of conflict.⁵¹ The militarization and institutionalizing of this is well underway. A watershed moment arrived on April 17 2007 when the UN Security Council met to discuss global security issues, suggesting that perhaps it was time for corps of 'green helmets' to join the blue helmets of the UN. However, it is important to note that this securitization of climate issues is not always welcomed unanimously - it being recognized

that the legitimate institutionalization confers in two ways: authorizing negotiation works to simultaneously set ‘acceptable’ or ‘tolerable’ limits for impact, and thus for mortality. A paper by the *Worldwatch Institute* takes this even further, arguing that climate is set to become a pretext for a new kind of ‘humanitarian war’:

A key question is how governments will address climate insecurity. Will prevention, in the form of radically different energy policies or other such responses, be key? Or might powerful governments one day be tempted to use the specter of environmental threats as an excuse for intervention—say, coercing others to mothball polluting industries or to stop cutting down forests in the name of climate stabilization?⁵²

The fusing of natural, military, economic and scientific activity characterizes contemporary climate conflict even if science depends on objectivity and impartiality. Its entanglement with large-scale security issues forces a reconsideration – not of its objectivity – but of the problems this objectivity attends to. The damping of negative feedback between scales lends environments their stability and resilience by softening the contact point between external cause and internal effect. Holding apart of this impact not only diffuses the linkages of cause, it breaks the chain of their attribution. In this sense the inter-scalar relation absorbs more than climatic interaction - it absorbs causal attribution and responsibility.

If this ambiguity and superimposition between military, economic and political policy regularly fills security reports, it is nowhere to be found in the main forum for international climate negotiation in which the idea of ‘policy’ represents a form of political neutralization especially with regard to specific impacts. For this reason, Di-Apping’s statement was all the more incendiary, even though he was disqualified as a ‘hyperbole prone’ by sections of the media.⁵³ In the final part of this case study, Di-Apping’s statement will be analyzed according to the same terms set out in the discussion of the ontological individuation of the phenomena and epistemic individuation in the

model, but this time attending to the way in which a public is formed, catalyzed into action by the small yet significant perturbation created by an untimely enunciation.

7.7 A private calculus

As the Climate Summit disbanded hundreds of thousands of protestors gathered outside of the Bella Centre in Copenhagen. The fracturing of a potential accord mirrored the disaggregation of the climate model, both caught in the ambiguous scales of environmental politics. Di-Aping's response to the colonial mentality of the G20 ('we have been forced to sign a suicide pact') and his invocation of the death camps of World War II ('climate genocide') were unexpected. Like a particle fired into view from an imperceptible background, Di-Aping aimed and succeeded in breaking all diplomatic protocols. His departure from convention crystallized comprehension for the crowds outside, bringing into public view the reality of a private calculus. In doing so, the statement disrupted the existing order of what can and cannot be said, what can and cannot be seen and what can and cannot be constituted as a problem. This disruption – which for Rancière is a paradigmatic moment of emancipatory potential – redistributes the field of perceptible problems within the body politic:

It makes visible what had no business being seen, and makes heard a discourse where once there was only place for noise; it makes understood as discourse what was once heard as noise.⁵⁴

This disruption to order begins to individuate another scale of phenomena; a public that forms around the dispute over temperature. Suddenly the implicit background of the argument irrupts into the surface, carrying with it a trail of amputated relations and demanding that they be included as evidence within the negotiating forum. This disruption redistributes the basic assumptions and problems that structure the debate, what is being questioned are the very terms and presentation of the discourse: is there in

fact a problem to be addressed, what is the object of this problem, what parties will be included in this dialogue?⁵⁵ After this disruption a new terrain of relevant (and irrelevant questions) is produced, no longer posed in terms of global averages (2 degrees, 2.5 degrees etc.) but rather in terms of the mortality of people and the differential impact of heat on the developing world. The individuation of the public begins with this act; the question that remains however is how to sustain the process of individuation beyond its initial efflorescence? How to hold together and bind this nascent public in such a way as to secure the possibility of justice? Rancière clarifies the problem:

The rationality of this act is nonetheless not enough to secure an equitable resolution of the problem; justice does not simply emerge as a consequence of the intelligibility of speech. There is no telos of mutual understanding since the political rationality of argument can never be some simple clarification of what speaking means. ⁵⁶

Nor can the stage upon which this political drama unfolds "be possibly identified with a model of communication between established partners concerning objects and ends belonging to a common language".⁵⁷ Here, Rancière strikes a distinctly Simondonian tone. The utterance makes the public, or as Simondon might put it, the relation individuates at the same time as its terms. There is an immanent idea of communication here, since communication is not conceived according to the transmission of an intelligible signal between a pre-existing sender and a receiver; *communicability* – the condition of possibility for communication, its potential intelligibility – emerges along with the event of communication. Rancière has in mind precisely the kind of linguistic statement that Di-Apping made, but closer scrutiny reveals that what has come into public view, what is demanded by the Group of 77 representing the poorest 120 nations in the world, is more than an articulate demand issued for participation in the dialogue. Di-Apping's words carry a political demand for a new type of mathematics, a differently scaled calculus. At its heart, it is a problem of biopolitics and the scale at which a specific population will be addressed by the climate model. Di-Apping's call then, is an attempt

to re-establish the proper political scale within a debate about the temperature increase, terms whose explanatory scale must take into account the millions of people whose lives the negotiations will directly put at risk.

For Rancière, a basic philosophical presupposition is the equality of all human beings, a position which necessarily leads to a unified conception of the *demos* and therefore to an idea of collective political orientation *prior* to any calculus of ends and means or distribution of social goods.⁵⁸ The fact of equality is held strictly apart from - and is incommensurable with - this calculus of parts and their allocation. The orientation of actors does not produce a common since the common is the ground that is always pre-supposed. In the case of climate conflict, this pre-supposition can only come across as an idealist assertion, with little or no account of how this equality – real or not – could begin to transform the extreme inequalities between parties, let alone become a condition of the body politic.

Returning to previous question: what happens after the initial moment of emancipatory rupture? Is it possible to sustain an ongoing individuation of the public since its mere existence and intelligibility will not directly translate into a power over the form of the dispute? Rancière holds to a conception of politics that is transcendent, that disturbs the existing partition between the visible and the invisible in a violent moment, arriving literally from the outside. The question as to what happens after this moment of irruption, when the negotiations begin, receives more considered treatment by another thinker. *The Public and its Problems* by American pragmatist philosopher John Dewey shares neither Rancière's contempt for consensual politics nor his presupposition of absolute equality.⁵⁹ Where Rancière grounds his politics in common equality, Dewey grounds his in common risk. Dewey's work can be said to prefigure in many important ways the Latourian idea of a 'hybrid problem', in which the natural and man-made interact. Dewey's public is always formed through a shared perception of potential harm. This shared sense 'coalesces into a problem' and begins to bind actors together to form a public. Neither the existence of the public nor the fact of common perception can be

pre-supposed; instead they are provoked into existence by a group feeling that gradually holds them together in an alliance. There is no single unified public for Dewey; instead there exists an excess of publics, assembling and dis-assembling temporarily at different scales, always in response to a specific problem. As Dewey writes:

...the public cannot for any length of time hold itself. It is not that there is no public, no large body of persons having a common interest in the consequences of social transactions. There is too much public, a public too diffused and scattered and too intricate in composition. And there are too many publics, for conjoint actions which have indirect, serious and enduring consequences are multitudinous beyond comparison.⁶⁰

For Dewey, there is no transcendent glue able to bind the public together; no inexorable historical trajectory, no innate inclination for truth or moral certainty can secure the instability and contingency of a public. Written in 1927, Dewey's text follows a rigorous particularism; eschewing any reliance on transcendent causes not directly attributable to immanent and observable phenomena, distrusting appeals to the inevitability of the state or its essential character and, in contrast, arguing in terms of relations that demand constant re-assembly.⁶¹ This process of assembly has a limit and thus a scale, since the coalition may weaken and dissolve or the problem might be resolved. The public will only draw together bodies that share in the effect and pull of the problem. The scale of the public is therefore open; nothing can guarantee its success except for the ongoing attempt to bind the various actors together in an effort to attend to the perception of potential harm. The scale of the public is not pre-determined by the consequences of conjoint action, pre-supposing neither a common equality, nor the necessity of an alliance, only the tendency of people to form associations around shared risks. In words that can hardly fail to resonate with the crowds that gathered outside of the summit and with the countless reports and articles inspired by Di-Apping's outburst, Dewey writes:

Sometimes the consequences are confined to those who directly share in the transaction which produces them. In other cases they extend far beyond those immediately engaged in producing them... . . . Those indirectly and seriously affected for good or for evil form a group distinctive enough to require recognition and a name. The name selected is The Public.⁶²

Dewey's idea of a network here is brilliant though counter-intuitive: public political organization does not occur because the parties concerned are *directly* effected, rather the public comes into being because of the possibility of *indirect* effects. The political fact of *indirect through conjoint* action radically opens the frame of argumentation to implicate the environment, since the environment both absorbs and separates the point of contact between actors, such that the environment might be seen as the medium of diffusion. For Dewey, if the action is between parties that share a direct link, this no longer qualifies as political and is better described according to social or personal terms; politics is reserved for situations in which the action is diffused, a diffusion that demands a corollary form of social organization. To repeat Dewey's line of argument: First, the collective perception of an objective problem produces some effect that begins to bind a network of actors together. Second, the association of bodies exists in time and space as long as the problem continues to exert this effect and as long as the bonds of the association can be held together. Third, the scale is thus co-extensive with the network and the problem that holds its attention. Finally, the links that bind the public to its problem are not direct; instead they exhibit some degree of ambiguity or diffusion. The environmental milieu – in that it diffuses the causal links between actors – creates an ambiguous chain of cause and effect. The kind of politics that comes into being through problems posed by climate change further radicalizes Dewey's conception of *indirect through conjoint action*. It is unlikely that Dewey could have anticipated the extraordinary distribution of commentators, activists, academics, scientists and politicians that have emerged in the aftermath of events such as the one in Copenhagen. However, this excess of publics individuating beyond the borders of territories, identities or institutions - much like the

trans-boundary effects of the climate itself – is a perfect example Dewey’s conception of a public.

Lest this summation sound too utopian, it is worth returning to Deleuze’s critique of the *sensus communis*, since according to Deleuze collective forms of stupidity and malevolence are just as likely to individuate as progressive ones. As mentioned previously, Deleuze draws on Bachelard’s idea of the *problematique* but radicalizes it, simultaneously making it the basis for all forms of individuation but destroying its grounding in a progressive teleology. Collective individuation, scientific or otherwise, would then be subject to the same trials of relevance against a plane of immanence that could never be secured.

If the account of scalar individuation is to avoid the hylomorphic framework described in the first half of this thesis, the public that forms around a problem must be immanent with the problem itself - the genesis of this public and the problem being co-extensive rather than pre-determined, as in appeals to innate equality or essential rights. More importantly, the problem needs to be understood as something that exists in its own right, a mechanism within the world outside of its assertion or perception within a specific subject. In conclusion, this case study will explore this mechanism, setting out the process of assembly that links and binds different individuations in a chain of immanence. Finally, it will ask what kind of conceptual implications can be drawn from this concerning the idea of scale.

7.8 Something in the world forces us to think ⁶³

While for Rancière the problem is always posed by human interlocutors, one need extend Dewey’s text only a little to grant an ontological primacy to the problem

itself.⁶⁴ For Dewey the public forms in response to the solicitation of a problem, which exerts an inhuman agency, attracting actors into its force field through common interest. Dewey and Simondon find common ground in this sense, since collective forms of subjectivity and knowledge, no less than matter, individuate themselves through problems. As Massumi writes with regards to Simondon:

Simondon approached the question of epistemology as a function of ontogenesis. There is an individuation of thought, he said, by the same token by which there is an individuation of matter, on the physical plane and from there on to the plane of life, and following - or prolonging - the same constitutive principals.⁶⁵

In different ways, the examples set out here attempt to explore these shared individuations of problems across ontological, epistemic and discursive registers, moving from one to the other, each 'prolonged' in a uniquely scaled chain of immanence. The links between these different individuations, the pathways upon which one problem forms the condition of possibility for another was set out such that: *self-organization in matter* expresses *causality in its behavior*. This causal behavior is in turn objectively linked to an *explanation in the model*. Finally, the explanation in the model was seen to individuate the *assembly of a public*. The objective indeterminacy of the open system finds its epistemic correlate in the objective ambiguity in the explanation. In turn, both of these find their political correlate in the distribution of relevance within a discourse. In this way, the individuation of a problem in the world, the epistemic individuation of its concept and a public, all partake in an immanent economy.⁶⁶ This economy in which the individuation of thought is provoked into existence by something that does not belong to it, is the psychic correlate of the material individuation, the germination of form in the first case being immanent with the crystallization of concepts in the second.⁶⁷ The correlation does not point to a unification of process across material, epistemic and discursive registers, only to the ubiquity and immanence of any individuation.⁶⁸

By granting an ontological primacy to the problem and arguing that scale is a fundamental attribute, a number of things stand to be gained. To begin with, a conceptual link can be formed between the ontological, epistemic and discursive registers. As seen in the example of the climate, the climate model and the climate dispute. It follows from this that if each problem constitutes its own field of individuations with their own immanent distribution of relevant and irrelevant points, then there is no immediate or simple possibility of commensurability across different problems. To map a measure from one problem onto another, that is to say to make them commensurate, requires a degree of translation since each scale is unique. This was shown in the chapter *Spatialising Co-existence* in which the epistemic model used by the architect begins to redraw the problem in its own terms, and also in this chapter with the example of the Earth Systems Modeling Framework. In each case, the convention establishes the possibility of communicability between different problems.

A speculative question can be drawn from this: if scalar incommensurability between problems is ontological, what becomes of politics and ethics in a condition characterized by this apparent and fundamental inconsistency - an inconsistency that appears not as an ontic lack, but as a real feature of the world? This speculative question will be addressed in the conclusion of this thesis, but in order to lay the ground for such comments, the sense in which immanence forms a limited and unstable political horizon should be set out. Therefore some further points on the idea of collective individuation and its relationship to discourse, especially in regards the production of truth, should be explained.

For Deleuze, the production of truth, whether in scientific discourse or in philosophy is an expression of force, residing in the ability of a problem to perturb or otherwise transform the field of problems in which it is installed:

What is essential is that there occurs in the heart of the problems a genesis of truth, a production of the true in thought. Problems are the differential elements in thought, the genetic elements of the true.⁶⁹

By locating in the problem a condition of truth, Deleuze re-orientes the notion of truth away from a test of falsity and reliability towards a test of relevance. Relevance – in that it structures and directs collective labor, attention and intellect towards one problem at the expense of others – establishes a vector of power that extends between the problem and the truths that it gives rise to - as from a teacher to a student. Scientific truth then, depends on the force with which a statement can be asserted; (where force should be taken in its full Latourian sense, beyond the idea of rhetorical persuasion or speech to encompass material behaviors) its power emerges from the redistribution of other problems in the field. In this sense, the truth is always immanent to the problem.

The critique of Bachelard's normative historiography of science by Michel Foucault can be seen as an accompaniment to the work of Simondon and Deleuze, but directed towards the way history (rather than philosophy) authorizes certain forms of truth. Power for Foucault operates through an anonymous discursive drift, implicitly generating values around certain problems without these values necessarily being articulated. As a description of the latent political power behind questions of expertise and scientific truth, Foucault's work is crucial. In his book, *A Vast Machine*, Paul Edwards describes the scientific effort on climate change as resulting in 'shimmering' truths. That is to say, the data that is produced does not converge on a precise and singular conclusion but occupies a bandwidth of reliability that has been tested and verified. More crucially, the account of climate modeling Edwards presents appears as if two clear sides were at stake. On one side of the fence, the impartial and evidence-based project of science, and on the other side sits the distorting influence of political lobby groups acting on behalf of the energy industry. As Edwards suggests:

On an idealized view, high-quality scientific knowledge should and will automatically command policy choices, limiting disputes by partisans to issues of implementation. Yet the implication of this profound authority is that credible science can be translated directly into political power.⁷⁰

Idealized or not, it makes little difference, in that Edwards has already framed science in terms of its quality, that is to say its veracity and credibility, when in fact these qualities are not the ones in question. In positing 'good science' as a natural vector for decision-making, Edwards implies that 'bad science' would be unfit for use in policy because of its unreliability. What is in question here is precisely the opposite, less the credibility of science vis-à-vis science and more the relevance of science vis-à-vis politics. In framing this debate as impartial advocates vs. partisans, Edwards exemplifies the misconception of partiality as the 'corrupter' of impartial science, where partiality is the realm of politics and objectivity is the realm of science. The models used by climate scientists to explicate the ambiguity of the material world can be understood in purely scientific terms, but only at the expense of unmeshing the models from the political and economic forces in which they are installed and called on to work for. By locating these models against the milieu of conflicts and negotiations that characterize the struggle over global carbon capacity, the objectivity of science can be reframed in the context of the political force field that scientific attention both enters into and forms. In this landscape of problems and their force fields, the attraction and repulsion of one scalar problem over another has an implicit history, such that each problem – human or non-human – is immanent to the changing background from which it emerges and which lends it sense. Unpacking the history of this problematic field requires an archaeology of scientific attention and relevance, especially as they are articulated around the problem of scale. As shown in the case of the argument on average temperature increase, a problem can be objective in a scientific sense, yet nonetheless partial in a political one since what is concealed behind the expertise able to produce the 'right number', is the direct dependence of first world GDP on carbon capacity. Within each degree of average increase, billions of dollars and millions of lives are congealed.⁷¹

CONCLUSION

8.0 The evisceration of scale

Though there has been an absence of intellectual attention around the idea of scale within the last 50 years in architecture, the period up until the early 1960's evidenced a number of disputes around the related idea of proportion. For example on 18 June 1957, the Royal British Institute of Architects forwarded a motion declaring that *systems of proportion make good design easier and bad design more difficult*. The motion was defeated but its proposal nonetheless brings to a kind of conclusion a period of interest in questions of proportion renewed along different terms by Rudolf Wittkower and later by his student Colin Rowe. The final chapter of *Architectural Principals in the Age of Humanism* Wittkower is titled *The Break Away from Laws of Harmonic Proportion* tracking the gradual move away from an idea of proportion as a divine mathematical emanation toward a more empirical model as began to happen in the seventeenth and eighteenth century. Wittkower describes the loss of the Platonic sensibility that dated back to the Renaissance with something approaching nostalgia, tracing a narrative from Blondel, through Perrault through the aesthetic relativity of Hume and Burke finally

concluding with the words of Ruskin who recommends that artists should be free to constitute their own systems of proportion. Wittkower student Colin Rowe who was in attendance at the aforementioned debate on systems of proportion at RIBA would re-introduce the importance of systems of proportion, but in a way that stripped them of any cosmological or empirical significance. Slowly, proportion takes on cosmological then social then economic and finally only a disciplinary significance; its conceptual horizon gradually shrinking with each step. An idea like proportion, wedded as it seems to be to ideas of propriety and the 'proper' can only be but lost when it no longer secures its orientation in a common value. Nor does commonality - in and of itself - guarantee or confer any kind of intrinsic worth, as Deleuze notes, stupidity and intelligence are equally likely to take collective form. Denaturalizing the propriety within scale by accounting for its historical genesis and locating it within a strictly immanent series of coordinates as this thesis has argued remains a largely critical gesture however.

The temptation here would be to simply re-inscribe the question of value, albeit in new and different terms. This would be a mistake however, in that this gesture would continue to operate within a structure that begins with the question of value subsequently proceeding to enter opposing values into a contest or competition. What is being proposed here is something quite different, not the assertion or - what would amount to the same thing - the negation of one specific value over another, but rather their suspension, a suspension that holds open long enough to attend to the genesis of new ones. In that sense, the purpose of this thesis is to set out precisely and in clear terms the possibility of an approach corridor, an entry point or an apprenticeship - attending to the chain of immanence that binds together ontological, epistemic and discursive individuations according to a scalar correlation. By doing so, the argument commits to an idea of value that emerges out according to the terms with which the problem is posed. It is the mechanism of individuation that links one to the other that has formed the focus of the thesis, not this or that conclusive end state.

There is an ethical current that runs through this line of argument because the return of the question of value or propriety within scale now occurs within a strictly limited horizon of action. By arguing for a deep inconsistency and incommensurability across scales and by demonstrating that every scalar individuation is necessarily limited and immanent to its terms, the possibility of a universal horizon disappears; instead a limited, purely constructed and provisional one appears to take its place. Furthermore, the link that binds notions of value to spatial reasoning, rationality or even to objectivity is in itself subject to historical change and cannot be secured once and for all. These two conclusions which follow from the preceding argument about scale: the limited horizon of action, and the immanence of any rationality to the problem that forms its sufficient reason, might seem to do nothing more than establish negative constraints on the agency of architecture - a contraction of power on one hand and an instability of practice on the other. This may be the case. But in stating this constraint according to these terms, is all that is accomplished to signal a situation that has existed for some time and perhaps all along? Certainly not. What is gained within this limited horizon is a rigorous account of scalar genesis - ontological, epistemic, discursive - by which new modes of thought and new modes of practice can be established. By setting out the objectivity of a correlation between ontological and epistemic registers a concept of explanatory scale is produced, one that is all the more precise (if not clear) for being situated alongside an ambiguity that it cannot eliminate.

8.1 A political pedagogy

The complex interlacing that characterises cities, expressed in complex feedback mechanisms, diffuse causal networks, and the resulting redistribution of risk that goes along with them demands a different kind of approach to the way complex problems are posed and made available for action. It is clear that the structuring of these questions as well as the environment in which their progressive specification comes to occur is increasingly complicated. The sheer number of phenomena and exponential possibility of their inter-relation makes intelligibility difficult and action only more so. The emergence

of a theory of scale is a direct response to this complexity, to the difficulty of posing a well-defined problem and to the political asymmetries that condition the space of inquiry around any problematic. Scale can be understood in one sense, as a grid of intelligibility thrown over this complex entanglement, a surface of variable resolution that allows certain elements to pass just as it obstructs certain others. The process by which these apertures, or as they have been referred to here, epistemic frames, resolve themselves in respect to a problem is in fact a question of learning whereby a form of knowledge individuates itself through a slow process of increasing specification. What is at stake finally then, is the possibility of agency and its dependence on pedagogy.

What is needed is a conceptual apparatus able to make sense of these intricate entanglements, one able to synthesis information across different bodies of knowledge and a wide spectrum of phenomena. In this condition of radical conflation and the instability that comes along with it, relying on existing scalar protocols and conventions that are based in commonality, proportion or measure is inadequate. By attending to the individuation, rather than the already individuated form of scale, both a disposition and a method toward the aforementioned challenges can be formulated. This is not negate the possibility of convention, since as this thesis has argued, convention builds a bridge of communication between different, singular sites of research, and thus forms the possibility of a shared field of inquiry, rather it is to demand the formulation of new conventions, ones better suited to the complexity of contemporary city and planetary environment, in order for this to happen, a clearer sense of the kinds of questions that must be addressed needs to be formulated first.

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FOOTNOTES: INTRODUCTION

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² COYNE & RICHARD (2012) Scale Adjustment in architecture and music. IN ADLER, G., BRITTAIN-CATLIN, T. & FONTANA-GIUSTI, G. (Eds.) *Scale: Imagination, Perception and Practice in Architecture*. London, Routledge. ADLER & GERALD (2012) Introduction. IN ADLER, G., CATLIN, B. & FONTANA-GIUSTI, G. (Eds.) *Scale: Imagination, Perception and Practice in Architecture*. London, Routledge.

³ BRENNER, N. (2001) The limits to scale? Methodological reflections on scalar structuration. *Progress in Human Geography*, 25, 591-614. And: HERROD, A. *Scale*, London 2010, Routledge.

⁴ COYNE & RICHARD (2012) Scale Adjustment in architecture and music. IN ADLER, G., BRITTAIN-CATLIN, T. & FONTANA-GIUSTI, G. (Eds.) *Scale: Imagination, Perception and Practice in Architecture*. London, Routledge.

⁵ ADLER & GERALD *ibid.* Introduction. IN ADLER, G., CATLIN, B. & FONTANA-GIUSTI, G. (Eds.), *ibid.*

⁶ MARSTON, S. A., WOODWARD, K. & PAUL JONES III, J. (2005) Human geography without scale. *Transactions Institute of British Geographers*, 30, 416-432.

⁷ Reference SUN, N.-L. Rethinking Globalisation: Re-articulating the Spatial Scale and Temporal Horizons of Trans-Border Spaces. *State - Space: A Reader*.

⁸ PAPANETROS, S. (2010) MICRO/MACRO Architecture, Cosmology, and the Real World. *Yale Perspecta*, 42, 108-125.

⁹ “While these two lines appear alike, their geometries refer to very different understandings of the relationship between form, matter and forces. The first curve is based on geometry that is assembled from circular arcs, his own version of the Vitruvian Figures aesthetical ethic of the whole made up of discrete parts. If any part of the line is changed, all the others have to be re-calculated and redrawn separately to be re-integrated into the line. The second curve is defined by a spline geometry based on the flow of forces through the curve; this force is regulated by the position of the triangular handles... ..The former, Lynn argues, presents a hylomorphic and humanist world view that sees matter as at once objective and inherently static. And which must have ideal and subjective geometries (in the universal Kantian sense of the subjective) imposed upon it to give it form. The second curve maps forces, forms and matter as an intrinsically dynamic and interrelated field, in which subjects and objects negotiate and unfold each other diagrammatically.” HIGHT, C. (2008) *Architectural Principals in the Age of Cybernetics*, London, Routledge, 191.

¹⁰ DASTON, L. & GALISON, P. (2010) *Objectivity*, Brooklyn, Zone Books. Reference PADOVAN, R. (1999) *Proportion*, London, E & FN Spon.

¹¹ Ibid.

¹² Humanism manifests itself across three registers: as measure, expression and reception. The first refers to the use of an idealized body as a metric, which is projected outward, as in the Vitruvian man. The second registers in architectural form, which is seen to express the innate creativity within the individual designer. The third is in phenomenological theories of reception in which the unique experience of a human subject forms the frame for value in the project.

¹³ PEREZ-GOMEZ, A. (1983) *Architecture and the Crisis of Modern Science* Cambridge MIT Press , PADOVAN, R. (1999) *Proportion*, London, E & FN Spon , HIGHT, C. (2008) *Architectural Principals in the Age of Cybernetics*, London, Routledge.

¹⁴ MARSTON, S. A., WOODWARD, K. & PAUL JONES III, J. (2005) Human geography without scale. *Transactions Institute of British Geographers*, 30, 416-432. Also: MILLER, H. L. A. B. (2006) Scale and the limitations of ontological debate: a commentary on Marston, Jones and Woodward. *Transactions Institute of British Geographers*, 32, 116-125.

¹⁵ See for example: ESCOBAR, A. (2007) The 'ontological turn' in social theory. A Commentary on 'Human geography without scale', by Sallie Marston, John Paul Jones II and Keith Woodward. 106-111. Also: PAUL JONES III, J., WOODWARD, K. & MARSTON, S. A. (2007) Situating flatness. *Transactions Institute of British Geographers*, 32, 264-276. Also: JONES, K. T. (1998) Scale as epistemology. *Political Geography*, 17, 25-28. Also: COLLINGE, C. (2006) Flat Ontology and the Deconstruction of Scale: A Response to Marston, Jones and Woodward. *Transactions of the Institute of British Geographers*, 31, 244-251. Also: COX, K. R. (2001) Territoriality, politics and the 'urban'. *Political Geography*, 20, 745-762. DUNCAN, S. & SAVAGE, M. (1989) Space, Scale and Locality. *Antipode*, 21, 179-206. COX, K. R. (1984) Space and the urban question review essay. *Political Geography Quarterly*, 3, 77-84. COX, K. R. (2003) Political geography and the territorial. *Political Geography*, 22, 607-610. And: TAYLOR, P. J. (1998) World-systems analysis and regional geography. *The Professional Geographer*, 40, 259-265.

¹⁶ These shifts in the concept have their origin in the prevailing Marxist framework within geography that dates back to the 1970's before expanding to investigate the role of gender, domesticity, culture and most recently the environment: LEGG, S. (2009) Of scales, networks and assemblages: the League of Nations apparatus and the scalar sovereignty of the Government of India. *Transactions Institute of British Geographers*, xxx, 234-253. Also: CHAPURA, M. (2009) Scale, causality, complexity and emergence: rethinking scale's ontological significance. *Transactions Institute of British Geographers*, 34, 462-474. Also: MARSTON, S. A., WOODWARD, K. & PAUL JONES III, J. (2005) Human geography without scale. *Transactions Institute of British Geographers*, 30, 416-432.

FOOTNOTES: THE SCALE OF MATTER

¹ Alan Turing makes a point about the difference between computational dependence on discrete and repeatable addresses. Turning is speaking to the ineliminable contingency of events in a world where very small fluctuations occurring below the threshold of measurability can lead to large effects. The paper from which this quotation is drawn argues against the Laplacian view that universal predictability could be

assured under conditions in which the starting position of every element was known. TURING, A. M. (1950) Computing Machinery and Intelligence. *Mind*, LIX, 7.

² Drawing on Schrodinger, Turing and Poincare, Giuseppe Longo's paper sets out some of the theoretical limits of mathematics and computation as they apply to biological systems, specifically the problems posed by distinct levels of organization and the discretization of continuous systems. LONGO, G. & BAILLY, F. (2003) Objective and Epistemic Complexity in Biology (Towards a "conceptual organization"). *Invited lecture, International Conference on Theoretical Neurobiology*. New Delhi, National Brain Research Centre, LONGO, G. (2007) From exact sciences to life phenomena: Following Schrödinger and Turing on Programs, Life and Causality. *Information and Computation*, 207, 545-558, 553.

³ See: PRIGOGINE, I. (1997) *The End of Certainty*, Free Press. Also: PRIGOGINE, I. & STENGERS, I. (1984) *Order Out of Chaos*, Shambhala.

⁴ LONGO, G. & BAILLY, F. (2003) Objective and Epistemic Complexity in Biology (Towards a "conceptual organization"). *Invited lecture, International Conference on Theoretical Neurobiology*. New Delhi, National Brain Research Centre.

⁵ In a riff on Leibniz - for whom God's calculus ensures the best of all possible worlds - Deleuze's invocation of a supreme calculator happens to be bad with numbers, never managing to reconcile the remainder which remains incalculable: "It is therefore true that God makes the world by calculating, but his calculations never work out exactly [juste], and this inexactitude or injustice in the result, this irreducible inequality, forms the condition of the world. The world 'happens' while God calculates; if the calculation were exact, there would be no world." This is not a reference to the Cartesian sense of misunderstanding or error, as will be made clear in the following pages, instead it refers to an ontological claim for the primacy of difference. DELEUZE, G. (1968 (1994)) *Difference and Repetition*, Paris, Gallimard, 280.

⁶ *Ontology* is defined as those structures or elements that a philosophical system takes to exist, to be real. It is distinguished from *epistemology* which is defined as a theory of knowledge, especially how it is acquired and organized and the kinds of claims that can be made within it. *Scale* commonly refers to proportion or ratio. This definition is the conventional use of the term within architecture, though it is often used as a synonym for size and also to describe groups of related questions, as in neighborhood scale. This last definition is the closest to the concept of scale that will be developed through this thesis.

⁷ See: PADOVAN, R. (1999) *Proportion*, London, E & FN Spon WITTKOWER, R. (1971) *Architectural Principals in the Age of Humanism* London, Norton & Company. PERRAULT, C. (1683 (1996)) *Ordonnance des Cinq Espe'ces de Colonnes (Ordonnance for the Five Kinds of Columns after the Method of the Ancients)*, Paris, The Getty Center For The History Of Art DURAND, J.-N.-L. (1802 & 1821) *Precis of the Lectures on Architecture: With Graphic Portion of the Lectures on Architecture*, Los Angeles, Getty Research Institute. PEREZ-GOMEZ, A. (1983) *Architecture and the Crisis of Modern Science* Cambridge MIT Press.

⁸ PAPANETROS, S. (2010) MICRO/MACRO Architecture, Cosmology, and the Real World. *Yale Perspecta*, 42, 108-125.

⁹ See "proportion noun" in STEVENSON, A. (Ed.) *Oxford Dictionary of English*. Oxford University Press online, 2001.

¹⁰ See: ROWE, C. (1982) *The Mathematics of the Ideal Villa and other essays*, Cambridge MA, MIT Press. Also: HAYS, K. M. (1992) *Modernism and the Post-humanist Subject: The Architecture of Hannes Meyer and Ludwig Hilberseimer*, Cambridge MA, The MIT Press.

¹¹ William Charlton puts it as follows in his commentary: "Phys. I centres around a question which Aristotle says elsewhere (*Met. Z 1028b2-4*) always has been, still is, and always will be, the focus of inquiry and perplexity, and the Greek for which is *ti to on*. This is sometimes translated "What is being?, but that would be a better translation of the more sophisticated formulation which Aristotle suggests we substitute for it, *tis hé ouisa*. *Ti to on* itself is a much vaguer question, something like 'What is there?', 'What exists?', 'What is real?', 'What is the World?'"
ARISTOTLE (1969) *Physics I & II*, Oxford, Oxford University Press. ARISTOTLE (1982) *Physics III & IV*, Oxford, Oxford University Press, xiii.

¹² *Ibid*, 74.

¹³ THOMAS, A. S., ARISTOTLE, P., BLACKWELL, R. J., SPATH, R. J. & THIRLKEKEL, W. E. (1999) *Commentary on Aristotle's Physics*, Notre Dame, Ind. Great Britain, 76.

¹⁴ Morphogenesis describes the creation of form. It marks the conjunction of two terms, one of which means *shape*, and the other, *beginning*. What is beginning here? It is tempting to state that it is simply the start of an outline, the first shaping of a contour. But this beginning, in which a form is said to have 'started', in as far as it is a beginning is also a first gesture that inaugurates subsequent gestures. This may mean little more than the fact that beginnings usually entail middles and ends, or that this sequence marks a series in which a form starts, develops and concludes. However, by returning to the question, 'what is beginning here?' it is also possible to suggest that the *beginning of form* is doubled by another beginning that is not only the beginning of shape or form but also the beginning of a sequence - that is a form of time. In the conjunction of *morphe* and *genesis* there are two beginnings that are immanent to each other. This doubling might be articulated as: form of time/time of form. Such philosophical questions regarding development and matter reverberate throughout this thesis.

¹⁵ ARISTOTLE (1969) *Physics I & II*, Oxford, Oxford University Press. Also: "And so it must be said that a principle of motion is in natural things in the way in which motion belongs to them. Therefore in those things to which it belongs to move, there is an active principle of motion. Whereas in those things to which it belongs to be moved, there is a passive principal which is matter." THOMAS, A. S., ARISTOTLE, P., BLACKWELL, R. J., SPATH, R. J. & THIRLKEKEL, W. E. (1999) *Commentary on Aristotle's Physics*, Notre Dame, Ind.; Great Britain, 76. See also: ARISTOTLE (1983) *Physics III & IV*. Trans. HUSSEY, E. Clarendon Press, Oxford.

¹⁶ AGAMBEN, G. (2011) *What is a Commandment?* London, The Centre for Research in Modern European Philosophy. DERRIDA, J. (1978) *Writing and Difference*, London, Routledge.

¹⁷ BURCHILL, L. (2007) The Topology of Deleuze's Spatium. *Philosophy Today*, 2007, 154.

¹⁸ Though this begins with a mytho-theological story, the persistence of the question of life, form and its appearance exceeds its original domain. The original genetic event and its repetitions are two of the major pre-occupations of both philosophical and scientific inquiry; the search for origins and an account of change

¹⁹ GLEICK, J. (2003) *Isaac Newton*, London, Pantheon.

²⁰ There is a more complex history to this debate that cannot be dealt with here. The resolution of the Newtonian position was not as widely accepted as might be suggested above. The dispute between Leibniz and Newton being only the most well-known example. See also: LEIBNIZ, G. W. & CLARKE, S. (1715-1716 (2000)) *W. Leibniz and Samuel Clarke: Correspondence*, Indianapolis, Hackett Publishing Co. Inc.

²¹ NEWTON, I. (1687 (1999)) *The Principia : Mathematical Principals of Natural Philosophy*, California, University of California Press.

²² PRIGOGINE, I. (1997) *The End of Certainty*, Free Press, 19.

²³ Ibid, 19.

²⁴ For an account of the personal history behind Descartes' pursuit of the automaton as model see: WOOD, G. (2003) *Edison's Eve: A Magical History of the Quest for Mechanical Life*, London, Anchor.

²⁵ DESCARTES, R. (1677 (2004)) *Principia philosophiae (Principals of Philosophy)*, London, Kessinger Publishing. Book 4, 203

²⁶ FOCILLON, H. (1934) *Vie des formes (The Life of Forms in Art)*, New York, Zone Books. Also: KUBLER, G. (1962) *The Shape of time: Remarks on the History of Things*, New Haven, Yale University Press.

²⁷ "Now, if indeed, whenever I do not sufficiently clearly and distinctly perceive where the truth lies, I refrain from passing judgment, it is clear that I am acting rightly and not being deceived. But if I either affirm or deny, then I am not making the right use of my freedom of choice; and if I adopt the view that is false I shall altogether be deceived." DESCARTES, R. (1642 (2008)) *Meditations on First Philosophy*, New York, Oxford University Press, 60.

Also see: "The first rule is: that each part of individual matter always continues to be in the same state, as long as it is not forced to change that state by collision with others." DESCARTES, R. (1637 (2003)) *Discourse on Method and Related Writings*, New York, Oxford University Press, 38.

²⁸ KIRK, J. (1993) *Organicism as reenchantment : Whitehead, Prigogine, and Barth*, New York, Peter Lang, 2.

²⁹ MAYR, E. (1982) *The growth of biological thought : diversity, evolution and inheritance*, Cambridge, Mass. ; London, Belknap Press, 3. This seems to suggest a historical continuity in the field of biology that stretches back to antiquity, but as Foucault warns, the discursive field is hardly as continuous as Mayr

believes. It is in fact marked by interruptions and discontinuities, none more so than around the constitution of 'life' as an epistemological problem:

“Historians want to write histories of biology in the eighteenth century; but they do not realize that biology did not exist then, and that the pattern of knowledge that has been familiar to us for a hundred and fifty years is not valid for a previous period. And that, if biology was unknown, there was a very simple reason for it: that life itself did not exist. All that existed was living beings, which were viewed through a grid of knowledge constituted by natural history.” FOUCAULT, M. (1966) *The Order of Things*, London, Routledge, 139.

As Foucault argues, it is impossible to speak of 'life' as a problem before the eighteenth century. It is not constituted as a problem and thus life as it has come to be known did not yet exist. All that existed was the taxonomical grid of natural history.

³⁰ MAYR, E. (1997) *This is biology : the science of the living world*, Cambridge, Mass. ; London, Belknap Press of Harvard University Press, 9.

³¹ Vitalism cannot simply be periodized as having precedents in ancient philosophy, nor can it be used to describe a coherent set of figures finding some resonance in names as different as Pasteur in chemistry, Wolff in biology and Bergson in philosophy. Here it is being used in a more specific sense to describe a dispute in embryology, extending through the nineteenth century as exemplified by figures like Driesch and Reichenbach. For a more detailed account of this period and its relation to the life sciences see: ANSELL-PEARSON, K. (1999) *Germinal Life: The Difference and Repetition of Gilles Deleuze*, Routledge.

³² For example, see 'Odic force' in REICHENBACH, K. (1851 (2006)) *Physico-physiological researches on the dynamics of magnetism, electricity, heat, light, crystallization, and chemism, in their relations to vital force* Montana, Kessinger Publishing. Entelechy in: DRIESCH, H. (1908 (1979)) *The Science and Philosophy of the Organism*, Brooklyn, Ams Pr Inc. More recently the idea of a morphogenetic field in: SHELDRAKE, R. (1988) *The Presence of the Past: morphic resonance and the habits of nature*, New York, Times Books.

³³ See: VIJVER, G. V. D. (2006) Kant and the Intuitions of Self-Organization. *Self-Organization and Emergence in the Life Sciences*, 143-161. Also: TOSCANO, A. (2006) *The Theatre of Production. Philosophy and Individuation between Kant and Deleuze*, New York, Palgrave Macmillan.

³⁴ KANT, I. (2005) *Critique of judgment*, Mineola, N.Y., Dover ; Newton Abbot : David & Charles.

³⁵ See Richard Dawkins explanation of statistical chances in: DAWKINS, R. (1986) *The Blind Watchmaker*, London, Penguin Books. And also: RICHARDS J, R. (2002) *The Romantic Conception of Life: Science and Philosophy in the Age of Goethe*, Chicago, University of Chicago Press.

³⁶ MCLUAGHLIN, P. (1990) Kant's Critique of Teleology in Biological Explanation: Antimony and Teleology. *Studies in History of Philosophy*, 16.

³⁷ TOSCANO, A. (2006) *The Theatre of Production. Philosophy and Individuation between Kant and Deleuze*, New York, Palgrave Macmillan.

³⁸ Ibid, VIJVER, G. V. D. (2006) Kant and the Intuitions of Self-Organization. *Self-Organization and Emergence in the Life Sciences*, 143-161.

³⁹ KANT, I. (1995) *Opus Postumum*, Cambridge, Cambridge University Press, 506-507.

⁴⁰ ZAMMITO, J. H. (1992) *The Genesis of Kant's Critique of Judgement*, Chicago, University of Chicago Press, 189.

⁴¹ As Toscano notes: "that matter cannot self organise is for Kant an analytical truth: 'lifelessness, *inertia*, constitutes the essential character of matter". How else can he hold to the unique dignity of man versus both the animal and natural world without subscribing to the pantheism or atheism he so despised in his contemporaries. The cost of this philosophical commitment is the cleavage of organic development and life. TOSCANO, A. (2006) *The Theatre of Production. Philosophy and Individuation between Kant and Deleuze*, New York, Palgrave Macmillan, 24.

⁴² Zammito's own translation of Kant in: ZAMMITO, J. H. (1992) *The Genesis of Kant's Critique of Judgement*, Chicago, University of Chicago Press, 215.

⁴³ DAWKINS, R. (1986) *The Blind Watchmaker*, London, Penguin Books.

⁴⁴ As Mayr argues: "...from the days of the earliest philosophers it was widely believed that the world must have a purpose because, as Aristotle said, "Nature does nothing in vain," and neither, a Christian would say, does God. Any change in this world, they would say is due to final causes that move the particular object or phenomenon towards an ultimate goal. The development of an organism from the fertilized egg to the adult stage was frequently cited, from Aristotle on, as an illustration of this striving towards a goal. ...It was almost universally believed that everything in nature, particularly all directional process, moved in an analogous manner toward a predetermined end." MAYR, E. (1976) *Evolution and the diversity of life : selected essays*, Cambridge, Mass., Belknap Press of Harvard University press, 59.

⁴⁵ Manuel Delanda states it as follows: "In many respects, the circulation is what matters, not the particular forms that it causes to emerge. The flow of energy and mineral nutrients through an ecosystem manifest themselves as actual plants and animals of a particular species. Our organic bodies in this sense are nothing more than temporary coagulations in these flows: we capture in our bodies at birth, then release it again when we die and micro-organisms transform us into a new bath of raw materials. The main form of matter-energy in the biosphere is the circulation of flesh in food chains." DELANDA, M. (1997) *A thousand years of nonlinear history*, New York, Zone Books, 241.

⁴⁶ LEWONTIN, R. C. & GOULD, S. J. (1979) The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Programme. *Proceedings of the Royal Society of London*, Series B, 205, 581-598.

⁴⁸ Ibid, 581.

⁴⁹ Ibid, 581.

⁵⁰ See: LONGO, G. (2007) From exact sciences to life phenomena: Following Schrödinger and Turing on Programs, Life and Causality. *Information and Computation*, 207, 545-558. Also: LONGO, G. & BAILLY, F. (2003) Objective and Epistemic Complexity in Biology (Towards a "conceptual organization"). *Invited lecture, International Conference on Theoretical Neurobiology*. New Delhi, National Brain Research Centre.

⁵¹ Lewontin detects a hylomorphic conception of the organism here. It is blindly mutating and acted upon by the environment but rarely is it an agent of its own transformation. In response to this he proposes an expansion of the causal traffic passing between the different scales of the environment-organism-assemblage, such that all are involved in mutually constructing each other. See: LEWONTIN, R. C. (1983) Gene, organism, and environment. IN BENDALL, D. S. (Ed.) *Evolution from Molecules to Men*. Cambridge, Cambridge University Press.

⁵² SERRES, M. (2000) *The birth of physics*, Manchester, Clinamen. LUCRETIUS CARUS, T. & MILANESE, G. (2007) *De rerum natura*, Milano, Mondadori.

⁵³ SERRES, M. (2000) *The birth of physics*, Manchester, Clinamen, 77.

⁵⁴ Indeed, in many physical systems small irregularities play a significant role in determining the behaviour of the system, particularly when it comes to symmetry breaking, as in processes of crystallization. Referred to as developmental noise/information as in the case of embryology, it explains why there is a difference between left and right expression of fingerprints when the gene in both cases is the same.

⁵⁵ PRIGOGINE, I. (1997) *The End of Certainty*, Free Press.

⁵⁶ For an account of these developments see: DELANDA, M. (2002) *Intensive Science Virtual Philosophy*, London, Continuum.

⁵⁷ SIMONDON, G. (2009 (1959)) The Position of the Problem of Ontogenesis. *Parrhesia*, 7, 4-16, 11.

⁵⁸ DELEUZE, G. (2004) On Gilbert Simondon. *Desert Islands: and Other Texts, 1953--1974 Semiotext(e) / Foreign Agents*. Also: DELEUZE, G. (1966) Review of Gilbert Simondon's *L'individu et sa genèse physico-biologique*. *Pli: The Warwick Journal of Philosophy*, 12, 43.

⁵⁹ The saturation of the global scale and the extension of crystal formation at the local scale are closely linked. Any starting point will actualize a process of crystallization - though never in the same way twice. In this sense crystal formation is invariant with regard to scale. DELEUZE, G. (1966) Review of Gilbert Simondon's *L'individu et sa genèse physico-biologique*. *Pli: The Warwick Journal of Philosophy*, 12, 43, 46.

⁶⁰ SIMONDON, G. (1992) The Genesis of the Individual, IN CRARY, J. & KWINTER, S. (Eds.) *Incorporations*. New York, Zone Books.

⁶¹ TOSCANO, A. (2006) *The Theatre of Production. Philosophy and Individuation between Kant and Deleuze*, New York, Palgrave Macmillan.

⁶² VIRNO, P. (2009b) Angels and the General Intellect: Individuation in Duns Scotus and Gilbert Simondon. *Parrhesia*, 2009, 58-67.

⁶³ Ibid, 60.

⁶⁴ For a further discussion of the critique of hylemorphism within Simondon see: DE BOEVER, A., MURRAY, A., ROFFE, J. & WOODWARD, A. (2012) *Gilbert Simondon: Being and Technology*, Edinburgh, Edinburgh University Press.

⁶⁵ DELEUZE, G. (1994) *Difference and repetition*, New York, Columbia University Press, 246.

⁶⁶ Ibid, 305.

⁶⁷ "...Simondon considers that for certain forms of individuation – essentially ones in which metastability is internalized as a charge of preindividuality, a potential in continuous need of resolution – the event of information does not disappear with an initial morphogenesis, constituting instead the continuous becoming of the individual through the resolution of its internal disparation; that is through the actualisation of its latent and heterogenous potentiality." TOSCANO, A. (2006) *The Theatre of Production. Philosophy and Individuation between Kant and Deleuze*, New York, Palgrave Macmillan, 260.

⁶⁸ According to Toscano: "We can distinguish at least four varieties of relationality in Simondon's general ontological schema: (1) the 'non-relation' of disparation, defining the energetic and material tensions between incompatible tendencies within being; (2) the relation between an individual and its environment, which makes of every individuation a double or co-individuation; (3) the internal relation between an individual and its preindividual component, those unresolved differences that it carries along with it and which are periodically resolved by its continual individualization; (4) the processual relation between a structured germ of individuality and the metastable domain which it structures by propagating or transducing itself." Ibid, 140.

⁶⁹ MASSUMI, B. (2007) "Technical Mentality" Revisited: Brian Massumi on Gilbert Simondon. *Parrhesia*, 2009, 36-45, 37.

FOOTNOTES: THE SCALE OF TRUTH

¹ KAMIN, L. J., LEWONTIN, R. C. & ROSE, S. (1984) *Not in Our Genes: Biology Ideology and Human Nature*, Pantheon.

² The Hegelian attitude on the other hand takes for granted that rationality is to be viewed sociologically and historically. From this angle, the phrase 'objective reality' is no more than an automatic and empty complement that any discipline will pay the objects it has just constituted. RORTY, R. (1979) Foucault and Epistemology. IN COUZENS HOY, D. (Ed.) *Foucault: A Critical Reader*. London Blackwell.

³ DELANDA, M. (2002) *Intensive Science Virtual Philosophy*, London, Continuum

⁴ WILLIAMS, J. (2006) Science and Dialectics in the Philosophies of Deleuze, Bachelard and DeLanda. *pragraph*, 29, 98-114.

⁵ DELEUZE, G. (1968 (1994)) *Difference and Repetition*, Paris, Gallimard.

⁶ Ibid.

⁷ Appropriately enough for a philosopher who so mistrusted the question of origins, in the English edition (1994) it arrives in the third chapter of five, or page 129 of 260; almost precisely in the middle.

⁸ PROTEVI, J. (2010) Preparing to learn from Difference and Reptition. *Journal of Philosophy: A Cross-Disciplinary Inquiry*. Nepal.

⁹ DELEUZE, G. (1968 (1994)) *Difference and Repetition*, Paris, Gallimard.

¹⁰ FOUCAULT, M. (1966) *The Order of Things*, London, Routledge. FOUCAULT, M. (1982a) *The Archaeology of Knowledge* London, Routledge.

¹¹ HAN, B. (1998) *Foucault's Critical Project: Between the Transcendental and the Historical* California, Stanford University Press, GUTTING, G. *Michel Foucault's Archaeology of Scientific Reason*, Cambridge, Cambridge University Press, HACKING, I. (1981) The Archaeology of Foucault. IN COUZENS HOY, D. (Ed.) *Foucault: A Critical Reader*. London, Blackwell.

¹² It must be noted that Delanda is aware of the risks that come with this position: "All the theoretical resources, which I will use to define processes of individuation, come from the hard sciences: physics, chemistry, biology. Similarly, all the resources needed to define immanent process-structures come from mathematics: topology, group theory, dynamical systems theory. This immediately raises the following objection: how can one develop a realist ontology which is supposed to serve as a foundation for objective knowledge while from the start one presupposes there is such a thing as "objective knowledge?"

The extract can be read in two ways. Either there is 'no such thing as objective knowledge' or 'you can start with objective knowledge as a pre-supposition'. The first possibility would clearly offend most rational individuals, especially someone committed to a realist, independent ontology. Clearly Delanda has the second line of argument in mind, he goes on to say: "But does one have to believe in rock-solid foundations at all. One may alternatively view the role of the philosopher as allowing the bootstrapping of an ontology."

Delanda takes the strangely dialectical notion of bootstrapping from computer science to describe a step-wise, progressive accumulation of knowledge in response to material events that switches between ontological and epistemological registers. In this he remains wholly within a Bachelardian epistemological model, failing to historicize the idea of objectivity itself. Furthermore, in committing to an idea of an independent reality, he implies that epistemologies exist only in the mind, when in fact minds exist as only one part of the large dispersed material network of instruments, documents, protocols etc. that structure epistemological inquiry. DELANDA, M. (2009) Ecology and Realist Ontology. IN HERZONGENRATH, B. (Ed.) *Deleuze/Guattari & Ecology*. London, Palgrave Macmillan, 27.

¹³ DELANDA, M. (2002) *Intensive Science Virtual Philosophy*, London, Continuum, 134.

¹⁴ BACHELARD, G. (1928) From *Essai sur la connaissance approche*. IN GUTTING, G. (Ed.) *Continental Philosophy of Science*. London, Blackwell. Patrice Maniglier, "What Is a Problematic?," *Radical Philosophy* 173.May/June (2012), Gaston Bachelard, "Corrationalism and the Problematic," *Radical Philosophy* 173.May/June (1975). TILES, M. (2012) What does bachelard mean by rationalisme applique? *Radical Philosophy*, 173, 24-32. CANGUILHEM, G. (1983) The Object of the History of Sciences. IN GUTTING, G. (Ed.) *Continental Philosophy of Science*. London, Blackwell, MANIGLIER, P. (2012) What is a problematic? *Radical Philosophy*, 173, 21-23, BACHELARD, G. (1975) Corrationalism and the Problematic. *Radical Philosophy*, 173, 27-32. DELEUZE, G. (1968 (1994)) *Difference and Repetition*, Paris, Gallimard.

¹⁵ DELANDA, M. (2002) *Intensive Science Virtual Philosophy*, London, Continuum, 129.

¹⁶ GARFINKEL, A. (1981) *Forms of Explanation: Rethinking the Questions in Social Theory*, New Haven, Yale University Press, 58.

¹⁷ Ibid, 60.

¹⁸ Ibid, 64.

¹⁹ See also Gutting on Canguilhem - another point worth noting is that, for Canguilhem, although the abnormal (or pathological) is grammatically and logically sub-sequent to the normal, it is existentially prior. This is because "rule begins to be rule only in making rules and this function of correction arises from infraction itself. GUTTING, G. *Michel Foucault's Archaeology of Scientific Reason*, Cambridge, Cambridge University Press, 147.

²⁰ GARFINKEL, A. (1981) *Forms of Explanation: Rethinking the Questions in Social Theory*, New Haven, Yale University Press, 59. Also see Canguilhem and the concept of the normative as that which has the potential capacity – within a certain bandwidth of tolerability – to resist transformation. "...disease is characterized by the fact that it is a reduction in the margin of tolerance for the environment's inconsistencies" CANGUILHEM, G. (1991) *The Normal and the Pathological* New York, Zone Books, 161.

²¹ This recalls the work of Evariste Galois also cited by Delanda, who developed a theory of groups whereby the form of the problem defines its solvability independently of its actual solutions. According to Galois, solvability emerges through a progressive change to elements within the equation, in order to test which of the variables are ordinary and have no effect on the efficacy of the law compared with those that are singular and transform the efficacy of the law.

²² HARMAN, G. (2011) On the Undermining of Objects: Grant, Bruno, and Radical Philosophy. IN BRYANT, L. R., SRNICEK, N. & HARMAN, G. (Eds.) *The Speculative Turn: Continental Materialism and Realism*. Melbourne, re.press.

²³ "...leaves many things, active and affective by the wayside. On the one hand to the formed or formable matter we must add an entire energetic materiality in movement, *carrying singularities*...that are already like implicit forms that are topological, rather than geometrical, and that combine with processes of deformation: for example the various undulations and torsions of the fibers guiding the operation for

splitting wood. On the other hand, to the essential properties of matter deriving from formal essence we must add *variable intensive effects*, now resulting from the operation, now on the contrary making it possible: for example: wood that is more or less porous, more or less elastic and resistant. At any rate, it is a question of surrendering to the wood, then following where it leads by connecting operations to a materiality instead of imposing a form upon a matter." DELANDA, M. (2002) *Intensive Science Virtual Philosophy*, London, Continuum, 141 .

²⁴ Ibid, 141.

²⁵ Where Platonic Idealism commits to a fixed underlying structure of essential unchanging forms, common across different phenomena, Delanda's idealism commits a dynamic underlying structure similarly common across different phenomena. DELANDA, M. (2000) *A Thousand Years of Non-linear History*, Zone Books, New York.

²⁶ WILLIAMS, J. (2006) Science and Dialectics in the Philosophies of Deleuze, Bachelard and DeLanda. *pragraph*, 29, 98-114, 113.

²⁷ DELEUZE, G. (1968 (1994)) *Difference and Repetition*, Paris, Gallimard, 165.

²⁸ DESCARTES, R. (1677 (1984)) *The Search for Truth by means of the Natural Light*, Cambridge University Press.

²⁹ DELEUZE, G. (1968 (1994)) *Difference and Repetition*, Paris, Gallimard, 165.

³⁰ Ibid, 166.

³¹ Ibid, 169.

³² Ibid, 170.

³³ "Recognition is a sign of the celebration of the monstrous nuptials, in which thought 'rediscovers the Church, the State, all the current values subtly presented in the pure form of an eternally blessed unspecified eternal object.'" Ibid, 170.

Nietzsche is the first to show that this infusion of value into common sense is essentially moral, and how morality secures the equation of a natural capacity for thought with its natural inclination towards the true perception of its object. Though Nietzsche will splice open the action of morality within thought by way of a critique of representation, he will also admit that the problem of representation cannot be done away with, its re-evaluation remains no less a necessity than its continued existence. Nor does Kant 'renounce the implicit presupposition', but rather posits a natural state in which 'thought confuses its interest and allows its various domains to encroach on one another'. NIETZSCHE, F (1909-1913). *Beyond Good and Evil*. Trans. by Helen Zimmern, 257-261.

³⁴ DELEUZE, G. (1968 (1994)) *Difference and Repetition*, Paris, Gallimard, 176.

³⁵ SMITH, D. W. (1996) Deleuze's Theory of Sensation: Overcoming the Kantian Duality. IN PATTON, P. (Ed.) *Deleuze: A Critical Reader*. London, Blackwell, 33.

³⁶ Ibid, 34.

³⁷ Ibid, 33.

³⁸ DELEUZE, G. (1968 (1994)) *Difference and Repetition*, Paris, Gallimard, 186.

³⁹ "Nevertheless, the dogmatic image does not ignore the fact that thought has other misadventures besides error: humiliations more difficult to overcome, negatives much more difficult to unravel. It does not overlook the fact that the terrible trinity of madness, stupidity and malevolence can no more be reduced to error than they can be reduced to any form of the same. Once again however these are no more than facts for the dogmatic image. Stupidity, malevolence and madness are regarded as facts occasioned by external causes, which bring into play external forces capable of subverting the honest character of thought from without..." Ibid, 187.

⁴⁰ "A tyrant institutionalizes stupidity, but he is the first servant of his own system and the first to be installed within it. Slaves are always commanded by another slave. Here too how could the concept of error account for this unity of stupidity and cruelty, of the grotesque and terrifying, which doubles the way of the world." Ibid, 189.

⁴¹ Ibid, 191.

⁴² Speaking in an interview in *Negotiations* he says: "Philosophers introduce new concepts, they explain them, but they don't tell us, not completely anyway, the problems to which those concepts are a response... The history of a philosophy, rather than repeating what a philosopher says, has to say what he has taken for granted, what he didn't say but is nonetheless present in what he did say." DELEUZE, G. (1997b) *Negotiations*, New York, Columbia University Press, 136.

⁴³ DELEUZE, G. (1968 (1994)) *Difference and Repetition*, Paris, Gallimard, 191.

⁴⁴ "Sense is located in the problem itself. Sense is constituted in the complex theme, but the complex theme is that set of questions and problems in relation to which the propositions serve as elements of response and cases of solutions". Ibid, 196.

⁴⁵ Ibid, 196.

⁴⁶ MANIGLIER, P. (2012) What is a problematic? *Radical Philosophy*, 173, 21-23, 21.

⁴⁷ For a comprehensive account of Bachelard's debt and departure from Descartes see: TILES, M. (1984) *Bachelard: Science and Objectivity*, Cambridge, Cambridge University Press.

⁴⁸ See also DASTON, L. & GALISON, P. (2010) *Objectivity*, Brooklyn, Zone Books.

⁴⁹ MANIGLIER, P. (2012) What is a problematic? *Radical Philosophy*, 173, 21-23, 22.

⁵⁰ LATOUR, B. (2005) *Reassembling the Social* Oxford, Oxford University Press.

⁵¹ BACHELARD, G. (1975) Corratationalism and the Problematic. *Radical Philosophy*, 173, 27-32, 30.

⁵² Ibid, 30. Also see: "A proposition by itself is particular, and represents a determinate response. A series of propositions can be distributed in such a way that the responses that they represent constitute a general solution...But precisely the propositions whether general or particular, find their sense only in the sub-adjacent problems which inspire them. Only the Idea or problem is universal. It is not the solution which lends generality to the problem it is the problem which lends universality to the solution." DELEUZE, G. (1968 (1994)) *Difference and Repetition*, Paris, Gallimard, 201.

⁵³ See DEWEY, J. (1927) *The Public and Its Problems*, Ohio, Swallow Press.

⁵⁴ TILES, M. (2005) Technology, Science, and Inexact Knowledge: Bachelard's Non-Cartesian Epistemology. IN GUTTING, G. (Ed.) *Continental Philosophy of Science*. London Blackwell.

⁵⁵ TILES, M. (1984) *Bachelard: Science and Objectivity*, Cambridge, Cambridge University Press, 12.

⁵⁶ Bachelard characterizes this process of replacement by generalization as "dialectical," not in the Hegelian sense of a synthesis of opposites but as a process of conceptual expansion whereby what previously appeared to be contraries (e.g., Euclidean and Lobachevskian geometries) and are seen as complementary possibilities. Earlier concepts are not mysteriously "sublated" into a higher unity but are rectified (corrected) on the basis of superior successor concepts that allow us to explain precisely the extent to which they are applicable. GUTTING, G. *Michel Foucault's Archaeology of Scientific Reason*, Cambridge, Cambridge University Press, 31.

⁵⁷ SMITH, D. W. (1996) Deleuze's Theory of Sensation: Overcoming the Kantian Duality. IN PATTON, P. (Ed.) *Deleuze: A Critical Reader*. London, Blackwell, 35.

⁵⁸ "We see to what degree the Kantian Critique is ultimately respectful: knowledge, morality, reflection and faith are supposed to correspond to natural interests of reason, and are never themselves called into question; only the use of the faculties is declared legitimate or not in relation to one or an other of these interests." DELEUZE, G. (1968 (1994)) *Difference and Repetition*, Paris, Gallimard, 173.

⁵⁹ Ibid, 197.

⁶⁰ In his introduction to *Anti-Oedipus*, Michel Foucault describes the book as an introduction to a 'non-fascist way of life', referring not only to forms of collective political fascism but to the little fascism's everybody carries around inside of them.

⁶¹ HACKING, I. (1981) The Archaeology of Foucault. IN COUZENS HOY, D. (Ed.) *Foucault: A Critical Reader*. London, Blackwell, 34.

See also: "For him the norms found in (purportedly) scientific disciplines are not unquestioned givens for historical reflection but themselves the outcome of contingent historical processes. Unlike Bachelard and

Canguilhem, he undertakes the writing of the history of science (or what claims to be science) without presupposing the norms of the domains he is dealing with. Bachelard had criticized philosophical claims, based on out-dated science, about necessary limitations on knowledge. Foucault opens the way to a historical critique of current scientific norms themselves as something less than absolute conditions for the possibility of knowledge. In this way, Foucault transforms the history of science in accord with his ultimate goal of dissolving constraints on human freedom.” GUTTING, G. *Michel Foucault's Archaeology of Scientific Reason*, Cambridge, Cambridge University Press, 255.

⁶² HAN, B. (1998) *Foucault's Critical Project: Between the Transcendental and the Historical California*, Stanford University Press, 44.

⁶³ Ibid, 44.

⁶⁴ FOUCAULT, M. (2001) *Fearless Speech*, Los Angeles, Semiotext(e), 74.

⁶⁵ “Individuation as such, as it operates beneath all forms, is inseparable from a pure ground that it brings to the surface and trails with it. It is difficult to describe this ground, or the terror and attraction it excites. Turning over the ground is the most dangerous occupation, but also the most tempting in the stupefied moments of an obtuse will. For this ground, along with the individual, rises to the surface yet assumes neither form nor figure. It is there, staring at us, but without eyes. The individual distinguishes itself from it, but it does not distinguish itself, continuing rather to cohabit with that which divorces itself from it. It is the indeterminate, but the indeterminate in so far as it continues to embrace determination...”

DELEUZE, G. (1968 (1994)) *Difference and Repetition*, Paris, Gallimard, 190.

⁶⁶ Ibid, 36. Olkowski's rendering of this translation though less literal than Patton's conveys more beautifully the sense of the text. For the sake of consistency Patton's text is used above and throughout, Olkowski's version is reproduced here:

“Let us imagine something which is distinguished – and yet that from which it is distinguished is not distinguished from it. The flash of lightening for example, is distinguished from the black sky, but must carry the sky along with it. One would say that the bottom rises to the surface without ceasing to be the bottom. There is, on both sides, something cruel – and even monstrous – in this struggle against an elusive adversary, where the distinguished is opposed to something which cannot be distinguished from it, and which continues to embrace that which is divorced from it.” DELEUZE, G. (1994) *Difference and repetition*, New York, Columbia University Press. As quoted in OLKOWSKI, D. (1999) *Gilles Deleuze and the ruin of representation*, Berkeley, University of California Press, 44.

⁶⁷ GARFINKEL, A. (1981) *Forms of Explanation: Rethinking the Questions in Social Theory*, New Haven, Yale University Press, 53.

⁶⁸ Ibid, 60.

FOOTNOTES: DISCIPLINARY PROBLEMS

¹ COX, K. R. (1998) Spaces of dependence, spaces of engagement and the politics of scale, or looking for local politics. *Political Geography*, 17, 1-23.1.

² LEFEVBRE, H. (1974) *The Production of Space*, Oxford, Blackwell.

³ “In the 1970s they began to examine how forces of capitalism were shaping and reshaping space in the post-Fordist era, and in particular the role of the production of scales in facilitating these processes. Prior to this point scale was primarily treated as inert, abstract space, and the central scale questions for human geographers were operational and methodological – that is, identifying the spatial levels at which specified processes operated; and determining the optimal levels of research” MOORE, A. (2008) Rethinking scale as a geographical category: from analysis to practice. *Progress in Human Geography*, 32, 203-225, 203.

⁴ “A comparable approach is called for today, an approach which would analyse not things in space but space itself, with a view to uncovering the social relationships embedded in it. The dominant tendency fragments space and cuts it up into pieces. It enumerates the things, the various objects, which space contains. Specializations divide space among them and act upon its truncated parts, setting up mental barriers and practico-social frontiers. Thus architects are assigned architectural space as their (private) property, economists come into possession of economic space, geographers get their own 'place in the sun', and so on. The *ideologically* dominant: tendency divides space up into parts and parcels in accordance with the social division of labour. It bases its image of the forces occupying space on the idea that space is a passive receptacle.” LEFEVBRE, H. (1974) *The Production of Space*, Oxford, Blackwell, 51.

⁵ SOJA, E. W. (1996) *Thirdspace: Journeys to Los Angeles and Other Real-and-Imagined Places*, London, John Wiley & Sons, HARVEY, D. (2009) *Social Justice and the City*, Georgia, University of Georgia Press, JAMESON, F. (1989) *Postmodernism, or, The cultural logic of late capitalism*, Michigan, University of Michigan Press, CASTELLS, M. (1977) *The urban question: a Marxist approach*, Cambridge MA, MIT Press.

⁶ For an example of the former, see the work of Neil Smith SMITH, N. (1984) *Uneven Development: Nature, Capital, and the Production of Space*, Athens, Georgia, The University of Georgia Press. For an example of the later see the work of Katherine T. Jones JONES, K. T. (1998) Scale as epistemology. *Political Geography*, 17, 25-28.

⁷ SMITH, N. (1984) *Uneven Development: Nature, Capital, and the Production of Space*, Athens, Georgia, The University of Georgia Press.

⁸ As Toscano points out with regards to Simondon, who conceived of individuation as an attempt to escape the strictures of a transcendent diagram of production, whether of matter or of social categories: "This led to an interpretation of Marxism as a worldview embedded in the hylomorphic domination of nature (as matter) by labour (as form-giving work), whose concepts of antagonism (class struggle) and of capacity (human nature) cannot do justice to the complexes of materials and forces, the lines of invention and the transindividual processes behind the ontogenesis of the social." TOSCANO, A. (2007) The Disparate: Ontology and Politics in Simondon. *Society for European Philosophy/Forum for European Philosophy annual conference*. University of Sussex, 2.

⁹ “We tend to take for granted the division of the world into some combination of urban, regional, national, and international scales, but rarely if ever explain how they came about. An understanding of scale gives us a final, crucial window on the uneven development of capital, because it is difficult to comprehend the real meaning of “dispersal”, “decentralization”, “spatial restructuring” and so forth, without a clear understanding of geographical scale.” SMITH, N. (1984) *Uneven Development: Nature, Capital, and the Production of Space*, Athens, Georgia, The University of Georgia Press, 234.

¹⁰ Ibid, 137.

¹¹ However, that these formative processes end up being articulated through the triadic structure of 'urban', 'national', and 'global' owes as much to the work of Immanuel Wallerstein. Smith applies this to the phenomena of development to a concrete analysis of the processes at stake. World-systems analysis: "means the attempt by Immanuel Wallerstein and his colleagues at the Fernand Braudel Center in Binghamton, New York, to produce a historical social science. It views the modern world as consisting of a single entity, the capitalist world-economy, which evolved from about 1500 to encompass the whole world by about 1900. This entity rather than the state is the prime object of analysis." TAYLOR, P. J. (1998) World-systems analysis and regional geography. *The Professional Geographer*, 40, 259-265, 259.

In the addendum to the 1992 reprint of *Uneven Development* Neil Smith, who draws on Wallerstein's structure yet nonetheless critiques it, suggests that the scalar categories adopted fail to adequately account for the way social interaction is able to construct scales, especially the way interactions at a lower level constrain and enable interactions at a higher level in the scalar hierarchy. Smith's position draws on various accounts of grass roots political mobilization and opens up a rich seam for further research into the scalar implications of local activism, such as in Aids activism, anti-gentrification activists environmental groups. See: SMITH, N. (1984) *Uneven Development: Nature, Capital, and the Production of Space*, Athens, Georgia, The University of Georgia Press. See also: MARSTON, S. A., WOODWARD, K. & PAUL JONES III, J. (2005) Human geography without scale. *Transactions Institute of British Geographers*, 30, 416-432.

¹² COX, K. R. (1996) The difference that scale makes. *Political Geography*, 15, 667-669, 668.

¹³ "In the first place we could broaden our extra-disciplinary appeal by greater attention in our research and papers to what brings us together as political geographers regardless of the different scales at which we work. Questions of territory, or the state, the territorial structure of the state, territorial non-correspondence, the globalization-localization debate, the interpenetration of scales (as in the recent special issue on the politics of food), the geography of interests and of identity, questions of context are all prominent here." Ibid, 667.

¹⁴ Collinge states: "To identify the subject matter of human geography it is generally necessary to draw spatial boundaries at some level of abstraction... Indeed, it is by codifying this system, projecting a world that is divided not only into a 'horizontal' structure (in which similar activities are organized at similar scales in different places) but also a 'vertical' structure (in which different activities are organized at different scales covering the same places), that scale analysis acquires its conceptual power." COLLINGE, C. (2006) Flat Ontology and the Deconstruction of Scale: A Response to Marston, Jones and Woodward. *Transactions of the Institute of British Geographers*, 31, 244-251, 244.

¹⁵ Paasi refers to this in terms of forms and structure: "A bad abstraction 'arbitrarily divides the indivisible and/or lumps together the unrelated and the inessential, thereby "carving up" the object of study with no regard for its structure and form' (Sayer, 1992: 138)." PAASI, A. (2004) Place and region: looking through the prism of scale. *Progress in Human Geography*, 28, 536-546, 537.

Also: "Hence one's definition of the appropriate scale of analysis and its associated boundaries should wait until the social process under investigation is clearly specified and theorized. This is a vital point which if accepted clearly militates against starting research with pre-defined spatial units - regions, localities or whatever." DUNCAN, S. & SAVAGE, M. (1989) Space, Scale and Locality. *Antipode*, 21, 179-206, 185.

¹⁶ PAASI, A. (2004) Place and region: looking through the prism of scale. *Progress in Human Geography*, 28, 536-546, 538.

¹⁷ BRENNER, N. (2001) The limits to scale? Methodological reflections on scalar structuration. *Ibid.*25, 591-614, 600.

¹⁸ *Ibid.* 605.

¹⁹ With regards to this last point the social geographer Ash Amin has explored the cultural politics of claims for regional autonomy, seeing in them more often than not a regressive claim for identity trying to fix a cultural history that is almost always more complex than it is made to appear: "I wish to claim, however, that underlying the very different normative registers of regionalism - from febrile localism to secular republicanism and an internationalist regionalism - there is common ground, based on the assumption that territorial autonomy will: a) restore local control and democracy; b) increase economic returns; and c) strengthen sense of attachment. [...] [A]ll three expectations spring from a strongly territorial imaginary of place and place politics, one that is radically at odds with the implications that follow from a relational reading of place." In this 2004 paper, Amin surveys what he describes as the regional "reaction against the demons of state centrism, big nation, or modernist universalism". For Amin, regionalism runs the danger of posing the question of re-distribution at the wrong scale, resulting in a 'conservative' and overly territorial interpretation of politics.

"Often, popular support for regional devolution has been sought by appealing to a local cultural heritage that needs to be recovered or protected from a threatening cultural 'outside'. An insider culture is imagined, and significantly, as a *territorially* defined public sphere or public culture that can sustain a regionalist political project. Many threads are woven in narrating a coherent regional community, from stories of colonization and a common external enemy, to stories of heroism and resistance, as well as the scripting of a regional folk culture. A strong regional culture along these lines is assumed to help cement a strong public sphere composed of common interests, local orientation and active deliberation over a local way of life." Against this idea, Amin – following on from post-colonial theorists argues that place is always enfolded by hybridized identities that are "no longer reducible to regional moorings or to a territorially confined public sphere, but is one made up of influences that fold together the culturally plural and the geographically proximate and distant" AMIN, A. (2004) *Regions unbound : towards a new politics of place. Geografiska annaler*, 86, 33-44, 35.

²⁰ *Ibid.*

²¹ COX, K. R. (2001) Territoriality, politics and the 'urban'. *Political Geography*, 20, 745-762, 747.

²² KOOLHAAS, R. (1978) *Delirious New York: A Retroactive Manifesto for Manhattan*, Oxford, Oxford University Press.

²³ The question is complex and dependent on many variables. Little empirical research has been attempted to verify and quantify the supposed benefits of these intensifications. In fact most of what passes for reasoned argument on the creative value of urbanisation is by and large anecdotal, based more on faith than on fact.

²⁴ "The result is that what is commonly defined as 'urban politics' is typically quite heterogeneous and by no means referable to struggles within, or among, the agents structured by some set of social relations corresponding unambiguously to the urban. It may, for example, be as much neighborhood politics, having to do with the commitment of people to the future of particular neighborhoods, as it is a matter for the city as a whole. By the same token the urban can be an object for national interest groups, for the central branches of the state itself as they try to mold the national settlement pattern in accord with national priorities having to do, perhaps with macro- economic policy, containing the inflationary pressures arising

from geographically uneven development." COX, K. R. (2001) Territoriality, politics and the 'urban'. *Political Geography*, 20, 745-762, 756.

²⁵ "On the other hand the term 'local' can be, and often is, used in a relative sense. Depending on context a local event can vary from the neighborhood, to the city, to the metropolitan area and even beyond as in the term 'local wars'." COX, K. R. (1997) Representation and power in the politics of scale. *Political Geography*, 17, 41-44, 42.

²⁶ Other writers such as Swyngedouw have emphasized the interweaving of global and local scales, such that the local is always an inflection of the global and visa-versa. As such, scale is always in the process of formation. One related question is the way in which the local is seen to embody concreteness precisely because it tends to embody experiences related to everyday life – in relation to the global, which is seen as more abstract. Echoing the critique of Wallerstein and by turns, Smith in which the global scale is seen to be removed beyond experience and so necessarily abstract, in contradistinction to the local, which is seen as the realm of contingency, chance, and in some way, freedom. This is evident with the continual reference to the local as a site for identity-based resistance grounded in difference against global political forces that threaten to homogenize:

"I conceive scalar configurations as the outcome of sociospatial processes that regulate and organize power relations . . . Scale configurations change as power shifts, both in terms of their nesting and interrelations and in terms of their spatial extent. In the process, new significant social and ecological scales become constructed, others disappear or become transformed." SWYNGEDOUW, E. (2001) *Nature, Place, and the Politics of Scale*. Oxford, School of Geography and the Environment Oxford University, 69.

²⁷ JONES, K. T. (1998) Scale as epistemology. *Political Geography*, 17, 25-28, 27.

²⁸ Ibid, 27.

²⁹ Ibid, 27.

³⁰ Swyngedouw and Heynen provide a poignant example of this: "In the summer of 1998, the Southeast Asian financial bubble imploded. Global capital moved spasmodically from place to place, leaving cities like Jakarta with a social and physical wasteland where dozens of unfinished skyscrapers are dotted over the landscape while thousands of unemployed children, women and men roam the streets in search of survival. In the meantime, El Niño's global dynamics were wreaking havoc in the region with its climatic disturbances. Puddles of stagnant water in the defunct concrete buildings that had once promised continuing capital accumulation for Indonesia became breeding grounds and great ecological niches for mosquitoes. Malaria and dengue fever suddenly joined with unemployment and social and political mayhem in shaping Jakarta's cityscape. Global capital fused with global climate, with local power struggles and with socioecological conditions to reshape Jakarta's urban socioecological conditions in profound, radical and deeply troubling ways." SWYNGEDOUW, E. & HEYNEN, N. C. (2003) *Urban Political Ecology, Justice and the Politics of Scale*. *Antipode*, 35, 1.

³¹ MARSTON, S. A., WOODWARD, K. & PAUL JONES III, J. (2005) Human geography without scale. *Transactions Institute of British Geographers*, 30, 416-432.

³² The increasing categorical porosity – of what is meant by a 'city-scale' for example, places demands on the theoretical frameworks used to describe complex paradoxical evidence of increased urbanization and diffusion of metropolitan settlement.

³³ Within geography, this hierarchical model is subject to critique on the grounds that many social processes exist as horizontal rather than as vertical relationships. See Helga Leitner and Byron Miller who suggest that: "...transnational networks represent new modes of coordination and governance, a new politics of horizontal relations that also has a distinct spatiality. Whereas the spatiality of a politics of scale is associated with vertical relations among nested territorially defined political entities, by contrast, networks span space rather than covering it, transgressing the boundaries that separate and define these political entities." cited in MARSTON, S. A., WOODWARD, K. & PAUL JONES III, J. (2005) Human geography without scale. *Transactions Institute of British Geographers*, 30, 416-432.

³⁴ Ibid, 418.

³⁵ ibid, 422.

³⁶ MARSTON, S. A., WOODWARD, K. & PAUL JONES III, J. (2005) Human geography without scale. *Transactions Institute of British Geographers*, 30, 416-432, 423.

³⁷ Ibid, 426.

³⁸ LEFEVBRE, H. (2009) *State, Space, World*, Minnesota University of Minnesota Press, 220.

³⁹ Ibid. 218

FOOTNOTES: PART II INTRODUCTION

¹ TAFURI, M. (1976 (1980)) *Teorie e storie dell'architettura (Theories and Histories of Architecture)*, New York, Laterza & Figli Spa (*Harper & Row Publishers*), 80.

² LAUGIER, M.-A. (1753 (1977)) *Essai sur l'architecture (Essay on Architecture)*, Los Angeles Hennessey & Ingalls Inc.

³ "The model of the hut, on the other hand, as described by the materialist Laugier, was held up as the true and scientific origin of shelter while at the same time it conformed to a description of the birth of architecture derived from a Vitruvian-humanist tradition. To turn this explanation of origins into a principle of form seemed logical to those who desired to purify the excesses of rococo, and essentially rational in terms of the elements of structure" VIDLER, A. (1998) *The Idea of Type: The transformation of the Academic Ideal, 1750-1830*. IN HAYS, K. M. (Ed.) *Oppositions Reader*. New York, Princeton Architectural Press, 441.

⁴ For a comprehensive description of the precedents to Laugier's text including the controversy and claims of plagiarism it inspired see: HERMANN, W. (1962) *Laugier and Eighteenth Century French Theory*, London, A. Zwemmer Ltd. For Emil Kaufmann, Jacques-Francois Blondel was a transitional figure working within the language of the Baroque but already demonstrating 'the germs of the tendency towards simplicity and 'purity''. See KAUFMANN, E. (1952) Three Revolutionary Architects: Boullée, Ledoux, and Lequeu. *Transactions of the American Philopical Society* 42, 431-562. SAVOT, L. (1624) *L'architecture françoise des bastimens particuliers*, Paris, A Paris : Chez Antoine Robinot. PERRAULT, C. (1683 (1996)) *Ordonnance des Cinq Espe'ces de Colonnes (Ordonnance for the Five Kinds of Columns after the Method of the Ancients)*, Paris, The Getty Center For The History Of Art Also: PEREZ-GOMEZ, A. (1983) *Architecture and the Crisis of Modern Science* Cambridge MIT Press CORDEMOY, J.-L. (1714) *Nouveau Traité de toute l'architecture*, Paris, Chez Jean-Baptiste Coignard. VOLTAIRE (1756) *Essai sur les mœurs et*

l'esprit des nations, Paris, Moland. D'ALEMBERT, J. L. R. (1751) *Le discours préliminaire de l'encyclopédie*, Paris, Vrin. DIDEROT, D. & D'ALEMBERT, J. L. R. (1750) *L'Encyclopedie Diderot & D'Alembert*, Paris, Bibliotheque de l'Image.

⁵ DURAND, J.-N.-L. (1802 & 1821) *Precis of the Lectures on Architecture: With Graphic Portion of the Lectures on Architecture*, Los Angeles, Getty Research Institute. QUATREMÈRE DE QUINCY, M. & YOUNES. (1999) *The true, the fictive, and the real : the historical dictionary of architecture of Quatremree de Quincy*, London, Andreas Papadakis.

⁶ As Oechslin notes this tendency was eventually “placed in the foreground of in the Third International Conference for New Construction in 1930”⁶ which took efficiency as its organising theme. See Oechslin: OECHSLIN, W. (1986) Premises for the Resumption of the Discussion of Typology. *Assemblage*, 1, 37-53.

⁷ The influence of Kant’s *Critique of Practical Reason* and its themes of autonomy in the subject would prove important here. See: KANT, I. (1788) *Kant: Critique of Practical Reason* Cambridge, Cambridge University Press.

⁸ KAUFMANN, E. (1955) *Architecture in the Age of Reason: Baroque and Post-Baroque in England, Italy and France*, Massachusetts, Archon Books. VIDLER, A. (2008) *Histories of the Immediate Present: Inventing Architectural Modernism* Cambridge, MIT Press.

⁹ PEREZ-GOMEZ, A. (1983) *Architecture and the Crisis of Modern Science* Cambridge MIT Press.

¹⁰ DASTON, L. & GALISON, P. (2010) *Objectivity*, Brooklyn, Zone Books.

¹¹ ARGAN, G. C. On the Typology of Architecture, in NESBITT, K. (Ed.). and ROSSI, A. (1966 (1986)) *Architecture of the City* New York, MIT Press. See also: JACOBY, S. & LEE, C. (2010) *Typological Urbanism*, London Wiley.

¹² See also Giulio Argan on the difference between objectivity and the projective ideological action of architectural ‘rationalism’: “It is not enough to claim that “rationalist” architects are interested not in nature, but in society; this undoubtedly correct position must be followed by an examination of the attitude assumed toward society, beginning with the statement that such an attitude cannot in any case be considered analogous to that adopted by the “classicists” toward nature.... In an age in which the triumphs of scientific and technological research offered apparently unlimited opportunities for man’s control of nature, many men (and not only architects) evidently believed that society could be transformed by processes analogous to those by which matter and natural forms were being transformed. The mistake would have been unpardonable if “rationalism” had aimed, like classicism, at agnostic end, the merely objective knowledge of certain constant laws of reality – the laws of society, in this case – rather than those of nature. Aiming as they did, at acting on a given social situation and at profoundly changing it, we can no longer speak of objective error, nor even of abstractness and utopianism. It would be much nearer the truth to speak of “ideology”; and this is also shown in the fact that very soon theoreticians sought to replace the clearly improper term “rational” with the more technically exact term “democratic” (it was Wright himself who suggested it), assumptions, which clearly allude to political thought and content” ARGAN, G. C. (1993 (1957)) *Architecture and Ideology*, in OCKMAN, J. (Ed.) *Architecture Culture 1943-1968*. New York Rizzoli, 254.

FOOTNOTES: SPATIALISING CO-EXISTENCE

¹ The reasons for this selection are two-fold. Firstly, if the critique of unity is taken to be a generalised feature of architecture and urbanism, it should stand that it applies to all projects, including those that declare their own unity in supposedly certain terms. Second, the context of Lebanon provides a particularly unstable background; lending the present critique a forceful example of the vulnerability of architecture within its context.

² AGAMBEN, G. (2010) *What is a Paradigm?* . Leuk-Stadt, European Graduate School.

³ According to this view, modern architecture and the project of modernization that it symbolized, was guilty of perpetuating numerous crimes. To name but two of the most common accusations: as a continuation of a colonial project, modern architecture - in both its high-modern and regionally inflected phases - serves to reinforce the subaltern status of the population, annihilating local difference in the name of a homogenized, euro-global identity. Secondly, as an instrumental intervention within the urban territory, it appears under the guise of progressive social reform but only manages to further perpetuate the uneven development of the city. This line of critique doubles – but this time in the register of identity politics and economics – with the architectural critique of modernism and its incompatibility with a historical model of the city (beginning in the 1960s). The unity of the post-colonial critique all too often reproduces a unity in the object of critique, such that the failure of the modern project applies *comprehensively*. This appears to occur even if the demands of serious scholarship insist on qualifications and prevent the failure from being framed as such. Not that this should be taken as an attack on the critical tools of architectural theory or criticism alone, since the idea of ‘unity’ is the self-declared principle *par excellence* of modern architecture and justifiably invites precisely this kind of criticism. See also: AVERMAETE, T., KARAKAYALI, S. & VON OSTEN, M. (2010) *Colonial Modern: Aesthetics of the Past Rebellions for the Future*, London, Black Dog and Haus der Kulturen der Welt, Berlin.

⁴ Originally named the *Tripoli International Fair and Exposition* project, it was later changed in honor of the Lebanese Prime Minister, Rachid Karame, who originated from Tripoli and in many ways was the patron of the project.

⁵ For a critical discussion on the ‘laboratory’ as a colonial model for spatial experimentation in the developing world see: AVERMAETE, T., KARAKAYALI, S. & VON OSTEN, M. (2010) *Colonial Modern: Aesthetics of the Past Rebellions for the Future*, London, Black Dog and Haus der Kulturen der Welt, Berlin.

⁶ BOTEY, J. M. (1996) *Oscar Niemeyer*, Barcelona, Gustavo Gill.

⁷ “Modulo was released quarterly and published continuously until 1965, when it was closed down by members of the military dictatorship for its presumed opposition to the government. It returned to circulation in 1975, when censorship laws began to relax, and ceased publication in 1989”. NIEMEYER, O. (1962a) Feira Internacional e Permanente do Líbano em Trípoli. *Módulo 7*, 4-5, LE BLANC, A. (2012) Palmeiras and Pilotis. *Third Text*, 26, 103-116. NIEMEYER, O. (1971) *Niemeyer, Oscar*, New York.

⁸ NIEMEYER, O. (1962a) Feira Internacional e Permanente do Líbano em Trípoli. *Módulo 7*, 4-5.

⁹ The situation in Tripoli continues to lack stability, this recent report points to further tensions in the city: DEHGHPISHEH, B. (2012) Lebanon's divisions are mirrored in responses to Damascus bomb attack. *Washington Post*.

¹⁰ UNDERWOOD, D. K. (1994) *Oscar Niemeyer and Brazilian free-form modernism*, New York, George Brazillier.

¹¹ In order to address this deficit of information, the spatial-analytic dimension of the following research is drawn from a detailed 3D digital reconstruction of the site and the surrounding city completed over the course of four years by the author and assistants. This material was based on site visits, photographs, archival drawings and satellite imagery.

¹² BALCOMBE, G. (1963) Brasilia; Architects: Oscar Niemeyer and Lucio Costa. *Architect and Building News*, 224/15, 40-45. Also: EVENSON, N. (1974) The architecture of Brasilia. *Canadian Architect*, 18, 50-56. Also: GORELIK, A. (2007) Brasilia 1956-2006. *Casabella*, 71, 4-29. Also: HUGS, A. (1995) Brasilia revisited. *Sites*, 26, 112-114. Also: MCQUADE, W. (1959) Brasilia's beginning; Architects: Oscar Niemeyer. *Architectural Forum* 110, February. Also: WILLIAMS, R., J. (2008) Oscar Niemeyer: Brasilia. *Blueprint*, 263, 34-38. Also: WRIGHT, C., L. & TURKIENICZ, B. (1988) Brasilia and the ageing of modernism; Architect: Oscar Niemeyer. *Cities*, 5, 347-364.

¹³ For a comprehensive account of this period, see GILMOUR, D. (1983) *Lebanon The Fractured Country*, Oxford, Oxford.

¹⁴ Non-Aligned Movement formerly established in 1961 by Tito, Nehru, Nasser and Sukarno in opposition to American and Soviet power blocs.

¹⁵ Via the National Pact, Lebanon gains independence from France, Maronites give up on the west and Europe; Sunnis give up on greater Syria, thus it establishes a sectarian structure in government based on the last census in 1932 and a formalization of the power sharing during the French Mandate.

¹⁶ GILMOUR, D. (1983) *Lebanon The Fractured Country*, Oxford, Oxford.

¹⁷ For a detailed account of the pre-war political economy see: MAKDISI, S. A. (2004) *The Lessons of Lebanon the Economics of War and Development*, London, I.B. Tauris, 12-30.

¹⁸ FAWAZ, L., NASRALLAH, F. & SHEHADI, N. (1991) *State and society in Lebanon*, Oxford, Oxford: Centre for Lebanese Studies.

¹⁹ Resolutions in Khartoum, Arab states declare a united position on Israel: 'no peace, no recognition, no negotiations' in aftermath of defeat in 1967 war. UN Resolution 242 demanding Israeli withdrawal from occupied Palestinian territory. Arafat assumes control of PLO. SALIBI, K. S. (1965) *The Modern History of Lebanon*, New York, Frederick A. Praeger.

²⁰ EL-KHAZEN, F. (2000) *The Breakdown of the State in Lebanon 1967-1976*, I.B. Tauris, 12.

²¹ TARĀBULSĪ, F. (2007) *A History of Modern Lebanon*, London, Pluto.

²² FAWAZ, L., NASRALLAH, F. & SHEHADI, N. (1991) *State and society in Lebanon*, Oxford, Oxford: Centre for Lebanese Studies. And also: ŞULH, R. (2004) *Lebanon and Arabism national identity and state formation*, London, I.B Tauris.

²³ HANF, T. (1993) *Coexistence in wartime Lebanon : decline of a state and rise of a nation* London, I.B Tauris.

²⁴ NIEMEYER, O. (1958) A Cidade Contemporanea. *Modulo*, 11, 5.

²⁵ UNDERWOOD, D. K. (1994) *Oscar Niemeyer and Brazilian free-form modernism*, New York, George Brazillier, 14.

²⁶ TAFURI, M. Per una critica dell'ideologia architettonica (Toward a Critique of Architectural Ideology). *Contrapiano (reprinted in Architectural Theory since 1968)*, 1.

²⁷ UNDERWOOD, D. K. (1994) *Oscar Niemeyer and Brazilian free-form modernism*, New York, George Brazillier, 32.

²⁸ The exemplary account of this period and its regional effect is provided in KASSIR, S. (2006) *Being Arab*, London, Verso.

²⁹ FISK, R. (1990) *Pity the Nation: Lebanon at War*, London, Andre Deutsch.

³⁰ Though still operating wholly within the channels of familial links and clientism, see MAKDISI, S. A. (2004) *The Lessons of Lebanon the Economics of War and Development*, London, I.B. Tauris.

³¹ GASPARD, T. K. (2004) *A political economy of Lebanon, 1948-2002 the limits of laissez-faire*, Boston, Leideb, 2.

³² In the background of the problem of how to construct a new and unified national imaginary is a geopolitical ideal, this ideal forms the context against which the later failure of the project must be understood. Looking back through the lens of subsequent regional shifts like the decline of pan-Arabism and the move away from secular to sectarian politics, this project's progressive geopolitical impulse cannot but be colored by a perception of naivety, optimism - or worse - nostalgia. When it is considered that the next major architectural project of this scale in Lebanon would be the colossal mosque built in Beirut's Central District (a mosque that would be named after the developer and former Prime Minister Rafiq Hariri) the distance between the two periods seems far greater than the 30 years between them would suggest.

This is not to say that it is possible to set up a binary reading with utopian modernism on one side and regressive sectarian backlash on the other, nor can modernity be understood as a distinctly European phenomenon. As Samir Kassir points out, Arab modernity is exemplified by the Nahda in the 19th and 20th century, an organic regional phenomenon, so too with the political re-orientation towards confessionalism which was in many ways also a modern phenomenon, bound up in the problem of capitalism and its concomitant process of urbanisation, especially in the movement of peoples from rural areas into expanding cities. KASSIR, S. (2006) *Being Arab*, London, Verso.

³³ “For some, therefore, Rowe’s ahistorical analysis suggested that there was a deep structure, or deep principals that all architecture adhered to as a semiotic system. For others, this syntax of lines, grids and points and grammatical rules of combination now were abstract and relative, and thus became mobile and productive of other architectures. This use of diagrams suggested a the generation of an architecture isomorphic to its analytical tools, suggesting new processes of design and pedagogy that allowed the architect to consciously access and manipulate in new architecture the same level of abstract order such diagrams were said to reveal in historical architecture The diagram could become a the locus of architectural order, even more real, or at least pure, than a built artefact and its inevitable contingencies and compromises. Methods of analysis used by the text of the critic, historian and theorist had become generative of new objects produced by the designer.” HIGHT, C. (2007) *Architectural Principals in the age of Cybernetics*, New York, Routledge, 84.

³⁴ GULICK, J. (1967) *Tripoli, a modern Arab city*, Cambridge, Harvard University Press, SALEM-LIEBICH, H. (1983) *The architecture of the Mamluk city of Tripoli*, Cambridge, Mass, Aga Kahn Program for Islamic Architecture at Harvard University and the Massachusetts Institute of Technology.

³⁵ This later development was characterized by a number of apartment buildings designed by a generation of architects working in France who had returned to Lebanon, bringing back a highly principled approach to modern housing. The final phase of development in the city occurs in the post-civil war period, the architecture of this period is of a similar density and yet in the war interim, the entire aesthetic and spatial vocabulary had changed, now drawing on the tropes of post-modern architecture in an ahistorical pastiche.

³⁶ CERDA, I. (1861) *General Theory of Urbanization*, Barcelona, Sociedad Editorial Electa Espana.

³⁷ See the introduction to: AURELLI, P. V. (2011) *The Possibility of an Absolute Architecture*, Cambridge, MIT Press.

³⁸ Points 79 and 80 of the Athens Charter state:

“(79). The speeds of mechanized transportation have disrupted the urban setting, presenting an ever-present danger, obstructing or paralyzing communications and endangering health.

(80). The principle of urban and suburban circulation must be revised. A classification of acceptable speeds must be established. A reformed type of zoning must be set up that can bring the key functions of the city into a harmonious relationship and develop connections between them. These connections can then be developed into a rational network of major highways.”

ARCHITECTURE, I. I. C. O. M. (1933) *La Charte d'Athenes (The Athens Charter)*. *Congress Internationaux d'Architecture moderne (CIAM)*. Athens, Greece, The Library of the Graduate School of Design, Harvard University.

³⁹ JACOBS, J. (1961) *Death and Life of Great American Cities*”, New York, Vintage.

⁴⁰ There is no ultimate synthesis at the end of this dialectical shift; the success of Jacobs’s argument has arguably led to a paralysis of planning in many developed cities, where large-scale questions regarding the redistribution of resources and the construction of infrastructure are hamstrung by local disputes.

⁴¹ MARX, K. (1858) *Grundrisse: Foundations of the Critique of Political Economy*, London, Penguin. See also the introduction *Modernism and the Post-humanist Subject* by K. Michael Hays: "Modernism, whatever else we may mean with that term, has something to do with the emergence of new kinds of objects and events and, at the same time, new conceptualizations of their appearance, of the changed event structures and relationships between objects, their producers their audiences, and consumers. A history of modernism then, must involve the concept of the producing, using, perceiving subject as well as the object. The subject is a signifying complex, constituted in the ideological space and categories of possible experience, formed through the very object of the world it would organize and explain." HAYS, K. M. (1992) *Modernism and the Post-humanist Subject: The Architecture of Hannes Meyer and Ludwig Hilberseimer*, Cambridge MA, The MIT Press, 4.

⁴² The closest translation would be the French 'esprit de cour', the term *asabiyah* is first used in a systematic way by the scholar Ibn Khaldun writing in the 14th Century to describe the different forms of social organization in sedentary and nomadic peoples in the Arabian peninsula, a reading that would later prove influential to Gilles Deleuze and Felix Guattari in their conception of 'smooth and striated space'. See: KHALDUN, I. (1377 (1989)) (*The Muqaddimah: An Introduction to History*) نودلخ نوابا مقذمة, New York, Princeton University Press.

⁴³ For an account of this period see: BURKE III, E. (1988) Rural Collective Action, in SHEHADI, N. & HAFFAR MILLS, D. (Eds.) *Lebanon: A History of Consensus and Conflict*. London, I.B. Tauris.

⁴⁴ JOHNSON, M. (2001) *All Honourable Men: The Social Origins of War in Lebanon*, London, London: Centre for Lebanese Studies in association with I. B. Tauris.

⁴⁵ Nonetheless, it would be also incorrect to project today's sectarian matrix backward, the ferocity of which was yet to be articulated in the character of the later stages of the civil war.

⁴⁶ KHALAF, S. & DENOEU, G. (1988) Urban networks and political conflict in Lebanon. IN SHEHADI, N. & HAFFAR MILLS, D. (Eds.) *Lebanon: A History of Conflict and Consensus*. London, I.B. Tauris & Co Ltd, 148.

⁴⁷ See also: HOTTINGER, A. (1966) Zu'uma in Historical Perspective. IN BINDER, L. (Ed.) *Politics in Lebanon*. London, John Wiley & Sons.

⁴⁸ NIEMEYER, O. (1962a) Feira Internacional e Permanente do Líbano em Trípoli. *Módulo 7*, 4-5.

⁴⁹ "The arcades and the department stores of Paris, like the great expositions, were certainly the places in which the crowd, itself become a spectacle, found the spatial and visual means for a self-education from the point of view of capital. But throughout the nineteenth century this recreational-pedagogical experience, precisely in being concentrated in exceptional architectural types, still dangerously revealed its restricted scope. The ideology of the public is not in fact, an end in itself. It is only a moment of the ideology of the city as a productive unity in the proper sense of the term and simultaneously, as an instrument of coordination of the production-distribution-consumption cycle." TAFURI, M. (1979) *Architecture and Utopia: Design and Capitalist Development*, Cambridge MA, The MIT Press, 83.

⁵⁰ "Exhibitions thus located their preferred audiences at the very pinnacle of the exhibitionary order of things they constructed. They also installed them at the threshold of greater things to come. Here, too, the Great Exhibition led the way in sponsoring a display of architectural projects for the amelioration of working-class housing conditions. This principle was to be developed, in subsequent exhibitions, into displays of elaborate projects for the improvement of social conditions in the areas of health, sanitation, education, and welfare - promissory notes that the engines of progress would be harnessed for the general good. Indeed, exhibitions came to function as promissory notes in their totalities, embodying, if just for a season, Utopian principals of social organization which, when the time came for the notes to be redeemed, would eventually be realized in perpetuity." BENNET, T. (1988) *The Exhibitionary Complex*. *New Formations*, 4, 73-102, 95.

⁵¹ "In their radical vocation and in their conception of architecture as a form of critique, the architects of the modern movement ultimately had origins in the revolutionary thought of the enlightenment. But it was their inability to carry out this vocation – less through error than being forced to make an impossible choice between humanism and technocracy – that now produced this sense of crisis. This negative experience explained, in Argan's view, why post war architecture had become so evasive with respect to politics."

OCKMAN, J. in introduction to ARGAN, G. C. (1993 (1957)) *Architecture and Ideology*. IN OCKMAN, J. (Ed.) *Architecture Culture 1943-1968*. New York Rizzoli.

⁵² EVANS, R. (1995) *The Projective Cast: Architecture and its Three Geometries*, Cambridge, The MIT Press, 36.

⁵³ Author in conversation with Professor George Arbid American University of Beirut, September 2008.

⁵⁴ Some ten years after the commission of the project in Tripoli, Karlheinz Stockhausen would premiere experimental works in a spherical concert hall for the Osaka expo of 1970.

⁵⁵ See: WITTKOWER, R. (1971) *Architectural Principals in the Age of Humanism* London, Norton & Company. WOLFFLIN, H. (1899) *An Introduction to the Italian Renaissance*, New York, Phaidon. EVANS, R. (1995) *The Projective Cast: Architecture and its Three Geometries*, Cambridge, The MIT Press.

⁵⁶ KOETTER, F. & ROWE, C. (1984) *Collage City* Cambridge MA, The MIT Press, 90.

⁵⁷ *Ibid*, 277.

⁵⁸ "For, if planning can barely be more scientific than the political society of which it forms and agency, in the case of neither politics or planning can there be sufficient information acquired before action becomes necessary. In neither case can performance await an ideal future formulation of the problem as it may, at last, be resolved; and if this is because the very possibility of that future where such formulation might be made depends on imperfect action now, then this is only once more to intimate the role of *bricolage* which politics so much resembles and city planning surely should." *Ibid*, 283.

⁵⁹ What is typological thought except an attempt to reason spatially with regards to the solicitation of a problem? Type is a good example of a sign enmeshed with its social and historical background. Whether in the arguments of Quatremere in which type takes the form of an intellection, or Durand in which as

economic and repeatable typological model emerges, or later in the work of G.C Argan in which type is understood as a retroactive method of analysis, what binds them all together is a diagrammatic projective and retroactive tension in which socio-political information is seen to have accumulated like sediment in the material of architecture.

⁶⁰ "Difference is not diversity. Diversity is given, but difference is that by which the given is given, that by which the given is given as diverse." DELEUZE, G. (1968 (1994)) *Difference and Repetition*, Paris, Gallimard, 280.

⁶¹ KOETTER, F. & ROWE, C. (1984) *Collage City* Cambridge MA, The MIT Press, 149.

⁶² ZIZEK, S. (2001) *On Belief*, London Routledge.

⁶³ For an analysis of taste as class marker see: BOURDIEU, P. (1984) *Distinction: A Social Critique of the Judgement of Taste*, Massachussets, Harvard University Press.

FOOTNOTES: THE CYBERNETIC ETHOS

¹ UP or Unidad Popular was a coalition of leftist parties in Chile coming into existence in 1969.

² MEDINA, E. (2011) *Cybernetic Revolutionaries: technology and Politics in Allende's Chile*, Cambridge MA, The MIT Press, PICKERING, A. (2010) *The Cybernetic Brain: Sketches of Another Future*, Chicago, The University of Chicago Press, BEER, S. (1973) *Proyecto Synco: Practica Cibernetica en el Gobierno*. Santiago, BEER, S. (1995c) *Diagnosing the System for Organizations*, London, Wiley, BEER, S. (1995a) *Brain of the Firm*, London, Wiley, BEER, S. (1995d) *The Heart of Enterprise*, London, Wiley, BEER, S. (1995b) *Designing Freedom*, London, Wiley.

³ GOSPLAN (Russian: Gosudarstvenniy Komitet po Planirovaniyu) or the State Planning Committee of the USSR was responsible for producing the five year economic plan for the Soviet Union, established in 1921 this centralized planning model was - despite the sophistication of the scientific models used - beset by problems of misreporting.

⁴ In 1880, 300 years of indigenous resistance was concluded with the slaughter of up to 10,000 Mapuche and the incorporation of Araucanía into Chile.

⁵ PETRAS, J. & MORLEY, M. (1978) On the U.S. and the Overthrow of Allende: A Reply to Professor Sigmund's Criticism. *Latin American Research Review*, 13, 205-221.

⁶ MEDINA, E. (2006) *Designing Freedom, Regulating a Nation: Socialist Cybernetics in Allende's Chile*. *Journal of Latin American Studies*, 38, 571-606.

⁷ Especially Fernando Flores. What brought Flores and Beer together was not a shared political outlook per se but rather conceptual commonalities in scientific and conceptual thought that Flores recognized and Beer appreciated. These conceptual similarities drew Beer and Flores together despite their different cultural and political convictions. This connection was fostered by Beer's enthusiasm to apply cybernetic thinking, operations and research techniques to the domain of politics.

⁸ GALISON, P. (1994) *The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision*. *Critical Inquiry*, 21, 228-266, 233.

⁹ MEDINA, E. (2011) *Cybernetic Revolutionaries: technology and Politics in Allende's Chile*, Cambridge MA, The MIT Press, 23.

¹⁰ DELANDA, M. (2002) *Intensive Science Virtual Philosophy*, London, Continuum.

¹¹ In particular, see the final chapter: '*Virtuality and the Laws of Physics*'. Ibid.

¹² "Where Darwin had assiduously tracked the similarities between human and animal in order to blur the boundary between them, Wiener's efforts were devoted to effacing the distinction between human and machine. Darwin's dog suffered remorse; Wiener's AA predictor had foresight" GALISON, P. (1994) *The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision*. *Critical Inquiry*, 21, 228-266, 245.

¹³ See also: DELANDA, M. (1991) *War in The Age of Intelligent Machines*, New York, Zone.

¹⁴ "His early efforts at computation and antiaircraft fire coalesced in a remarkably ambitious calculating device that he called the "antiaircraft (AA) predictor," designed to characterize an enemy pilot's zigzagging flight, anticipate his future position, and launch an antiaircraft shell to down his plane. But Wiener's electronic manipulation did not stop with halting Nazi air attacks. In the course of characterizing the enemy pilot's actions and designing a machine to forecast his future moves, Wiener's ambitions rose beyond the pilot, even beyond the World War. Step by step, Wiener came to see the predictor as a prototype not only of the mind of an inaccessible Axis opponent but of the Allied antiaircraft gunner as well, and then even more widely to include the vast array of human proprioceptive and electro-physiological feedback systems" GALISON, P. (1994) *The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision*. *Critical Inquiry*, 21, 228-266, 233.

¹⁵ MEDINA, E. (2011) *Cybernetic Revolutionaries: technology and Politics in Allende's Chile*, Cambridge MA, The MIT Press.

¹⁶ BEER, S. (1995c) *Diagnosing the System for Organizations*, London, Wiley, BEER, S. (1995a) *Brain of the Firm*, London, Wiley.

¹⁷ In fact, Beer spent a significant portion of his career trying to enlist organic systems as computing analogues in order to harness the creative agency embedded in matter capable of self-organization. Within the frame of modern science and engineering, design entails figuring out what needs to be done to achieve some result and then arranging "inert lumps of matter" to achieve those specifications. Digital computers depend on this sort of design, specifying material configurations right down to the molecular level of chemical elements on silicon chips. Beer's idea instead was, as we have seen, to find lively (not inert) chunks of matter and to try to enroll their agency directly into his projects." PICKERING, A. (2010) *The Cybernetic Brain: Sketches of Another Future*, Chicago, The University of Chicago Press, 236.

¹⁸ Ibid.

¹⁹ This forms a departure from the concept of the model, introduced later, in relation to a case study on climate where the model attempts to build a mathematical version of the causal mechanism in nature.

²⁰ Ibid.

²¹ Indeed Beer had evolved the idea of the VSM as a diagram of business organisation able to adapt to complex situations: "The aim of the firm had, as usual, to be to survive in an environment that was not just fluctuating but also changing—as new technologies appeared in the field of production and consumption for example. How was this to be accomplished? What would a viable firm look like? The place to look for inspiration, according to Beer, was again nature, but now nature as the source of inspiration in the design of viable organizations, rather than nature as the immediate source of adaptive materials. Beer's idea was to read biological organisms as exemplary of the structure of viable systems in general, and to transplant the key features of their organization to the structure of the firm" PICKERING, A. (2010) *The Cybernetic Brain: Sketches of Another Future*, Chicago, The University of Chicago Press, 244.

²² "Cybersyn was, on one occasion, operated in both a surveillance and a command-and-control mode. This was the time of the gremio strike in October 1972, a "CIA-instigated trucker's strike" in Chile which threatened to halt flows of goods around the country.³⁶ The Cybernet information system was then switched temporarily to monitoring shortages around the country and figuring out how to use the transportation available to overcome them. Beer was very pleased that this approach worked and that the strike was defeated (Beer 1981, 312–15), but there was no homeostatic give-and-take involved in this episode in negotiating plans between different levels, and it serves to show just how readily the organic quality of the VSM could be conjured away, and, indeed, this possibility seems to have appealed to Allende's enemies." *ibid*, 267.

²³ MEDINA, E. (2011) *Cybernetic Revolutionaries: technology and Politics in Allende's Chile*, Cambridge MA, The MIT Press, 33.

²⁴ For a discussion of Beer's algedonic meter see Pickering: "And this is the clever bit — the viewers could also see how the politicians would react to the feedback, and so on in a cascade of feedbacks between the TV studio and its audience. In effect, some channel, however crude, would thus be opened for mass debate—or, better, a dance of agency with the government. Again, policymaking could thus emerge in real-time interaction." PICKERING, A. (2010) *The Cybernetic Brain: Sketches of Another Future*, Chicago, The University of Chicago Press, 270.

²⁵ VON UEXKULL, J. (2010) *A Foray into the Worlds of Animals and Humans: with A Theory of Meaning*, Minneapolis, University of Minnesota Press, BUCHANAN, B. (2008) *Onto-Ethologies: The Animal Environments of Uexkull, Heidegger, Merleau-Ponty, and Deleuze*, New York, SUNY Press, SLOTERDIJK, P. (2004) *Sphären III, Schäume*, Frankfurt Suhrkamp, AGAMBEN, G. (2004) *The Open: Man and Animal*, Stanford, Stanford University Press, DELEUZE, G. & GUATTARI, F. (1987) *A Thousand Plateaus: Capitalism and Schizophrenia*, University of Minnesota Press.

²⁶ CANGUILHEM, G. (2001) The Living and its Milieu. *Grey Room*, 3, 7-31.

²⁷ "Information is therefore a primer for individuation; it is a *demand for individuation*, for the passage from a metastable system to a stable system; it is never a given thing. There is no unity and no identity of information, because information is not a *term*; it supposes the tension of a system of being in order to receive it adequately. Information can only be inherent to a problematic; it is *that by which the incompatibility of the non-resolved system becomes an organizing dimension in the resolution*; information

supposes a phase *change of a system*, because it supposes an initial preindividual state that individuates itself according to the discovered organization. Information is the formula of individuation, a formula that cannot exist prior to this individuation. An information can be said to always be in the present, current, because it is the direction [sens] according to which a system individuates itself." SIMONDON, G. (2007) *The Position of the Problem of Ontogenesis. L'individuation psychique et collective*. Paris, PUF, 10.

Also: "According to Simondon, cybernetics had failed to go in this direction. Wiener had the "huge merit" to have started the first inductive investigation into machines and established cybernetics as a comprehensive, interdisciplinary research project. But, following Simondon, he had failed to define his research object in an appropriate manner. Cybernetics only focused on a specific type of machines, i.e. machines with feedback mechanisms. More generally, Simondon stated: "Right from the start, [Cybernetics] has accepted what all theory of technology must refuse: a classification of technological objects conducted by means of established criteria and following genera and species." For Simondon, the problem did not consist in applying biological procedures to technology (as we will see, he himself made use of such procedures). His point was that Wiener had made the wrong choice relying on a quasi-Linnaean, stable classification. What Simondon was after was a dynamic theory of technology, i.e. a theory that would grasp technological objects in their development and their relation to inner and outer milieus or Umwelten. In other words, Simondon did not want to start another botany of machines, he was interested in their individuation, development and evolution." SCHMIDGEN, H. (2004) *Thinking technological and biological beings: Gilbert Simondon's philosophy of machines*. Berlin, Max Planck Institute for the History of Science, 13.

²⁸ MEDINA, E. (2011) *Cybernetic Revolutionaries: technology and Politics in Allende's Chile*, Cambridge MA, The MIT Press, 27.

²⁹ ROSE, N. (1991) *Governing by Numbers: Figuring out Democracy Accounting, Organizations and Society*, 16, 673-692, 673.

³⁰ The other text is: WEINER, N. (1965) *Cybernetics, Second Edition: or the Control and Communication in the Animal and the Machine*, Cambridge MA, The MIT Press.

³¹ In the current context, any account of global influence drawn from small-scale intervention easily shrugs off any criticism. It is therefore unsurprising to note the links between complexity theory and its emergence with recent discourse on the city. Architectural practice – according to this logic – must directly affect the protocols (but not the forms) that drive urban morphogenesis. This bottom-up ethos holds considerable sway over urban discourse, since research into the abilities of local, small-scale interactions influencing large-scale structures dictates much urban thought, which is still recovering from the perceived failures and universal ambitions of modernism.

³² JACOBS, J. (1961) *Death and Life of Great American Cities*, New York, Vintage, 433.

³³ The efforts made by Walter Isard and Jay Forester towards systems thinking and economic geography was significant, as well as one important sense to the eighteenth century. See also: FORRESTER, J. W. (1968) *Principals of Systems*, New York Productivity Press, ISARD, W. (1990) *Location Analysis General Theory*, New York, NYU Press.

³⁴ FOUCAULT, M. (2007) *Security, Territory, Population: Lectures at the College de France 1977-1978*, New York, Palgrave Macmillan.

³⁵ Alternatively translated in the text accompanying the lecture as *'If I cannot bend the Higher Powers, I will move the infernal regions'* FOUCAULT, M. (2010) *The Birth of Biopolitics*, New York, Picador. FREUD, S. (1899) *The Interpretation of Dreams*, London, Sterling Press.

³⁶ FOUCAULT, M. (2010) *The Birth of Biopolitics*, New York, Picador.

³⁷ The literal translation is: 'Don't disturb things that are at peace'. Stepping off from this quote, Foucault extended the theme of security developed in the previous academic year into a discussion of liberalism and biopolitics.

³⁸ FOUCAULT, M. (2010) *The Birth of Biopolitics*, New York, Picador, 31.

³⁹ That Pinochet comes to power via an exercise of political action seemingly prohibited by the system he would go on to install is far from a paradox. And though it was not set out to describe a coup, the constitution of an exceptional condition is for Agamben (via Schmitt) - the definition of political sovereignty in so far as the sovereign is defined by the ability to constitute an exception to the rule of law. See: AGAMBEN, G. (2005) *State of Exception*, Chicago, University of Chicago Press.

⁴⁰ FOUCAULT, M. (2007) *Security, Territory, Population: Lectures at the College de France 1977-1978*, New York, Palgrave Macmillan.

⁴¹ "The milieu is a set of natural givens - rivers, marshes, hills - and a set of artificial givens - an agglomeration of individuals, of houses etc. The milieu is a certain number of combined, overall effects, bearing on all who live in it. It is an element in which a circular link is produced between effects and causes, since an effect from one point of view will be a cause from another." *ibid*, 21.

⁴² *Ibid*.

⁴³ RANCIERE, J. (2004) *Disagreement: Politics and Philosophy*, Minnesota, University of Minnesota Press.

⁴⁴ MEDINA, E. (2011) *Cybernetic Revolutionaries: technology and Politics in Allende's Chile*, Cambridge MA, The MIT Press.

⁴⁵ OSBORNE, T. & ROSE, N. (1999) Governing cities: notes on the spatialisation of virtue. *Environment and Planning D: Society and Space*, 17, 737-766.

⁴⁶ "The force field with which we are confronted in our present is made up of a multiplicity of interlocking apparatuses for the programming of this or that dimension of life, apparatuses that cannot be understood according to a polarization of public and private or state and civil society. In the name of public and private security, life has been accorded a 'social' dimension as a result of the formation of a complex and hybrid array of devices for the management of insecurity and risk comprised by practices of social work and welfare, mechanisms of social and private insurance, and a range of other social technologies. In the name of national and individual prosperity, an 'economic machine' has taken shape, which may have as its object an economy made up of enterprises competing in a market, but traces out and structures that domain through devising and implanting modes of economic calculation, through fiscal regimes, through promoting changes in economic organization, and through techniques of financial regulation and accounting. In the name of public citizenship and private welfare, the family has been configured as a matrix for organizing domestic, conjugal and child rearing arrangements and instrumentalizing wage

labour and consumption. In the name of social and personal well-being, a complex apparatus of health and therapeutics has been assembled, concerned with the management of the individual and social body as a vital national resource, and the management of 'problems of living', made up of techniques of advice and guidance, medics, clinics, guides and counselors." ROSE, N. (1993) Government, Authority and Expertise in Advanced Liberalism *Economy and Society* 22, 283-299, 286. Also: VIRNO, P. (2002) *Grammar of the Multitude*, New York, Semiotext(e).

⁴⁷ SCHUMACHER, P. (2010) *The Parametric City* Tokyo, A.D.A. Edita.

⁴⁸ TANSLEY, A. G. (1935) The Use and Abuse of Vegetational Concepts and Terms. *Ecology*, 16, 284-307.

⁴⁹ Recall here the idea of scale and its relationship to explanatory resolution as described by Manuel Delanda in *Intensive Science Virtual Philosophy*, whereby the resolution of the 'mesh' that is the description/causal explanation must correlate – in a way that can be objectively assessed – with the phenomena being described. DELANDA, M. (2002) *Intensive Science Virtual Philosophy*, London, Continuum.

⁵⁰ "We are trying to create a second nature, complex variegated order... a new way of working with parametrically malleable, soft forms. Soft forms are able to incorporate a degree of adaptive intelligence. They are no longer just forms, but may have gravity or structural constraints, material constraints, performative logics inbuilt that make them intelligent." SCHUMACHER, P. (2010) *The Parametric City* Tokyo, A.D.A. Edita.

⁵¹ BEER, S. (1995a) *Brain of the Firm*, London, Wiley, 146.

⁵² VALDES, J. G. (1995) *Pinochet's Economists*, Massachusetts, Cambridge University Press, 7.

⁵³ PETRAS, J. & MORLEY, M. (1978) On the U.S. and the Overthrow of Allende: A Reply to Professor Sigmund's Criticism. *Latin American Research Review*, 13, 205-221, 206. See also: VALDES, J. G. (1995) *Pinochet's Economists*, Massachusetts, Cambridge University Press.

⁵⁴ BEER, S. (1995a) *Brain of the Firm*, London, Wiley, cited in MEDINA, E. (2011) *Cybernetic Revolutionaries: technology and Politics in Allende's Chile*, Cambridge MA, The MIT Press, 35.

FOOTNOTES: CLIMATE CONFLICT

¹ The conflict spurred on by Richard Dawkin's 'gene oriented mechanics' and with Stephen Jay Gould and Richard C. Lewontin in 1979 with their paper 'The Spandrels of San Marco and the Panglossian Paradigm' can be read in both ideological and scientific terms, biology having its Marxists and market acolytes no less than other fields. See: DAWKINS, R. (1976) *The Selfish Gene*, Oxford, Oxford University Press. DENNETT, D. C. (1996) *Darwin's Dagerous Idea*, New York, Simon and Schuster, *ibid*, JAY GOULD, S. & LEWONTIN, R. C. (1979) The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Programme. *PROCEEDINGS OF THE ROYAL SOCIETY OF LONDON, SERIES B*, 205, 581-598. Daniel C. Dennet DENNETT, D. C. (1996) *Darwin's Dagerous Idea*, New York, Simon and Schuster.

² See: RANDALL, D. A. L. A. & WOOD, R. A. L. A. (2007) Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. IN SOLOMON, S., QIN,

D., MANNING, M., CHEN, Z., MARQUIS, M., AVERYT, K. B., TIGNOR, M. & MILLER, H. M. (Eds.) *IPCC Fourth Assessment Report AR4*. Geneva, Intergovernmental Panel on Climate Change. See also LE TREUT, H. & SOMERVILLE, R. (2007) *Climate Change: The Fourth Assessment Report Historical Overview of Climate Change Science*. Geneva, United Nations Intergovernmental Panel on Climate Change (IPCC). SAKAGUCHI, K., ZENG, X. & BRUNKE, M. A. (2011) Temporal- and Spatial-Scale Dependence of Three CMIP3 Climate Models in Simulating the Surface Temperature Trend in the Twentieth Century. *Journal of Climate*, 25, 2456 - 2470. WIENS, J. A. & BACHELET, D. (2009) Matching the Multiple Scales of Conservation with the Multiple Scales of Climate Change. *Conservation Biology*, 24, 51-62.

³ The eccentricity of the earth's tilt combined with numerous other oscillations that make up the astronomical seasons contribute to climate phenomena in important ways. For example, the Milankovitch cycle correlates with the onset of the last ice age. Further, changes to the spectral signature in the infrared bandwidth reliably reflect changes in atmospheric composition.

⁴ SAKAGUCHI, K., ZENG, X. & BRUNKE, M. A. (2011) Temporal- and Spatial-Scale Dependence of Three CMIP3 Climate Models in Simulating the Surface Temperature Trend in the Twentieth Century. *Journal of Climate*, 25, 2456 - 2470.

⁵ "In addition, many of the key processes that control climate sensitivity or abrupt climate changes (e.g., clouds, vegetation, oceanic convection) depend on very small spatial scales. They cannot be represented in full detail in the context of global models, and scientific understanding of them is still notably incomplete." LE TREUT, H. & SOMERVILLE, R. (2007) *Climate Change: The Fourth Assessment Report Historical Overview of Climate Change Science*. Geneva, United Nations Intergovernmental Panel on Climate Change (IPCC), 106.

⁶ See also: LATOUR, B. (2003) "Atmosphere, Atmosphere". IN GALLERY, N. T. (Ed.) London, Tate Britain.

⁷ For an account of the role of the IPCC see: CUFF, D. J. & GOUDIE, A. S. (2008) *The Oxford Companion to Global Change*, New York, Oxford University Press.

⁸ CENTRAL-INTELLIGENCE-AGENCY (1974) *A Study of Climatological Research as it Pertains to Intelligence Problems*. Washington D.C., United States Government. A recent study commissioned in 2006 and released in 2007 makes an interesting comparison: SULLIVAN, G. R., BOWMAN, F., FARRELL JR., L., GAFFNEY II, P. G., KERN, P. J., LOPEZ, J., PILING, D., PRUEHER, J. W., TRULY, J., WALD, C., F. & ZINNI, A. C. (2007) *National Security and the Threat of Climate Change*. Virginia, Security and Climate CNA.org.

⁹ "In the national and international security environment, climate change threatens to add new hostile stressing factors. On the simplest level, it has the potential to create sustained natural and humanitarian disasters on a scale far beyond those we see today. The consequences will likely foster political instability where societal demands exceed the capacity of the government to cope." Ibid. 8.

¹⁰ HELM, D. (2009) *Climate Change Policy: Why has so little been achieved?* IN HELM, D. & HEPBURN, C. (Eds.) *The Economics and Politics of Climate Change*. New York, Oxford University Press.

¹¹ “It is sometimes said that the difference between a weather forecast and an economic forecast is that a weather forecast cannot change the weather, whereas an economic forecast can change the economy. Matters are less clear cut these days, where a climate-change forecast can in principle change societal carbon footprints, and hence climate.” GLEICK, J. (1992) *Genius, Richard Feynman and Modern Physics*. , Little, Brown and Co. quoted in PALMER, T. N. & P.J., H. (2011) Handling Uncertainty in Science. *Philosophical Transactions of the Royal Society A*, 369, 4861-4684, 4682.

¹² COLLIER, P., CONWAY, G. & VENABLES, T. (2008) Climate Change and Africa. IN HELM, D. & HEPBURN, C. (Eds.) *The Politics and Economics of Climate Change*. New York, Oxford University Press.

¹³ YAMIN, F., DEPLEDGE, J., SMITH, J. & BURTON, I. (2006) Perspectives on Dangerous Anthropogenic Interference; or How to Operationalize Article 2 of the UN Framework Convention on Climate Change. IN SCHELLNHUBER, H. J. (Ed.) *Avoiding dangerous climate change* Cambridge, Cambridge University Press.

¹⁴ DEPLEDGE, J. & FARHANA, Y. (2008) The Global Climate-Change Regime: A Defence. IN HELM, D. & HEPBURN, C. (Eds.) *The Economics and Politics of Climate Change*. Oxford, New York.

¹⁵ The United Nations Collaborative programme on Reducing Emissions and Forest Degradation in Developing Countries (REDD) has been described by Indigenous Rights Organisations as the “largest legal land grab the world has ever seen” and ushering in a new wave of colonial expansion into the developing world through large scale expropriation of land by companies planning to sell carbon credits on the carbon market leading to a massive transfer of ownership from native communities. See also: SHARIFE, K. (2011) *Climate Change: Buying and Selling Pollution, who gains?* Paris, The Africa Report.

¹⁶ EDWARDS, P. N. (2010) *A Vast Machine: Computer Models, Climate Data and the Politics of Global Warming*, Massachusetts, The MIT Press.

¹⁷ “Aviation, military and agricultural concerns were the chief clients for weather modification ideas, which reached a zenith during the Vietnam War. For example, between 1967 and 1972, a US Air Force effort called Operation Popeye attempted to wash out parts of the North Vietnamese resupply route known as the Ho Chi Minh Trail by seeding clouds over Laos during monsoons. Among the largest efforts was Project Stormfury, which tested techniques for steering or extinguishing tropical cyclones before they made landfall”. *ibid.* 518.

¹⁸ BODANSKY, D. (2001) The History of the Global Climate Change Regime. IN LUTERBACHER, U. & SPRINZ, D. F. (Eds.) *International Relations and Global Climate Change*. Massachusetts, The MIT Press.

¹⁹ Also known as the “Charney Report”: SUOMI, V., E. (1979) *Carbon Dioxide and Climate: A Scientific Assessment*. Massachusetts, Climate Research Board Assembly of Mathematical and Physical Sciences National Research Council.

²⁰ Though there is no consensus with regards to the impact climate change will have on mortality rates in Africa, there is no doubt that the increased urbanization, climate stress and poverty will only exacerbate

existing health problems. See: RAMIN, B. (2009) Slums, climate change and human health in sub-Saharan Africa. *Bulletin of the World Health Organization*, 87, 886. Increasingly there are calls to link climate change analysis to health and mortality projections: LEWIS, S. (2008) It's time for a body count. London, The Guardian. Mortality rates are difficult to estimate due to the mixed causal factors involved, nonetheless some attempts have been made, for a review see: REVKIN, A. C. (2009) Forum Says Climate Shift Brings Deaths. New York, New York Times.

²¹ EDWARDS, P. N. (2010) *A Vast Machine: Computer Models, Climate Data and the Politics of Global Warming*, Massachusetts, The MIT Press.

²² Attribution of cause is also described as 'the human fingerprint on greenhouse gases'; this nascent idea uses a model to correlate anthropogenic factors with a specific series of indicators. If the same input reliably produces the same climatic fingerprint (pattern of change) then that input can be said to have reliably produced the change. In this sense, much like the development of human fingerprints, small topological irregularities act as developmental noise, canalizing development in unique ways. These pathways can be analyzed using stochastic tests to produce a causal link between emission and impact.

²³ RANDALL, D. A. L. A. & WOOD, R. A. L. A. (2007) Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. IN SOLOMON, S., QIN, D., MANNING, M., CHEN, Z., MARQUIS, M., AVERYT, K. B., TIGNOR, M. & MILLER, H. M. (Eds.) *IPCC Fourth Assessment Report AR4*. Geneva, Intergovernmental Panel on Climate Change.

²⁴ Entire scientific fields, often including multiple sub-disciplines, lie behind these component models. Coupling the models together also means joining these communities. In many cases, brining their knowledge to bear on global climate models has required a dramatic change in focus, in instrumentation and in collective practice. Many of these changes have to do with scale. See *ibid*.

²⁵ "[The principle] of dividing things again by classes, where the natural joints are, and not trying to break any part, after the manner of a bad carver." PLATO (1995) *Phaedrus*, New York, Hackett and Co.

²⁶ Unfortunately Lorenz unwittingly contributed to one of the major mystifications in climate science: the idea of the butterfly effect, or that a minor perturbation can have major consequences. Though mathematically correct, the popularity of the idea obscures the power of negative feedback which attenuates disruption and maintains stability.

²⁷ LE TREUT, H. & SOMERVILLE, R. (2007) Climate Change: The Fourth Assessment Report Historical Overview of Climate Change Science. Geneva, United Nations Intergovernmental Panel on Climate Change (IPCC).

²⁸ *Ibid*.

²⁹ See also: "The question at which scale to cut off the model for a simulation is determined by a trade-off on the allocation of computational resources between possible ensemble size and numerical complexity". See also: THOMPSON, J. M. & SIEBER, J. (2011) Climate predictions: the influence of nonlinearity and randomness. *Philosophical Transactions of the Royal Society A*, 370, 1007-1011.

³⁰ The relation between model sensitivity and explanation is explored in: HELD, I., M. (2005) The Gap Between Simulation and Understanding in Climate Modelling. *American Meteorological Society*, November, 1609-1614.

³¹ There are perhaps two kinds of ways that the scale at which a problem is posed can be objectively assessed. Either the problem is under-determined and the contrast space has too much detail, or, it is over-determined in which case the contrast space is specified with too little detail, and the account of the parts is too vague. This is the same as saying there is either redundant or insufficient causality in the explanation. For a further refinement of over-determination see also: HARMAN, G. (2011) On the Undermining of Objects: Grant, Bruno, and Radical Philosophy. IN BRYANT, L. R., SRNICEK, N. & HARMAN, G. (Eds.) *The Speculative Turn: Continental Materialism and Realism*. Melbourne, re.press.

³² TRENBERTH, K. E. (1993) *Climate System Modelling*, Massachusetts, Cambridge University Press.

³³ This is seen clearly in the complications that are involved in translating the scale of a GCM, essentially a model of the earth's surface, ocean and atmosphere in which each grid of resolution is typically 300 kilometers across, with a Regional Circulation Model (RCM), which is able to provide a higher resolution of data, typically 50 kilometers across critical in determining the specific effects of climate change in most parts of the world.

³⁴ LE TREUT, H. & SOMERVILLE, R. (2007) Climate Change: The Fourth Assessment Report Historical Overview of Climate Change Science. Geneva, United Nations Intergovernmental Panel on Climate Change (IPCC), 113.

³⁵ For further information on Regional Climate Models (RCM) and their interaction with General Circulation Models (GCM) see: MURPHY, J. (2002) The Hadley Centre regional climate modelling system: PRECIS — Update 2002 Providing Regional Climates for Impacts Studies. London, The Hadley Centre.

³⁶ RANDALL, D. A. L. A. & WOOD, R. A. L. A. (2007) Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. IN SOLOMON, S., QIN, D., MANNING, M., CHEN, Z., MARQUIS, M., AVERYT, K. B., TIGNOR, M. & MILLER, H. M. (Eds.) *IPCC Fourth Assessment Report AR4*. Geneva, Intergovernmental Panel on Climate Change.

³⁷ “In contrast, the primary needs of a society attempting to plan for or respond to climate change lie at far finer spatial resolutions (e.g. catchments). For example, while GCM accuracy decreases as spatial scales become finer, in hydrological, as in most other applications, one usually needs *increasing* detail as spatial scales decrease (e.g. information on individual rainfall events in a catchment basin to determine runoff and storage); consequently, the scales of accuracy of GCMs are in direct opposition to that of societal need.” HEWITSON, B. C. & CRANE, R. G. (1996) Climate downscaling: technique and application. *Climate Research*, 7, 85-96, 86.

³⁸ “The understanding of the atmosphere as a multi-scale system and of the role of scale interactions in determining weather and climate variability has developed strongly, especially following the major TOGA COARE1 experiment in 1992–1993. As a result, it has become increasingly clear that the inherent assumption in traditional parametrization schemes that there is no coupling between dynamics and physics

on the unresolved scales is now being challenged.” PALMER, T. N. & P.J., H. (2011) Handling Uncertainty in Science. *Philosophical Transactions of the Royal Society A*, 369, 4661-4684, 4668.

³⁹ This platform works as a commonly agreed upon format allowing different disciplines and institutions to share information and compare experimental results in a consistent way. The ESMF is an open source platform that allows climate researchers to both integrate their findings with other researchers, but perhaps more importantly, it standardizes the protocols of information exchange between these researchers, allowing for a continual re-testing of experiments in order to verify their results. In acknowledgement of the instability of the interaction between the various lines of inquiry, the standard is itself open to modification by the scientific community. See also: DA SILVA, A., BALAJI, V., KILLEEN, T., JONES, P., MARSHALL, J. & ZAPOTOCNY, J. (2004) Future Directions for the Earth System Modeling Framework (White paper). Earth System Modelling Framework (ESMF).

⁴⁰ IPCC, 1996a, Chapter 8 See also: “The basic difference is that each approach represents technology in a fundamentally different way. The bottom-up models capture technology in the engineering sense: a given technique related to energy consumption or supply, with a given technical performance and cost. In contrast, the technology term in top-down models, whatever the disaggregation, is represented by the shares of the purchase of a given input in intermediary consumption, in the production function, and in labour, capital, and other inputs. These shares constitute the basic ingredients of the economic description of a technology in which, depending on the choice of production function, the share elasticities represent the degree of substitutability among inputs.”

⁴¹ RANDALL, D. A. L. A. & WOOD, R. A. L. A. (2007) Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. IN SOLOMON, S., QIN, D., MANNING, M., CHEN, Z., MARQUIS, M., AVERYT, K. B., TIGNOR, M. & MILLER, H. M. (Eds.) *IPCC Fourth Assessment Report AR4*. Geneva, Intergovernmental Panel on Climate Change. Also: “But more importantly, the Lorenz model also indicates that the predictability of a chaotic system is flow dependent, so that while some weather patterns or regimes may be highly unpredictable, others may contain substantial predictability; in other words, the predictability is itself both variable and predictable” PALMER, T. N. & P.J., H. (2011) Handling Uncertainty in Science. *Philosophical Transactions of the Royal Society A*, 369, 4661-4684, 4668.

⁴² For an example from climate science see: HEWITSON, B. C. (2003) Developing Perturbations for Climate Change Impact Assessments. *EOS Transactions, American Geophysical Union*, 84, 337-348.

⁴³ GARFINKEL, A. (1981) *Forms of Explanation: Rethinking the Questions in Social Theory*, New Haven, Yale University Press, 58.

⁴⁴ Ibid.

⁴⁵ DELANDA, M. (2002) *Intensive Science Virtual Philosophy*, London, Continuum.

⁴⁶ “Di-Aping first attacked the 2 degrees C warming maximum that most rich countries currently consider acceptable. Referring continuously to science, in particular to parts of the latest IPCC (Intergovernmental Panel on Climate Change) report, which he referenced by page and section, he said that 2 degrees C globally meant 3.5 degrees C for much of Africa. He called global warming of 2 degrees C “certain death

for Africa,” a type of “climate fascism” imposed on Africa by high carbon emitters. He said Africa was being asked to sign on to an agreement that would allow this warming in exchange for \$10 billion, and that Africa was also being asked to “celebrate” this deal.” WELZ, A. (2009) Emotional scenes at Copenhagen: Lumumba Di-Aping @ Africa civil society meeting – 8 Dec 2009.

⁴⁷ “Another Met Office study analyses how a 4C rise would differ from a 2C rise, concluding that threats to water supplies are far worse, in particular in southern Europe and north Africa, where regional temperatures would rise 6-8C. The 4C world would also see enhanced warming over most of the US, Canada and northern Asia.” CARRINGTON, D. (2010) Climate change scientists warn of 4C global temperature rise. London, The Guardian.

⁴⁸ REVKIN, A. C. (2009) Forum Says Climate Shift Brings Deaths. New York, New York Times.

⁴⁹ SULLIVAN, G. R., BOWMAN, F., FARRELL JR., L., GAFFNEY II, P. G., KERN, P. J., LOPEZ, J., PILING, D., PRUEHER, J. W., TRULY, J., WALD, C., F. & ZINNI, A. C. (2007) National Security and the Threat of Climate Change. Virginia, Security and Climate CNA.org, 1.

⁵⁰ BORGER, J. (2007) Darfur conflict heralds era of wars triggered by climate change, UN report warns. London, The Guardian.

⁵¹ This is recognized already by epidemiologists working on projected mortality rates who suggest that the heat stress will exaggerate existing differences in life expectancy between developed and developing nations. Though there is no clear consensus, a 2006 report concludes: “Projections of the global health effects due to the global climate changes signal a massive impact on the less favoured parts of the world.” SUNYER, J. & GRIMALT, J. (2006) Global climate change, widening health inequalities, and epidemiology. *International Journal of Epidemiology*, 35, 213-216.

⁵² RENNER, M. (2007) Worldwatch Perspective: Security Council Discussion of Climate Change Raises Concerns About "Securitization" of Environment. Massachusetts, World Watch Institute.

⁵³ “Yesterday the hyperbole-prone G77 spokesman, Sudanese negotiator, Lumumba Stanislaus Di-Aping, demanded the US sign the Kyoto Protocol and that it cough up \$200 billion in financing for developing countries to cope with climate change. An American journalist had to ask him to repeat the figure, just to make sure he had heard right. The day before, Mr. Di-Aping had likened rich nations not pushing for a tougher deal to Nazi appeasers and implied that UN Secretary-General Ban Ki-moon was favouring rich countries over poor.

Even mild-mannered diplomats are starting to lose patience. After one outburst by Mr. Di-Aping about doom and disaster for Africa if a much tougher climate deal was not sealed, a European diplomat noted that Mr. Di-Aping wouldn't be experiencing it personally since he lived in New York.” TAYLOR, L. (2009) An artificial but self-sustaining world of councils and advisers. Melbourne, The Australian.

⁵⁴ RANCIERE, J. (2004) *Disagreement: Politics and Philosophy*, Minnesota, University of Minnesota Press, 30.

⁵⁵ Nor will the intelligibility of speech or its emergence into perception guarantee a resolution of the problem, instead the disruption stages a drama that must and will be continually re-enacted. While

Rancière cautions against reading this act as brute irruption it is also true that he does not fully develop – outside of some well known examples - a theoretical account of its germination.

⁵⁶ Ibid, 43.

⁵⁷ Ibid, 50.

⁵⁸ For Rancière, the demos appears when an excluded group demands to be included within the public sphere, taken as a legitimate partner, despite representing an as yet uncounted part, in making this claim they stand in for the whole of society.

⁵⁹ DEWEY, J. (1927) *The Public and Its Problems*, Ohio, Swallow Press.

⁶⁰ Ibid, 137.

⁶¹ Recalling the work of Latour, for whom Dewey is a major influence: “John Dewey’s great insights is that, on the contrary, there is nothing more complex, nothing more susceptible of mistakes, nothing in greater need of specific and constantly refreshed inquiries than to detect what, at any point, is the public’s problem.” LATOUR, B. (2007) *How to Think Like a State*. Paris, 4.

⁶² Ibid, 15.

⁶³ DELEUZE, G. (1994) *Différence et Répétition*, Paris, Gallimard, 139.

⁶⁴ For an expansion of this point see: BENNET, J. (2010) *Vibrant Matter: A Political Ecology of Things*, Durham, Duke University Press Books.

⁶⁵ MASSUMI, B. (2007) "Technical Mentality" Revisited: Brian Massumi on Gilbert Simondon. *Parrhesia*, 2009, 36-45, 37.

⁶⁶ Gilles Deleuze’s *Difference and Repetition* both radicalizes Simondon’s idea of the pre-individual and expands Kant’s analytic of the sublime in order to fully develop an idea of psychic individuation. The description of the sublime is the one moment in Kant’s critical project in which a clear discord of the faculties emerges. It is here that an experience of pain cleaves the subject in two, a split produced by an immensity of experience that cannot be processed, leaving only: 'a discordant accord between the demands of reason and the faculty of the imagination'. With regards to experience, this discord is an impossibility - its sensory dimensions cannot be reconciled, but, 'from the transcendent point of view, it is that which can *only* be imagined, that which is accessible *only* to the imagination in its transcendental exercise' DELEUZE, G. (1994) *Différence et Répétition*, Paris, Gallimard.

Kant turns the discordant fracture of one faculty into the conditions of possibility for the accord of another. Even though Kant will eventually resolve this discord transcendentally, Deleuze will transform this exceptional mechanism within the Kantian schema, transplanting it out from the theory of the sublime and making it the basis for *all* forms of psychic individuation. The result of this is that thought would always be 'communicated violently from one faculty to the other.' Both the ambiguity of the event and its fractured reception are real - thought takes place through the world, in the clamor of things and their traffic of signs.

⁶⁷ The psychic phase transition is perhaps best described by an anecdotal experiment that Deleuze recalls, though does not reference. Only half jokingly, he describes a test in which a monkey is given a series of colored boxes in which only the blue ones have food. Initially the monkey opens all the boxes randomly. Eventually the monkey acquires the concept and only opens the blue boxes. This much seems relatively straightforward, *except* for a specific phase transition between the first ignorant phase and the last learned one in which the monkey *has not yet formed the concept*, but nonetheless produces a statistically significant increase in blue boxes opened.

⁶⁸ The individuation of thought begins with an ambiguous sign - in this case with a disturbing problem affecting the partition between natural and man-made worlds. As Deleuze notes in *Difference and Repetition*, a sign, say, a changing weather pattern or the extreme climate event, can provoke a discord of the faculties, carrying ambiguous excess, irresistibly soliciting the attention of the intelligence, and calling on perception and memory to continue their inquiry. Though recognition attempts to tie these qualities back to the object in a clear and reassuring way, there is a time in which they present themselves to perception, provoking confusion and 'perplexing the soul.' There is a specific idea of the perceptual economy at work here, an elaboration of the earlier work on Proust and the energetic flow of amorous, worldly and sensual signs. Like a field of metastable molecules, a sign is encountered as a gradient of relational and intensive qualities, being bigger or smaller, brighter or darker, louder or quieter. For this reason signs are never transparent, as Bogue states: "...rather, they are hieroglyphs, enigmas that point beyond themselves to something hidden... ...Every sign has something enfolded within it, something 'other,' that must be unfolded if it is to be understood." BOGUE, R. (2004) Search, Swim and See: Deleuze's apprenticeship in signs and pedagogy of images. *Educational Philosophy and Theory*, 36, 327-342, 327.

For Simondon, any individuation carries a reserve of pre-individual energy that is not exhausted in the process of actualization. This reserve forms a resource for further explications. In order to explicate the sign's enigmatic side and move from the space of encounter into the specification of a problem and its concept, the indeterminacy - "enmeshed in the matter" of the sign - must be unfolded. This process of explication is described by Deleuze as an 'apprenticeship of the senses', and while it was not written with scientific research in mind, the pedagogical dimension to the concept illuminates problems relating to the way knowledge is acquired. Rather than converge on a single truth, or form a progressive 'union of the intelligences' as in Bachelard, the idea of an apprenticeship articulates the oscillating relationship between the ambiguity of a background that cannot secure knowledge, and the foreground truths that precipitate out of it. This process of truth construction is not an argument for the relativity of truth claims, but rather an enmeshing of the truth back within the shifting grounds that lend it power.

⁶⁹ Ibid, 201.

⁷⁰ EDWARDS, P. N. (2010) *A Vast Machine: Computer Models, Climate Data and the Politics of Global Warming*, Massachusetts, The MIT Press, 406.

⁷¹ It is precisely this political background to the apparent impartiality of the scientific enterprise that is obscured by references to technical expertise, as Edwards suggests: "So making knowledge work means getting people to trust it - to buy it on credit as it were, where the credit belongs to an authority they are willing to believe. For that you need representatives: experts from all over, whose presence provides a

symbolic guarantee that the knowledge works from many local perspectives, not just from the perspectives of the centers of power. You may also need another type of representative, not an expert but a political ambassador to serve as a watchdog against the corruption of the political process by partisan interest. Second, you have to distribute the knowledge you create around the world. Here the two types of representatives can serve you well, connecting you with local experts and spreading your knowledge to a broader local public.” EDWARDS, P. N. (2010) *A Vast Machine: Computer Models, Climate Data and the Politics of Global Warming*, Massachusetts, The MIT Press, 406.