Smoothing, Striating and Territorialising: The assembling of 'science in the making'

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Abstract

Drawing on a rich two-year ethnographic study that followed evolutionary biologists in their everyday work, this paper explores the making of scientific knowledge through the spatial conceptual imagery developed by Deleuze and Guattari (1987). In particular, this paper focuses on a field expedition to the South Pacific and investigates how different rhythms, forces and intensities are harmonized and assembled in the production of scientific knowledge. Within this setting, maintaining a balance between striating and smoothing forces is an important, yet difficult task. On many occasions, alternative rhythms and 'tropical forces' jeopardized the success of the expedition, despite the scientists' best efforts to formalize the research process and bring the striations of the laboratory into the forest. Paradoxically, these challenges also played a key role in the inquiry as they opened new possibilities and ultimately led to more intense engagements with the tropical forest and its rhythms and spatiality.

Keywords: Knowledge, Science, Space, Territories, Deleuze & Guattari, Smooth & Striated

1. Introduction

Much research within the areas of science and technology, sociology and geography has been devoted to exploring the multifaceted and intricate relationship between space and knowledge-making practices (see Golinski, 2005; Harris, 1998; Latour, 2000; Latour and Woolgar, 1986; Pyenson, 2002; Turnbull, 2003). Problematizing this relationship has represented a productive line of inquiry in the social study of sciences (Latour and Woolgar, 1996; Law and Mol, 2001). In particular, the exploration of 'knowledge in the making' (Beaulieu 2010) has advanced our understanding of the complexity, contextuality and performativity of scientific practices and knowledge (Latour, 2000; Michael and Rosengarten, 2012; Turnbull, 2003). This research has opened up many black boxes surrounding scientific practices and has greatly contributed to our grasp of the complex sets of relations, associations and connections underlying the making and production of scientific knowledge in different contexts (Knorr-Cetina, 1999; Latour, 2000; Law and Mol, 2001).

This paper sets out to develop this work further by providing a detailed examination of the dynamics and tensions that underlie the spatial production of knowledge in the context of evolutionary biology as well as the different forces that connect and assemble through the localised production of spaces, facts and knowledge. In order to do so, we draw from the concepts of smooth/striated spaces and territorialising forces developed by Deleuze and Guattari (1987)[1]. The concepts of smooth and striated provide 'a dynamic thickness to space' (Saldanha, 2017: 3), as they enable an engagement with the constant process in which these spaces can both open up and close down a wide range of possibilities and outcomes. Striated spaces are envisioned as highly codified and extensive forms of space that are governed by a plethora of rules and a grid-like imagery. On the opposite, smooth spaces are characterized by their openness, revolutionary potential and resistance to codifying processes (Deleuze and Guattari, 1987). While striating may appear to limit, control and govern space, smooth

processes are connected to a greater extent with the creative and radical set of forces and outcomes that emerge in less predictable ways. However, one should refrain from positioning smooth and striated spaces as either good or bad or pre-existing in some *a priori* sense (Buchanan and Lambert, 2005). In contrast, it is important to appreciate how they assemble through overlapping and constantly energizing tensions, emanating via different relational encounters.

We contend that these concepts can prove particularly insightful in exploring the mutual constitution of scientific knowledge and space, and in doing so raise a range of questions relating to the issue of spatialities and 'science in the making'. In particular, our paper revolves around the following questions: (i) How can the spatial imagery of smooth and striated processes enable a greater engagement with the tensions and dynamics of 'science in the making'? (ii) How do different rhythms, logics and intensive forces become harmonised in the production of scientific knowledge? (iii) What are the issues that may arise through attempts to striate, control and formalise smooth spaces in the production of scientific knowledge?

These questions emerged during a two-year ethnographic study that followed a group of evolutionary biologists through their many 'work' spaces (e.g. laboratory setting, herbarium, tropical forest, etc.). The research entailed going beyond the spatial boundaries of the laboratory (Hine, 2007; Latour, 2000) to study the heterogeneous nature of 'scientific practice in the making' and explore the diverse trajectories that can align to the making of different spaces, territories and scientific facts. As we followed scientists through their work and in a variety of contexts and research projects, we began experimenting with the spatial imagery of Deleuze and Guattari (1987). In doing so, we were able to explore in detail complex meshworks and entanglements involved in the daily practices of knowledge making of the scientists. This involved moving away from a reliance on the *a priori* existence of physical or discrete spaces of scientific truth making (e.g. the laboratory or the field) in order to experiment with

alternative forms of space and truth-making processes and become sensitive to different ways knowledge and space making emerge in practice. The empirical accounts developed in this paper are concerned with events and encounters surrounding a scientific expedition to the South Pacific.

Through an engagement with the assembling of the different forces underlying the processes of striation and smoothing, this paper thus approaches the making of scientific facts and spaces as an on-going and constant becoming of different connections, relational entanglements and inclusions/exclusions. By focusing on these tensions and interplay between specific processes of smoothing and striating that underlie the making of various forms of space and knowledge (Deleuze and Guattari, 1987)[2], we were able to focus on these moments of creation, assemblage and dislocation connected to the making of scientific knowledge. Engaging with the conceptual imagery of striated and smooth therefore allowed us to explore how beneath certain images of stability, objectivity and harmony, many different intensive forces and encounters of controversy may bubble and smoulder. This becomes particularly noticeable through encounters where the more directional, metric-based and grid-like formalism of striation provides a sense of over-coding or inflexibility in ways that are seen to restrict new possibilities (e.g. as they become stifled or closed down at the bequeath of standardised controls). However, on other occasions striated processes may be seen to open up new territories and spaces of fabrication and innovation, as the striated aligns more closely with smoothing processes of creation and discovery.

This paper is structured as follows. Firstly we provide an overview of the literature concerned with the spatiality of scientific practice and the concepts of smooth and striated space. This is followed by a presentation of the methodological approach and ethnographic work that underlies our research. We then draw on empirical examples to illustrate the main ideas underlying this paper. The final section brings together the main ideas of the paper,

highlights the contributions of this research and raises further questions to consider.

2. 'Science in the Making': Smoothing, Striating and Territorialization

Scientific facts, practices and spatialities

Various scholars have explored the different truth-making activities and spatialities connected to the production of scientific knowledge (see Latour, 2000 for instance). This has notably been visible through the abundance of 'laboratory ethnographies' spawning from the 1980s (see for instance Doing, 2004; Knorr-Cetina, 1999; Latour and Woolgar, 1986; Law and Williams, 1982; Lynch, 1985; M'Charek, 2005; Mol, 2002; Traweek, 1988). These laboratory ethnographies understood scientific research as an on-going construction (Lewis and Atkinson, 2011; Stephens and Lewis, 2017; Stephens et al., 2008) that relies on the assemblage of complex sets of relations, actions and practices (Law, 2004). The idea that scientific knowledge is a social construction (although not merely a subjective undertaking), in part emanates from the work of Latour and Woolgar (1986) and has been widely developed by other authors (see for instance Demeritt, 2001; Hess, 1997; Ryghaug and Skjølsvold, 2010). Tracing the connections and associations underlying the production of scientific facts does not involve dismissing the process of scientific knowledge production as merely subjective (Latour, 2000), as this would fail to appreciate the 'making of objectivity' with regards to the construction of facts and the chains of circulating references that underlie such a process.

This interest in the making of scientific knowledge has been paralleled by an engagement with the spatiality of scientific practices. As highlighted by Livingstone (2003: 12), 'attending to the microgeography of the lab (…) takes us a long way toward appreciating that matters of space are fundamentally involved at every stage in the acquisition of scientific

knowledge'. This is further exemplified by Latour (2000) in *Pandora's hope: Essays on the reality of science studies* where he discusses how he followed researchers and research practice outside the boundaries of the laboratory. In particular, Latour highlights how different spaces and activities fill very specific functions in the making of facts and knowledge, with the idea that a combination of spaces and practices are mobilized through the activities of the scientists. For instance, while fieldwork may be pivotal in biological sciences in order to appreciate the ecological context of the system studied, other actions (e.g. experiments, research questions, etc.) might require a 'laboratory' or office setting. As noted by Latour (2000: 38), 'in losing the forest, we win knowledge of it'.

In the same line of thought, various papers have explored other spaces involved in the making of scientific knowledge, but typically left aside scientific accounts (Livingstone, 2000; Naylor, 2002; Secord, 1994). Research in that area has also explored the boundarisation of scientific activities, notably by rethinking the boundary between the laboratory and the field in practice (Kohler, 2002). This research has taken us a long way from a focus on the laboratory as the central and primordial space of scientific knowledge-making (Gross, 2016; Hine, 2007) in order to appreciate the multiplicity of spatialities involved in the assembling of scientific knowledge and the different space-making activities that lie beneath such a process. Engaging with 'science in practice rather than science in theory' (Law and Mol, 2001: 610), not only allows us to explore space relationally (Jones, 2009; Thrift, 2006), but in addition, it opens up further spaces in which to delve into different images concerned with the making of space, truth and knowledge.

This body of research has been particularly insightful in the unfolding of the various spaces connected to scientific inquiry. This paper seeks to extend this further by going beyond formal notions of scientific spaces, facts and truths, in order to delve deeper into the dynamic tensions, overlapping processes and images that circulate around particular scientific

encounters and knowledge-making events. In particular, we draw from the conceptual imagery of smoothing, striating and territorialization (Deleuze and Guattari, 1987) in order to open up different avenues of exploration and experimentation connected to the study of spatialities and 'science in the making'.

Smooth and Striated Spaces, Tensions and Processes

Deleuze and Guattari's work on space and topology has led to many creative engagements, notably within the field of geography (Antonioli, 2003; Bear, 2013; Doel, 1996, 1999; Martin and Secor, 2013; Robinson, 2016; Springer, 2014; Thrift 2006; Woodward et al., 2012), with research on geopolitics (Dittmer, 2014), cartography (Farías, 2011; Gerlach, 2014) as well as landscape and territoriality (Bear, 2013). Alongside this engagement and in the wake of non-representational theories, various scholars have also emphasized the need to think space relationally (Jones, 2009; Thrift, 2006), thus drawing our attention onto the multiplicity, relationality and complexity of spaces (Massey, 2005). Furthermore, by engaging with relational spaces, it becomes possible to produce alternative geo-philosophies (Bonta and Protevi, 2004) and provide different ways of thinking central spatial concepts, such as scale or territoriality (e.g. Amin, 2002; Jones et al., 2007; Marston et al., 2005; Springer, 2014).

The concepts of smooth and striated spaces lie at the centre of the spatial philosophy of Deleuze and Guattari (1987) and have been particularly influential in attempts to think space *differently* (see Buchanan and Lambert, 2005). The Deleuzo-Guattarian conceptual imagery around smoothing, striating and territories has been mobilized in various contexts and across different disciplinary settings. This has, for instance, included research on virtual spaces (Aroles, 2018a; Nunes, 1999); digital learning spaces (Bayne, 2004); the investigation of space production (Munro and Jordan, 2013); the unfolding of mega sport events (McGillivray and

Frew, 2015); the mobility of transnational students (Lysgard and Rye, 2017), as well as a broad range of studies within the field of geography (for instance, Bear, 2013; Bradshaw and Williams, 1999; Labussiere and Nadai, 2014).

Deleuze and Guattari (1987) introduce the concepts of smooth and striated by comparing two board games: Chess and Go. Each piece in the game of Chess is given an intrinsic quality and value (e.g. the bishop can solely move diagonally) and its movements are therefore coded. Conversely, Go pieces possess situational properties (Deleuze and Guattari 1987); the value and role of the pellet is continually performed/created through the relation of the stone to its environment and other stones during the game. Deleuze and Guattari (1987) explain how the games differ: while Chess codes and decodes space (through the intrinsic qualities and properties of its pieces), the game of Go territorializes and deterritorializes space (through the situational and relational properties of the stones)[3]. Deterritorialization is 'a transversal process that defines the creativity of an assemblage: a nonlinear and nonfiliative system of relation' (Parr, 2010: 71). Put differently, deterritorialization entails the dissolution of strongly established cultural codes and the setting aside of identity as a framework of reference (Aroles, 2018b). In addition, it does not occur without some form of subsequent reterritorialization taking place (Hillier, 2005). The processes of deterritorialization and reterritorialization are pivotal to an understanding of the ways in which smooth spaces and smoothing forces operate. Striation can be viewed in terms of a molar process of stabilisation, while smoothing is a molecular process of deterritorialization with both coming together through relational encounters of reterritorialization. For Deleuze and Guattari (1987: 481), this highlights a crucial difference in how space is occupied: 'in striated space, one closes off a surface and "allocates" it according to determinate intervals, assigned breaks; in the smooth, one "distributes" oneself in an open space, according to frequencies and in the course of one's crossings'.

Within this conceptual frame, the figure of the nomad is pivotal. The nomad is the image of smooth space and lines of flight. In contrast, the image of striated space is closely aligned with the State through grid-like codes, rules and goal-driven outcomes. The State is therefore seen as seeking to exert control over space through the process of striation and in that sense, the State is viewed as diametrically opposed to smooth spaces (to the nomad). This amounts to an opposition between *nomos* and *polis* (Deleuze and Guattari, 1987). Furthermore, smooth spaces are characterised by a revolutionary potential, as they seek to undo problematic over-coding and striations in order to open up and liberate new spaces. Moreover, while homogeneity may be considered as the intense outcome of striation, heterogeneity characterizes smooth spaces.

The conceptual imagery of smooth and striated spaces as a complex mixture of forces (Buchanan and Lambert, 2005) highlights a continual process of engagement, exchange and creation (Osborne and Rose, 2004). Not only is a smooth space 'constantly being translated, transversed into a striated space; striated space is constantly being reversed, returned to a smooth space' (Deleuze and Guattari, 1987: 474). Through the overlay of a tangent Euclidean space upon the points of the smooth space, a smooth space will necessarily be translated into a striated space; 'this is the triumph of the logos or the law over the nomos' (Deleuze and Guattari, 1987: 373). The complex process of entanglement between smoothing and striating forces also allows us to appreciate that no space can be seen as completely striated and smooth; for instance, the city, which is typically presented in the image of striation, is traversed by a wealth of smoothing forces (Frichot et al., 2016).

Some connections can be drawn with the work of Latour (2005, 2013) and the ways in which he examines certain tensions underlying the making of black boxes and matters of concern. While certain stabilising practices and scripts may be seen as 'restricting' or 'directing' possibilities and opportunities within specific settings, they can also be key in

supporting particular outcomes through complex and heterogeneous networks and mediations of everyday practice. In other words, as disorder provides additional possibilities for creativity and alterity, orderings can open up spaces in which disorder can transverse and connect. It is precisely these enmeshments between striating & smoothing, creativity & order, rigidity & openness that this paper sets to explore in depth within the context of scientific research and the practices of 'science in the making'. By focusing on these mixtures and encounters between processes of smoothing and striating, Deleuze and Guattari (1987: 500) suggest that it becomes possible to explore how 'the forces at work within space continually striate it, and how in the course of its striation it develops other forces and emits new smooth spaces'. Our paper seeks to engage more deeply and intensively with this conceptual imagery by unravelling different tensions, territorializing processes and ways of making and occupying spaces.

3. Ethnographical inquiry and Field Sites

The empirical material within this paper emanates from an ethnographic study of the complex relationship between spatialities and 'science in the making'. The study spanned over a period of two years and involved the combination of many different approaches to the process of data collection. This included both participant and non-participant observations in different contexts, informal discussions with various scientists, attendance at various meetings and gatherings, as well as documentary analysis (e.g. scientists' field notes, topic-specific scientific research papers, etc.). The research amounted to hundreds of hours of discussion, observation and analysis and entailed the exploration of various spaces connected to scientific practices. In particular, the research involved following scientists (i.e. conducting both participant and non-participant observations) in a research laboratory, a herbarium as well as a tropical forest in the context of a scientific field expedition to the South Pacific. We sought to go beyond narratives

revolving solely around the laboratory (Hine, 2007) and embraced the constructed-ness of field sites in different settings (Amit, 2000). This enabled us to produce a richer account of the complex entanglements between the constitutive forces underlying the making of space and science. Tracing practices outside the physical boundaries of the laboratory proved pivotal in order to unfold the complex processes through which knowledge becomes assembled and allowed us to explore how other spaces, rhythms and forms of action actively and productively participate in this process.

The empirical accounts presented in this paper focus on the events, encounters and actions revolving around one particular project that emerged during the course of our two-year long ethnographic research, namely the study of a particular group of epiphytic Australasian plants (i.e. plants that grow on trees). These plants form, more or less, specialized associations with ants: in exchange of shelter and sometimes food, the plants would receive protection (against herbivores) and nutrients from the ants. The study of this group of plants involved the organisation of a field trip to the South Pacific in order to collect some of these plants and study them in their natural environment. The research also extends beyond the fieldwork, as it explores how intensities and forces emanating from other spaces and events emerged during the course of this expedition.

In order to embrace the dynamicity, complexity and heterogeneity underlying actions, events and practices connected to the making of scientific knowledge, it was also key throughout the course of the study to move away from a focus on *a priori* divides and positions. To achieve this aim we sought to develop new empirical sensibilities that grappled with different intensive forces and tensions and shifted our analysis away from merely focusing at the more extensive level of forms (Aroles and McLean, 2017). In that sense, this paper is aligned with the call to rejuvenate research methodology in social sciences (Aroles and McLean, 2017; Helmreich, 2011; Law, 2004; Lury and Wakeford, 2012). This involves

seeking different ways to engage with the research focus, the conceptual ideas and the methodological endeavour (see Gab and Ribes, 2014), while also keeping in mind that 'the theoretical approach adopted is organic to the issues explored' (Crociani-Windland, 2011: 2).

4. Encounters, Imaginations and Expectations

Assembling prospects: Preparing a field expedition to the South Pacific

One of the projects that emerged during the course of the research consisted in the study of a group of Australasian plants. A group of scientists engaged in preparatory work for a field expedition to the South Pacific to study those plants. This revolved around three main activities: a careful reading of the existing literature, the preparation of the material and devices needed for the fieldwork, and finally the administrative processes required to conduct fieldwork. Many devices were gathered for the field: GPS navigation systems to assist scientists in the localization of plants; plastic bags along with silicate gel to collect and preserve plant samples; climbing gear to access the plants; as well as miscellaneous 'more general' laboratory pieces of equipment (chemical droppers, sample tubes, etc.) and products. For instance, the decision to bring (or not) a particular device or chemical relied on a plethora of factors, including plane weight allowance, import legislations, the operating conditions of various devices, etc. Preparing for this scientific expedition also involved getting in touch with the national university to establish a collaboration that would help with permits, access and logistics. While it took a long time and various negotiations to find the right person to discuss fieldwork, the scientists finally received an answer from Tunde, who works at the herbarium of that university. The scientists then started the administrative procedures that would allow them to undertake fieldwork. This notably involved paying the fees for the biosecurity

processes, the use of material at the herbarium (‘bench fees’) and the dispatch of collected materials (back to their European laboratory).

An examination of the ways in which the scientists prepared the material required for this scientific expedition also exposed their approach to viewing, representing and constructing the field. In particular, attending to this phase of preparation revealed the scientists’ anticipations of the field along with their first attempts to bring the striations of the laboratory into the field setting. This phase of preparation could be seen as an attempt to create the field as a direct extension of the laboratory (Latour, 2000). This entailed imagining the similarities and differences between these images of ‘scientific space’ and developing ways to ensure some form of spatial and temporal continuity between the two. Put differently, this meant reflecting on the ways in which the rhythms and vitality of these two forms of space could be harmonized, although in ways that focused more on bringing the forest into the laboratory, rather than the other way round. While fieldwork is rather common in evolutionary biology, the ‘field’ – as a romanticized space for scientific discovery can be seen as escaping the formalisation and colonisation of the process of scientific inquiry. As noted by Stengers (2000: 139), in the field ‘one does not find experimental apparatuses in the Galilean sense, giving the scientist the power to stage his own question, that is to say, to purify a phenomenon and give it the power to bear witness to this subject’. By extension, what constitutes or makes the field is always assembled *differently* through various mediations.

While different images and relations assembled in preparation for the expedition, there was often a consensus as to what could (and could not) reasonably be translated to the field. These anticipations and mediations and how they connected to previous field experiences and the study of similar research projects, therefore underlay the image making of the field. As noted, through their actions, the scientists attempted to pre-striate or code the field in specific ways; this was noticeable through the miscellaneous scientific protocols, devices, materials,

chemicals, training sessions and ‘administrative processes’ that framed the research process. When the scientists were in their institute preparing their trip, the South Pacific could be seen as ‘already there’, almost touchable, yet not in the sense of actually ‘being there’. Its rhythm, along with the rhythms and striations of previous fieldwork, were already impacting on the ways in which the field expedition was being prepared. In the same way, the scientists may have felt intensive sensations during the fieldwork with forces, practices, timings and forms of action connecting them to the laboratory and the herbarium. The distinction between the ‘preparatory phase’ and the ‘actual’ field research is therefore not clearly defined, as actions and intensities constantly emerge, assemble and overlap between different times, spaces and forms of actions.

Tropical Encounters: Assembling spaces, times and actions

Shortly after landing in the capital city, the scientists took a smaller plane in order to reach the island where they would meet up with Tunde. Prior to the departure, they had identified geographic areas where they wanted to undertake research and identified one specific island that would provide an ideal place for the fieldwork and the setting up of various experiments. As early as the second day of the expedition, they spotted the very first specimens of the plants and noted down the GPS coordinates. For people unfamiliar with the process of data collection in a field expedition, this simply looks like a series of numbers. However, one of the scientists explained that this information is not only useful for conservation matters, but also in producing a ‘transect’ (i.e. recording the occurrences of a species along a particular path). This can inform many biological processes, such as how the plant is dispersed. Collecting GPS coordinates in such a way establishes a form of grid over the forest and corresponds to a particular way of coding plant distribution. It becomes a way of ‘knowing the

forest and the plants'. All the complex interactions and associations between the plants and the forest are then translated into a series of rigid numbers. While this process of striating the forest through this metric of simplification is seen as key to assembling certain forms of data and speeding up the research process, it can also close down the capacity to map other realities that may underlie these numbers and practices of abstraction. In other words, although the coding through striating may open up certain possibilities for mapping in a grid-like and metric-based manner, it can also stifle or lose other vitalities, connections and performances.

One aspect that stifled the scientists' ability to perform their role (the way they had initially intended) was the 'spatial position' of the plants. The plants studied are epiphytes and can therefore be rather challenging to reach, especially in these areas where the canopy is extremely high. As the first plant specimens spotted would be not reachable without hours of further preparation and intervention, the members of the expedition decided to continue until they came across a 'reachable' plant. A scientist took out his climbing gear in order to take a closer look at the plant. Armed with a machete, Tunde cleared the surroundings of the tree where the plant was in order to facilitate the ascension. Despite a period of training prior to the departure, climbing proved much harder than expected: the humidity of the jungle coupled with the presence of moss on the trunk of the tree meant that the climbing rope was more prone to slip, and some trees were also too small to climb on. The presence of various insects also made the ascension harder and the high temperatures created further difficulties. The dominant rhythm of this expedition was challenged, as the scientists experienced the 'viscosity' of the forest. They needed to find ways of dealing with these 'resistances' and 'interruptions'. In other words, a whole set of mediators presented a challenge to the tranquil image of the forest as a controlled and striated environment (cf. the image of the laboratory)[4] and new ways of harmonising with these different forces were required in order to overcome these challenges. After some time, support from the local team and much effort, the scientist managed to reach

a suitable plant. A scientist could then take many close-ups and collect a leaf sample that would be used once the scientists had returned to their European laboratory.

The example of the scientists practising their climbing skills on trees at the research institute is reminiscent of Latour's discussion of the journey of two twins (Latour, 1997). The first twin could be described as enjoying a smooth travel through high-speed trains due to intermediaries being well aligned, while the second twin is required to negotiate the dense vegetation, vines and potentially dangerous animals within the forest. For Latour (1997), the second twin experiences a difficult and slow journey, as they encounter and negotiate a plethora of mediators. In contrast, the other twin experiences a feeling of ease and appreciates the smooth continuity of the process. This contrasts with the Deleuzo-Guattarian imagery of smoothness, which aligns with the many rich, intensive and heterogeneous forces that lie beneath the imagery of extensive forms. For instance, before the fieldtrip, the scientists developed various skills and knowledge of climbing at the research institute. While this helped in the context of climbing in the forest, many different mediators were encountered in practice which made this a very different experience and challenged preconceived ideas and expectations regarding their experience of the field. In other words, they did not encounter well-aligned intermediaries that allowed them easy access to the plants. Problems may arise where striated codings do not align well with the everyday practices and occurrences within the field and fail to connect well with certain deterritorializing forces or attempts to reterritorialize within these spaces. In addition to striations being associated with attempts to bring spaces 'under control' or produce well-aligned intermediaries, the over-coding of striated processes would also limit the ability to flex and adapt to local conditions and reduce the possibilities to produce effective outcomes. Therefore, it was key that the scientists were able to develop innovative and creative ways of making 'scientific knowledge' and conducting their work within these different and complex spaces.

During the initial days the scientists focused on the locations provided by previous studies. They subsequently decided to follow Tunde's suggestion to explore different areas in order to find more accessible plants. Early in the morning, the scientists loaded the SUVs with all the equipment needed and the mission was swiftly on its way. Tunde's suggestion proved very successful, as within an hour from our departure, 'reachable' specimens had been found and the scientists began conducting various forms of experiments. The aim of one of these experiments was to obtain more information about how the ants interact with the plants. Ants were easily spotted as upon touching the plant, one produces vibrations that resonate through the plant and prompt the ants to flood out of the plant and rush towards the source of the vibrations[5]. Two scientists decided to set up, what they called, 'cafeteria experiments'. A cafeteria experiment involves making available different types of food to animals in order to determine which one they prefer. For this experiment, they used a previously drilled flat piece of wood (with four holes) in which they put four different solutions: a control solution (a solution consisting solely of water) and three different sugary solutions. The use of the control solution was an attempt to confirm the validity of the experiments (if the ants were to feed indistinctively on the water and on the sugary solutions, then the experiment would not be conclusive).

Once the 'cafeteria' had been placed onto a branch of a tree, they stayed on a different branch of the tree to monitor ant food preferences in the 'cafeteria'. Images of the field were, however, not assembling quite the way the scientists had planned/wanted. The heavy tropical rains and the piece of wood used proved problematic for this experiment. The heavy tropical rains would dilute the prepared solutions and the ants were much less likely to journey out from

the plant to access the solutions. In terms of the research process, the climatic conditions and the unwillingness of the ants to emerge in the heavy rain acted as mediating and deterritorializing forces that put into jeopardy the 'success' of the experiment. This provided yet another example of how the forces within the tropical forest were challenging the rhythm of this scientific inquiry, or rather imposing their own rhythm on this process. It also highlighted the requirement for the scientists to accommodate these miscellaneous tensions and forces in order to maintain vital connections in the making of knowledge. The piece of wood was also problematic, as the ants would attack it rather than feeding on the different solutions provided. The scientists searched for alternative ways of organizing the experiment in order to make sure they could assemble the data needed and repair and align these broken connections. They placed the solutions onto a branch directly and using various leaves and twigs, they managed to place a cover over the 'cafeteria'; through a process of reterritorialization (as new codes, forces and practices relating to the experiment emerged). At last the experiment could continue through these different sets of relations and forms of engagement.

One of the scientists on the field trip commented that while the laboratory and the field can complement one another, they felt that they differ in the type of research as well as in 'the way of making science'. This is not to deterministically associate a form of research to a space, but rather to look at the mutual constitution of both spaces and scientific research. While it might first appear that there is an attempt to translate the laboratory (or at least its logic) into the field, the scientists are fully aware that this can be a problematic endeavour as they have to deal with unpredicted mediators and forces that could potentially disturb or completely destroy the process of data collection. Additionally, the pressure to engage with what could be described as over-coded and uncompromising ways of operating can produce inflexible striating strategies (such as an overreliance on GPS coordinates and a subsequent reluctance to

explore ‘freely’ the surrounding environment). In that sense, while gathering a wealth of data, there was a continual awareness that an over-reliance on inflexible practices, devices, measurements and cartographic representations would actually be a hindrance and frame the expedition in a certain way.

The scientists therefore highlighted that while the various protocols, chemicals, materials and devices could be simply seen as an attempt to transpose the logic of the laboratory into the field, it is important to acknowledge the complexity and heterogeneity of the different territories of ‘science in the making’ and how they overlap and are continually reterritorialized. As opposed to merely attempting to impose one on the other, the imagery of the interplay of the striated and the smooth alongside the different territorializing forces accentuates the complex foldings of space, time and action that underlie overlapping encounters of knowledge and truth-making practices. By becoming sensitive to the different and complex entanglements, tensions and forces associated with knowledge in the making, both the scientists and researchers on this fieldwork began to grasp additional insights into how the different practices and relations play out in terms of a complex assembling of different (de/re)territorializing forces and relational encounters. This includes exploring the coming together and overlapping of different forms of territorialization such as: the formalism associated with performing data and sample collection in standardised ways; the demands of scientific practice and the need to maintain circulating references and lines of scientific objectivity; the different individual and organizational forces that impact on the everyday practices within the laboratory and field; and the different mediating forces within the field. Different forms of deterritorializing and reterritorializing can therefore emerge in connection to the assembling and overlapping of various striating and smoothing encounters. Rather than viewing this process in terms of discrete places or spaces, we can see how these striations and smoothing connect different territorializing forces through various folds, trajectories, spacings and timings with many

different assemblages popping up and reforming. This was particularly apparent in the next stage of the field trip as following the completion of various forms of sample collection and setting up of experiments the group decided to adopt a more fluid approach to exploring the forest.

Exploring More Intensively: Local striations and leaving the GPS behind

As the field expedition continued, the days varied in terms of intensity. Some days would be really busy and focused on specific tasks, while others would be less constrained as they solely involved checking that the on-going experiments were 'working' according to plan. These moments when scientific protocols, representations of the forest and timing became less prevalent provided the scientists with the opportunity to explore their surroundings with fewer constraints. Up to this point, the exploration of the jungle had been framed by the different reports and diaries of explorers that the scientists used as the basis for their fieldwork. The expedition was able to take a slightly different turn, as things became less rigid and directed and fewer technical devices were used with the scientists relying more on their intuition as far as the exploration went (i.e. exploring and relating differently to the forest). This clearly contrasted with other moments when the scientists sought to systematically code the space investigated by amplifying striating forces from the laboratory. Amongst other things, this involved leaving the GPS behind as there was no fixed route, direction or required end point navigationally.

Two members of the expedition decided to explore the area neighbouring the first experiments, but before they left, Tunde gave them some directions and indications. He suggested that every five meters, they should leave a light mark on the trunk of a large tree. The action of marking the trees with machete cuts could be read as a form of local striation, as

it involved producing a series of spatial markers as a way of navigating the tropical forest. However, it can still be difficult as the marks are just on one side of the tree, so if the scientists do not ‘go straight’, they can struggle to find the marks on their return journey. In that sense, adopting a linear-like progression can be seen as key when negotiating the forest through the striating practice of machete cuts. Additionally, this form of striation appears more ‘in tune’ with the tropical forest and one might argue that the process of striation has become deterritorialized from the GPS coding of navigation. New forms of local striation and practice entered the scene (along with new codes and forms of relationality), as they engaged further with the tropical forest.

After exploring for over two hours, they spotted a plant specimen in a tree that looked different from the other plants (similar but distinct). However, the specimen was not reachable; for now this encounter with this intriguing plant remained distant and visual. Interestingly, the encounter was registered as remarkable and worthy of more engagement (rather than the scientists just passing by as they had done when encountering many other plants). The plant stood out in terms of the scientific imagery of discovery and the expansion of knowledge. The two scientists started exploring very attentively the area around that particular specimen and they found some similar-looking specimens at an attainable height nearby. This action of looking for ‘more’ highlights how this attraction towards this plant reveals a wealth of forces and intensities coming from ‘elsewhere’ (e.g. pure past of experiences of scientific exploration and discovery, but also future images of papers, recognition in the community, etc.). In order to assess whether or not this was a ‘new’ species, they relied on the knowledge developed through their reading of various monographs and floras (with a form of pure past entering the encounter through these previous experiences), but also their current practices of evaluation and assessment.

The scientists described this specimen as having a clearly different morphology from the ones they have studied so far: could they have discovered a 'new' species? This encounter with what could potentially stand for a new species not only linked to future events in the form of expected publications, further experiments to be performed, etc., but also to another set of striating intensities and strategies in order to confirm this potential discovery. These striating forces were thus seen to assist the scientists in accelerating the course of their expedition. While these practices, devices, metrics and circulating references were seen as key to their scientific truth-making activities (as they noted down various details and recorded measurements), these never stood alone, as various striating and smoothing forces would continually become together through this process. Through this process, new possibilities would open up while others would close down.

5. Conclusion

Building on a two-year long ethnographic inquiry, this paper sought to experiment with the spatial imagery of Deleuze and Guattari (1987) in order to delve into the rhythms, spatialities and minutiae of 'science in the making'. In particular, within the context of a field expedition to the South Pacific, this paper explored the mutual constitution of science and space through a focus on the complex enmeshments between smoothing and striating forces and processes of (de/re)territorialization. By attending to these processes and enmeshments, this paper has approached the everyday practices of scientists through a form of imagery receptive to the on-going and performative assembling of science and space. Our research has sought to highlight how the spatial imagery of Deleuze and Guattari (1987) enables a greater engagement with the tensions and dynamics underlying truth-making activities and 'science in the making'.

Our empirical research highlighted different cases in which certain rhythms would

occasionally overflow other forms of rhythmicity and reshape the direction(s) of the scientific inquiry. This would not only impact on the assembling of relational forces but also on the production and articulation of knowledge. Occasionally, this involved scientific activities slowing down in order to accommodate and match the spacings and rhythms of the localized setting. For instance, when the scientists had to negotiate with the notion of Pacific Time (i.e. dealing with the paperwork, etc.) or needed to 'repair' experiments that were not going according to plan and develop new connections in order to 'get things done' (grappling with the viscosity of the forest). Striations would sometimes create difficulties especially when certain knowledge and space making practices lacked the flexibility or adaptability to cope with localized conditions (e.g. envisioning the field as a direct extension of the laboratory). While on other occasions, 'successful' and 'well-aligned' striations were seen as 'speeding' up the research project by aligning the tropical forest with the logic of the laboratory (e.g. mapping the forest through GPS coordinates).

During certain occasions, the scientists were seen as 'successfully' enacting the tropical forest as a form of extension of the laboratory, while in others, they achieved the goal of the experiment by effectively aligning with the different intensive forces within the forest. Attempts to organize the space of the tropical forest in such a way that the scientists could effectively collect and assemble data were apparent through certain forms of striation. However, the scientists were required to engage further with the constant mediations and reverberations of the forest and harmonise the different tensions, rhythms, spacings and forms of actions underlying the apparently stable and linear images of science in the making. In particular, our study highlighted how a strict reliance on striating strategies could limit the possibilities for creative engagement (e.g. the scientists merely understanding and engaging with the forest through the grid of their devices and GP coordinates), while a dramatic dominance of smooth processes and countless lines of flight could open up too many

possibilities and lines of flight leading to too much uncertainty and images of uncontrolled chaos (with the risk of intensities failing to assemble convincingly in the making of facts and truths or leading to a response swing towards greater striations). Both cases would lead to knowledge failing to materialize in a way that could accommodate the requirements and specificities of scientific inquiry.

As Deleuze and Guattari (1987) state, neither smooth nor striated spaces are more preferable and the key is the maintenance of a balance between the two. While these two processes (smoothing and striating) may have a tempestuous relationship, they are also important partners in the making of new spaces and forms of knowledge. In practice much work is invested in order to strike a balance between striating processes and smoothing forces. This includes directing flows of energy towards the assembling of specific territories and the making of scientific knowledge, truth and facts in specific ways. Maintaining this balance is a particularly difficult endeavor and through our research, it emerged that it was a process that was beyond the control of the scientists. On many occasions, alternative rhythms (e.g. Pacific time) and 'tropical forces' (e.g. heavy rains) jeopardized the success of the expedition, despite the scientists' best efforts to maintain a form of control over the research process. Paradoxically, these challenges played a key role in the inquiry in that they opened new possibilities, 'forced' the emergence of more creative responses and ultimately led to more intense engagements with the tropical forest and its rhythms and spatiality (e.g. discovering a new species). Furthermore, this raises the question of what becomes closed down or opened up through the complex folding of striating and smoothing processes and different (de/re)territorializing forces and how this is accounted for within the different narratives of scientific work and knowledge production. This could potentially open up further lines of inquiry connected to how such a focus on the spatial imagery of Deleuze and Guattari (1987) raises certain questions concerning different ethics of care and notions of value that allow us

to delve into many different and polymorphic connections between knowledge, territories and values.

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[1] Other science and technology scholars have sought to engage with the work of Deleuze (see Heeney, 2017; Jensen and Rodje, 2013).

[2] By bringing together the field of social studies of science and Deleuzo-Guattarian thinking, this paper commits to a transdisciplinary engagement (Barad, 2007).

[3] While the example of Chess and Go may be questioned at different levels, the example provides a good way of introducing some of the key differences between these two forms of space.

[4] See (Pálsson, 1998) on the sea and the aquarium.

[5] We almost have here the image of the spider (Deleuze, 2000) that only answers to vibrations on its web.