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Generative Process in the artworks of Stefanus Rademeyer

Rhett Martyn

A research paper presented to the Faculty of Humanities of the University of the Witwatersrand in partial fulfillment of the requirements for the degree of Master of Arts in Fine Arts

Johannesburg

Declaration

I declare that this Research paper is my own unaided work. It is submitted for the degree of Masters of Arts in Fine Art at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any other degree or examination at any other university.

Rhett Martyn

15 February 11, 2012

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Abstract

In this research I investigate the use of generative processes in the artworks of South African artist Stefanus Rademeyer (b 1976). In his sculptures and computer generated drawings Rademeyer explores complex systems and the emergence of dynamic forms through generative processes of making. He does this by way of assembling units and employing algorithmic equations as the generative driver behind the making of his art. The generative algorithms that he employs often describe the inherent form and intricacy of various natural features such as geological, crystalline and botanic structures. With reference to Phillip Galanter's (2003) widely used definition of generative art as well as commentaries by other authors in the field, I examine generative art as a systems-based practice in which a set of rules is set into motion with some degree of autonomy contributing to the completion of the work of art. The aim of this research is to examine selected works by Rademeyer in terms of such systems oriented art practice and to investigate how and to what end he employs such processes.

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Generative Processes in the Artworks of Stefanus Rademeyer

Introduction

In this research I examine selected works by South African contemporary artist Stefanus Rademeyer as examples of generative art, i.e. systems oriented art practice that involves some degree of autonomous process in contributing to or resulting in the completion of a work of art. I investigate how and to what end Rademeyer employs autonomous processes and engages with the sequential dimension of such processes in realizing his works. I am particularly interested in how a certain detachment from the process or some form of autonomy associated with the process may lead to a highly ordered aesthetic and how he negotiates between order and chaos through employing such generative processes of working. I am interested in his particular concerns, as a young South African artist, in choosing to work with such generative processes.

Stefanus Rademeyer completed a BA Fine Arts and an MA Fine Arts[1] degree at Wits University and practices as a full-time artist in Johannesburg. He has had several solo exhibitions[2] since his master's degree and has always shown an interest in complex systems and the emergence of dynamic forms through generative processes of making. Rademeyer creates his sculptures and computer generated drawings by way of assembling units and employing algorithmic equations as the generative driver. The generative algorithms that he employs often describe the inherent form and intricacy of various natural features such as geological, crystalline and botanic structures. Generative art in the context of Rademeyer's sculptures and digitally generated drawings is, to use Pearson's (2011: xviii) words, "grown, much like a flower or a tree is grown; but its seeds are logic and electronics rather than soil and water. It's an emergent property of the simplest of processes: logical decisions and mathematics. Generative art is about creating the organic, using the mechanical." Rademeyer's sculptural forms shown on his exhibition titled *Surface Depth* (2004), for example, work to adopt a sense of translating "concepts and

[1] Rademeyer graduated with an MA in Fine Arts in 2006 and the title of his dissertation was: *Representations of Transcendence in the Work of Anselm Kiefer and Anish Kapoor*.

[2] Rademeyer's solo exhibitions include: *Surface Depth* (2004), Warren Siebrits Modern and Contemporary Art , Johannesburg, *Ideograph* (2006), Warren Siebrits Modern and Contemporary Art , Johannesburg and *Resonant Structures* (2011), Goodman Gallery, Johannesburg. Rademeyer has also participated in various group exhibitions.

ideas into a schematic representation and then transform[ing] these 'blueprints' into three dimensional sculptural form" (Eksteen, 2004: 2). These structures made up of closely stacked wooden units to achieve complex three-dimensional surface patterns seem to exist between the workings of the mind and "the physical embodiment and segmentation of time literally evident in the thousands of units that make up each sculpture" and the relationship between two and three dimensional space leads to what Eksteen (ibid: 1) refers to as: "negating the surface to create the form and negating the form to create surface." I will investigate Rademeyer's interest in taking such an approach to creating his sculptures and am interested in how this may possibly be seen to connect to broader concerns.

In this paper I will examine two distinct trajectories evident in his work, namely the generative process he employs in his digital drawings and the generative process he uses in the making of his three dimensional work. Before examining his work, however, it is important to define and provide a brief historical context on generative art.

Generative Art Defined

Phillip Galanter defines generative art as "any art practice where the artist uses a system, such as a set of natural language rules, a computer program, a machine, or other procedural invention, which is set into motion with some degree of autonomy contributing to or resulting in a completed work of art" (2003: n.p.). Adding to this he says: "The key element in generative art is then the system to which the artist cedes partial or total subsequent control." Galanter's definition has been widely accepted but also challenged by critics for its breadth of including of a whole range of practices outside the domain of digital arts. Inke Arns (n.d: n.p.), for example, finds Galanter's description of generative art too generalized, challenging his assertion that generative art is an ''inclusive', comprehensive, wide-reaching definition," which she says "leads Galanter to the conclusion that 'generative art is as old as art itself.'"

Opinion is therefore varied as to whether generative art should be defined as a practice exclusive to digital mediums, or whether it encompasses a broader spectrum of practices. Galanter (2003: n.p.) further claims: "Second, generative art is uncoupled from any particular technology. Generative art may or may not be "high tech" asserting that "[i]n principle any computer based generative method could be carried out by hand." In the following chapter I will elaborate on various definitions of the genre in order to sketch the terrain somewhat more. Though Galanter's definition has been widely contested since 2002, the core of his sentiment, which insists that generative art is not exclusively a digitally based practice, does seem to enjoy some broader support. Mat Pearson (2011: xii) even says: "the only place computers really come into it (generative art) is in attempting to simulate these computations or creating new ones to rival those of the natural world."

At face value the description of generative art is often limited by two reference points, one that it is a software art practice that focuses on the "processual relations of coding and aesthetic output" and the other, that it is characterized by abstraction likened to the visual arts in the first half of the twentieth century (Whitelaw, 2005: 1). Much of Michael Whitelaw's writing advocates a position that Generative art is systemically dependent on processes, computation's and automated sequences fed into computers as algorithm's which in turn manifest in visual form. In other words, his focus tends toward generative art that is digitally manifest. Pearson (2011), on the other hand, sanctions a definition of 'computation' that is not confined to digital mediums alone. In the introductory chapter to *Generative*

Art: A Practical Guide Using Processing (ibid: xii), Pearson implies that Generative art incorporates a wide-ranging spectrum of processes, and also that the processes of 'computation' can indeed be broadly encompassing: "Computing is what a stream does as it finds its way downhill towards the ocean. It's what the planets do as they move into their orbits. It's what our bodies do as they maintain the balance to keep us upright. It's what our DNA does as it unravels. Computing is what I am doing now as I process these ideas and output them as text- and what your brain is doing as you read the words and form your own ideas as a result." His definition of computation therefore supports Galanter's (2003: n.p.) notion that generative art is "uncoupled from any particular technology." Adrian Ward (n.d.) furthermore bolsters this broader definition by asserting that Generative art is a term for a working method which stems from "concentrating on the processes involved in producing an artwork, usually (although not strictly) automated by the use of a machine or computer, or by using mathematic or pragmatic instructions, to define the rules by which such artworks are executed."

Despite the fact that Pearson (2011: 6) works almost entirely as a digital generative artist he accepts that the tools of generative art "aren't a defining factor" but rather that it is the way that various mediums are used "that provides a commonality." In his book he claims that it is his programing language, specifically the processing language, that is the chosen tool, but he is careful to assert that "to be able to call a methodology generative, our first hard and fast rule needs to be that autonomy must be involved. The artist creates ground rules and formulae, usually including random and semi random elements, and then kicks off an autonomous process to create an artwork […] the second hard and fast rule must be a degree of unpredictability. It must be possible for the artist to be as surprised as anyone else."

In his definition of generative art Phillip Galanter identifies the defining aspect of generative art as seeming to be the use of an autonomous system for art making. He (2003: n.p.) thus identifies the key element in generative art as being "the system to which the artist cedes partial or total subsequent control." In his definition, Carlo Zanni (2002:n.p.) refers to generative art as "[…] artwork which uses mathematical algorithms to *automatically or semi-automatically* generate expressions in more conventional artistic forms" and Adrian Ward (ibid) says: "Generative art is a term given to work which stems from concentrating on the processes involved in producing an artwork, *usually (although not strictly) automated* by the use of a machine or computer, or by using mathematic or pragmatic instructions to define the rules by which such artworks are executed" (my emphases added). When I

asked Rademeyer (Personal communication, 31 January 2012) about a certain detachment from the process of making, he objected to the idea of autonomy by saying: "I think this is a 'myth' surrounding generative art practices. It (generative art) involves a tremendous amount of control. The only autonomy in the process would be where one has incorporated parameters into an algorithm that will introduce a value that could fall within a specific range." As Rademeyer correctly points out, generative art is not about abandoning ship once the working processes and sequences have been set into motion. On the contrary, he (ibid) notes that "I spend months refining my algorithmic code to create a structure of sufficient detail and complexity. This also involves repeatedly printing out the images at very high resolutions, looking at them carefully, returning to the digital drawings and altering the code." This emphasis on the control involved in the process is backed up by Geoff Cox (n.d.: n.p.) when he points out that "although generative art might appear autonomous and out of control, my argument is that control is exerted through a complex and collaborative interrelation of producer/s, hardware and software." Galanter's reference to autonomy seems to apply to the building processes of artworks, which must be distinguished from the design processes involved in "refining […] algorithmic code" (2003: n.p) Whitelaw (2005:1) claims that there is a difference between the "processual relations of coding and aesthetic output," and if this is indeed the case, then works like Rademeyer's *Arborescent Geometries* fit neatly into a generative category as the design focus is placed on the algorithm rather than the physical manifestation of the artwork. In this way the algorithm becomes the instructive sequence for a growth form, and by Rademeyer's own account, the resultant features are sometimes unpredictable and "random elements are really integrated into the symmetrical structuring principles that governs the work" (ibid).

While generative art is mostly associated with the digital realm, many theorists agree that generative art is not a process exclusively practiced through digital mediums. Galanter (2003: n.p.) points out that "a given work might be created only partially via the use of an autonomous system. In principle any computer based generative method could be carried out by hand." Furthermore, generative art is not entirely manifest in two dimensional forms but can also occupy the "world of objects," as Whitelaw (2008: n.p.) puts it: "Getting beyond the screen and into the world of objects is a significant move for a field that has, until the last few years, reveled in its own immateriality." In the context of the above, Rademeyer (personal communication, 31 January 2012) clarifies how generative art connects to his practice, which also features sculptural work, in the following extract:

> I think my concerns here would be to find the best 'material' translation for a specific idea that I had in mind. This process traces the 'actualization' of the 'virtual.' A form or structure can exist in the 'virtual,' described by vector points in space, or by algorithmic processes that generate coordinates. The visualization of this process translates 'data' into a visual form, therefore making it accessible through the senses. In this way it is possible for a viewer to 'perceive' extremely complex structures, without necessarily having to understand the logic that generates them. This is what I would call intuitive vision. The thousands of modules in the wooden sculptures or the millions of modules in the algorithmic drawings all coagulate to create a complete form with a specific visual rhythm, texture, dimensions, line densities, fluctuations, opticality etc. This brings it into the realm of 'things,' of direct experience where the object can be weighted and referenced with other objects in the world. In the light-boxes this translation is very apparent, because some of the 'virtuality' can be inferred through the holographic use of light and reflections. So one can say that in a sense these works sit between two worlds, a world of geometric abstraction and a world of matter.

According to Pearson (2011: 7) the term "generative art" has been around since the 1960's, but more importantly he cites the generative ethos as one that is a lot older than the term itself, claiming Mozart's *Musikalisches Würfelspiel* (musical dice game) as an early example. Here, pre-written sections of music corresponding to the six-sided dice could be cut and pasted and re-written to a combination of throws. As significant figures in relation to generative art practice, artists such as John Cage, William Burroughs and Marcel Duchamp could be mentioned who "embraced randomization as a fecund generative principle." Minimalists such a "Carl Andre, Mel Bochner and Paul Morgenson used simple mathematical principles to generate compositions. The conceptual artist Sol LeWitt used combinatorial systems to create complex works from simple components, and conceptual artist Hans Haacke explored physical generative systems in his early work" (Galanter, n.d.: 3). The emergence of generative artists in the digital age, Pearson (ibid) claims, can be traced back to the 'Algorists'[3] of the 1960's. These were a group of visual artists, amongst them Frieder Nake[4], George Nees[5], Vera Molnar[6], Paul Brown[7], and Manfred

[3] In his online article *THE ALGORISTS,* Roman Verostko (2011) writes about the movement as follows: "In the last quarter of the 20th Century I was one of a likeminded group of artists who wrote instructions for executing our art. On occasion I referred to my art as "writing the score for drawing." We felt a need to identify the nature of algorithmic art. Our adaptation of the term "algorist" was first introduced in 1995 by Jean Pierre Hebert (JPH), Ken Musgrave and myself. The story behind this adaptation, to be addressed later on this page, followed a panel discussion on "*Artists and Algorithms*" at a SIGGRAPH conference in Los Angeles".

[4] Born 1938-12-16 in Stuttgart, Germany, Frieder Nake belongs to the founding fathers of (digital) computer art. (Compart, 2011: n.p.)

[5] Born 1926 in Nürnberg, Germany, Georg Nees is a pioneer of computer art, an honorary professor of computer science at the University of Erlangen, Germany. Nees, Frieder Nake and A. Michael Noll are collectively known as the "3N" of computer art. (Compart, 2011: n.p.)

[6] Vera Molnar, a French artist, was born in Budapest, Hungary in 1924. 1968 when she began creating art with the use of a computer, an IBM 370 with an IBM 2250 CRT monitor, and plotter. Now the machine imaginaire was real, allowing Molnar to quickly adjust parameters and see the visual result. Entire sessions could now be saved and reproduced later as a print, painting, or sculpture by Molnar or an assistant." (Galanter, n.d.:n.d.)

Mohr[8], who published much of their philosophy in '*Artificiata*'[9] from 1969 onwards in which they famously claimed that "algorithms are the universal language of computer art, they remain constant throughout changing technologies." According to Prof. Enrica Colabella (2008: 206), commenting at the 11th Generative Art Conference: "This kind of Art (generative) is a philosophy, a way of thinking able to produce a set of variations of a performed idea/code related to a defined problem." Colabella (ibid) claims that generative art "works, generating an *unicum ad continuum*, as a mirror of Nature. We can use in evolutionary way the verbal substantive generativism, coined by Noam Chomsky in 1953 in his great systematic work about the semiotic rules of language. For the reason that the G.A. process is strongly connected in similarity to a generative process of language in: 1. It is similar to a sound, that we memorize in connections of sequences, outlining differences in a not linear schema. 2. It is linear, adapting the memorized sequences to the linear schema of writing, in different versus up/down, right/left and vice versa." Colabella thus considers generative art more as a philosophy encompassing the general idea of adaptation, sequence, process and growth through instructive codes, sequences and drivers.

With specific reference to virtual and digital design realms, Soddu Celestino (2000: 293) claims that generative art relies on the "existence of a code, of an identifiable and designed DNA that represents the idea" which it in turn relies on and leads to "the existence of a designed artificial life[10] built as an unpredictable environment. This artificial environment can sometimes be hostile or structured to be difficult to overcome. This allows the code to germinate, self-organize, grow and develop its particular personality, making experiences and sometimes fighting adversities." Artificial DNA and artificial life are the two systems that must be designed to activate a generative design." Expanding on this idea of artificial life, editor of *Artificial Life*, Mark Bedau (n.p: n.d.) notes:

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[7] Anglo-Australian computer artist Paul Brown: pioneered computing curriculum set up by systems artist Malcolm Hughes in the mid-1970s at the Slade School of Art, part of the University College London. (Brown, n.d.:n.d.)

[8] Manfred Mohr is considered a pioneer of digital art: "After discovering Prof. Max Bense's information aesthetics in the early 1960's, Mohr's artistic thinking was radically changed. Within a few years, his art transformed from abstract expressionism to computer generated algorithmic geometry. Encouraged by the computer music composer Pierre Barbaud whom he met in 1967, Mohr programmed his first computer drawings in 1969." (Mohr, n.p.: n.d.)

[9] Artificiata see: http://www.emohr.com/tx_kurtz_e.html (Mohr, n.p.: n.d.)

[10] Named in 1986 by Christopher Langton, an American computer scientist, and commonly referred to as Alife or alife, artificial life is the field of study and an associated art form which engages systems related to life. As Celestino (2002: 291-294) points out, Alife becomes the necessary context "that will serve as environment to the (generative) code's evolution." Furthermore, Celestino claims that generative systems must always "yield different results, even if it must maintain a predefined degree of difficulty in order to complete the evolution of the project with a sufficient degree of complexity" (also see http://alife.org/). Celestino's theory, however, stands in slight contrast to Galanter's understanding of Generative art. Galanter's definition seems not to necessitate Alife, given that generative art may or may not be digitally based. There is also the issue of "complexity" associated with generative art practice that needs to be considered. Many theorists seem to sanction the notion that "the word generativism can describe the process for gaining the result of complexity" (Colabella 2008: 207). Galanter (2006: 6), on the other hand, asserts that generative art can be both simple and complex.

> Artificial Life is devoted to a new discipline that investigates the scientific, engineering, philosophical, and social issues involved in our rapidly increasing technological ability to synthesize life-like behaviors from scratch in computers, machines, molecules, and other alternative media (the official journal of the International Society of Artificial Life (ISAL)). By extending the horizons of empirical research in biology beyond the territory currently circumscribed by life-as-we-know-it, the study of artificial life gives us access to the domain of life-as-it-could-be.

In introducing the generative art work of Stefanus Rademeyer it is important to discuss the role that systems, complexity and complexity theory play as he clearly engages with such notions, which relate to generative practices. In an interview he (Siebrits, 2004: n.p.) comments: "One of my desires as an artist is to make works that have a complexity that is inexhaustible. For me the moment an expression can be approximated or quantified it loses its mystery." Oded Goldreich (2001: 1) notes, with regard to computer sciences that "Complexity Theory is […] concerned with the study of the intrinsic complexity of computational tasks […] Complexity Theory aims at understanding the nature of efficient computation." Kirshbaum (2002: 1) defines "Complex Systems Theory" as follows:

> A Complex System is any system which involves a number of elements, arranged in structure(s) which can exist on many scales. These go through processes of change that are not describable by a single rule nor are reducible to only one level of explanation; these levels often include features whose emergence cannot be predicted from their current specifications. Complex Systems Theory also includes the study of the interactions of the many parts of the system.

Attempts to develop a way of quantifying and measuring the relative complexity of a system have been envisaged by Kolmogorov,[11] Solomonoff[12,] and Chaitin,[13] but generally speaking, complex systems can only be performed digitally or by machines, rather than manually. Commenting on some of his own work, Rademeyer (2011: n.p.) states that "[s]ome of the structures that I draw consist of twenty million

[11] Kolmogorov Andrey Nikolaevich Kolmogorov (25 April 1903 – 20 October 1987) was a Soviet mathematician, preeminent in the 20th century, who advanced various scientific fields, among them probability theory, topology, intuitionistic logic, turbulence, classical mechanics and computational complexity (Vitanyi, 1996.n.p.)

[12] Ray Solomonoff (1926-2009) Theory, father of the Universal Probability Distribution, creator of the Universal Theory of Inductive Inference. First to describe the fundamental concept of Algorithmic Information or Kolmogorov Complexity see: (http://www.idsia.ch/~juergen/ray.html)

[13] "Gregory Chaitin is well known for his work on metamathematics and for the celebrated number, which shows that God plays dice in pure mathematics. He has published many books on such topics, including Meta Math! The Quest for Omega. His latest book, Proving Darwin: Making Biology Mathematical, attempts to create a mathematical theory of evolution and biological creativity. He is a professor at the Federal University of Rio de Janeiro and an honorary professor at the University of Buenos Aires, and has honorary doctorates from the University of Cordoba in Argentina and the University of Maine in the United States. He is also a member of the Académie Internationale de Philosophie des Sciences (Belgium)." (Chaitin, n.d: n.p.)

different shapes that come together in one structure, so it is physically impossible to do it manually." He further notes that these structures "almost have personalities, because they're so complex you imbue them with certain qualities." Their visual complexity is mesmerizing, compelling the viewer to "look deeper, to know and understand more." It absorbs the viewer into a new environment and Rademeyer (n.d.: n.p.) speaks of an immersive experience where a sense of boundaries begins to blend. Processes that incorporate this kind of intense layering, adaptation and transformation through mechanical means could be described as evolutionary in nature in that it involves gradual development to ever more complex forms and it is therefore no wonder that generative art is sometimes also referred to as "evolutionary art." More accurately, evolutionary art is a branch of generative art.

In an essay titled *Complexism and the Role of Evolutionary Art*, Philip Galanter (2008: 312) states: "We will see that the significance of evolutionary art is that it takes complexism as both its method and content. Evolutionary art is a new kind of dynamic iconography: the iconography of complexism. And complexism offers nothing less than the reconciliation of the sciences and the humanities through a higher synthesis of the modern and the postmodern." According to Galanter (ibid), complexity theory was born "with the founding of the Santa Fe Institute in 1984 serving as a significant milestone." He continues:

> [F]or more than 20 years scientists from diverse fields have been working together in a new way to create a new multidisciplinary understanding of systems. Under the general rubric of "complexity science" and "complexity theory" various systems, and various kinds of systems, have been studied, compared, contrasted, and mathematically and computationally modeled. An abstract understanding of systems that spans the physical, biological, and social sciences is beginning to emerge. Science generally proceeds in a reductive manner, the thinking being that by breaking down complicated phenomena into their figurative (or literal) atomic parts one gains predictive and explanatory power. The problem with reductionism, however, is that it doesn't fully address the problem of putting the pieces back together again. This is especially true of complex systems. When scientists speak of complex systems they don't mean systems that are complicated or perplexing in an informal way. The phrase "complex system" has been adopted as a specific technical term. Complex systems typically have a large number of small parts or components that interact with similar nearby parts and components. These local interactions often lead to the system organizing itself without any master control or external agent being "in charge." Such systems are often referred to as being self-organizing. These self-organized systems are also dynamic systems under constant

> change, and, short of death or destruction, they do not settle into a final stable "equilibrium" state. To the extent these systems react to changes in their environment so as to maintain their integrity, they are known as complex adaptive systems.

The common-language saying that 'the whole is greater than the sum of its parts' seems to apply here: The weather, for example, forms coherent patterns such as thunderstorms, tornados, and hot and cold fronts, yet there is no central mechanism or control that creates such patterns. Weather patterns 'emerge' all over and all at once. In the near term weather can be predicted with some accuracy, but beyond more than a few days the weather becomes quite unpredictable. Galanter (ibid) points out that the stock market is similarly a complex system with emergent properties: "Billions of shares and transactions are linked in a finite chain of cause and effect and patterns such as booms and busts emerge from the overall system. Yet no one factor dominates or "plans" the market. Even with all of the relevant information available to the public, the stock market generates surprising and unpredictable behavior."

Complexity sciences relate back to early "emergent properties theory" as it has been called (ibid). Emergence, described on http://cscs.umich.edu as a "wooly headed" theory, has gained much notoriety and criticism, mostly from so-called "mechanists" and "reductionists," for its tendency to be vague and often unscientific. As a philosophical canon it seems to have gained more momentum though, especially since George Henry Lewes gave it a certain philosophical weight in *Problems of Life and Mind* (1875). In the book *Evolutionary Theory: The Unfinished Synthesis* by Robert G. B. Reid (1985:120), Reid highlights the properties of emergentism through which the similarities to later complexity sciences is rendered explicit:

> All organized bodies are composed of parts, similar to those composing inorganic nature, and which have even themselves existed in an inorganic state; but the phenomena of life, which result from the juxtaposition of those parts in a certain manner, bear no analogy to any of the effects which would be produced by the action of the component substances considered as mere physical agents. To whatever degree we might imagine our knowledge of the properties of the several ingredients of a living body to be extended and perfected, it is certain that no mere summing up of the separate actions of those elements will ever amount to the action of the living body itself.

As illustrated previously, generative art incorporates a multitude of theoretical considerations. So far I have looked at how artificial life, complexity theory and emergent properties inform the genre, however generative art also draws from the natural sciences. It is no wonder then that meteorology, biology, and geography often use artificial life, complexity theory and emergent properties theory as systems models, models which are shared by generative theorists and practitioners who claim that their processes often imitate natural phenomena. At the 11th Generative Art Conference in 2008 Prof. Enrica Colabella (2008: 206) asserted that "Generative Art is the Art of process and not only of result. G.A. works using the rules of the alive world, as a mirror of Nature." Colabella describes the synergy between generative art and the natural sciences: "I've arrived at this point ironically through looking at processes related to crystallography and cellular mitosis in science and biology." Pearson (2011: 3) reinforces Colabella's claims by saying: "Generative art is just another byproduct of the eternal titanic battle between the forces of chaos and order trying to work out their natural harmony, as expressed in the ballet of light and pixels." Allan Watts (ibid: xviii) adds: "Things which are made, such as houses, furniture, and machines, are an assemblage of parts put together, or shaped, like sculpture, from the outside inwards. But things which grow shape themselves from within outward- they are not assemblages of originally distinct parts: they partition themselves, elaborating their own structure from the whole to the parts, from the simple to the complex." Watts thus underscores again the ascendance in complexity that generative art seems to follow as a mirror of the natural world.

The process of imitating nature, often referred to as 'biomimetic,' is one often utilized by generative artists. In biology, biomimicry is sometimes referred to as bioinformatics and computational biology, terms used to refer to the research fields concerning themselves with designing solutions to molecular problems in biology. Similarly, biomimicry as a concept for "growing artworks" is utilized as a design solution to computational problem solving in generative art. Asked about references in his work to features such as plants and geological structures, Rademeyer (Personal communication, 31 January 2012) commented as follows:

> Biomimesis is probably one of the most central concerns or interests in my current work, both in visual and sonic genres. In nature form is usually very mimetic, here mimesis refers to the relationship between form and function, in other words, a form will exhibit its functional properties explicitly, form follows function. There is a direct correlation between processes and structures in nature that appeals to me; the natural world also has had billions of years to refine those processes, so there is a lot that one can learn from the structures in nature. If I create a small simulated structure or process or environment that behaves or looks similar to the natural world, it gives me an insight

> into the way the natural world is structured, the dynamic relationships between parts, and how that is visually expressed. (Personal communication, 31 January 2012)

Elaborating on his understanding of biomimesis, Rademeyer explains how he distinguishes between representational and processual conceptions of mimesis. For Rademeyer representational models are depictive essentially re-presenting natural formations, while processual models mimic the operational mechanism of natural formations such as plant life (Rademeyer, n.d.:n.p.). His work can be seen to embody the latter and in prints like his *Arborescent Geometries* (2011) he uses algorithms to simulate natural formations, thus mimicking the biorhythms inherent to nature. He elaborates as follows:

> I prefer to use the word 'modeling' when defining the process of simulating a natural environment. Mimesis in this case is very different from representation or naturalism in painting. Here the processes that give rise to the complexity of a natural environment are revealed, analyzed, codified, translated, and re-applied in the virtual reconstruction of the environment. It goes beyond the realm of appearance, and becomes a powerful tool that can be used to re-calibrate, re-structure, re-synthesize and manipulate the mechanisms that give rise to ecosystemic behavior […] If articulated at this level, the virtual environment starts to resemble a natural system, with its complex feedback-loops, climatic modulations and even evolutionary changes (ibid).

In technical terms, biomimicry can be identified in the implementation of concepts of Phyllotaxis[14] or Phyllotaxy, for example, sequences like the Lindenmayer system and the Fibonacci[15] sequences, these being systems and arrangements that are present in nature, especially in the growth patterns of plants. L-systems or Lindenmayer's were introduced and developed in 1968 by the Hungarian theoretical biologist and botanist Aristid Lindenmayer [16] (1925–1989). The system is a parallel rewriting system which is able to explain and model the growth processes of plant formations. As Kottwitz (2011) notes, "a L-system consists of an alphabet of symbols that can be used to make strings, a collection of production rules which expand each symbol into some larger string of

[14] The term phyllotaxis means "leaf arrangement" in Greek and was coined in 1754 by Charles Bonnet, a Swiss naturalist (The myth of the Golden Ratio, n.d.:n.p).

[15] Fibonacci, mathematician (c.1175 - c.1240) Fibonacci, also known as Leonardo of Pisa, was born in Pisa. The sequence 1, 1, 2, 3, 5, 8, 13, 21, 34, 55,defined by F(1) = 1, F(2) = 1, and F(n) = F(n-1) + F(n-2) for n = 3, 4, 5, ...is named the Fibonacci sequence. The sequence is create by adding the last number of the sum, to its answer eg, 1+1=2, 1+2 =3, 2+3=5, 3+5=8 etc. The sequence is said to have many corresponding applications, and is often equated to the ratio of the unraveling of the nautili's spiral. (Horadam,1963: 54-60) Also see: (http://faculty.evansville.edu/ck6/bstud/fibo.html)

[16] Aristid Lindenmayer born November 17, 1925 died October 30, 1989 was a Hungarian biologist. "In 1968 he developed the L-systems or Lindenmayer Systems, which modeled the behavior of cells of plants and L-systems are capable of modeling the growth patterns of whole plant structures. Originally the L-systems were devised to provide a formal description of the development of such simple multicellular organisms, and to illustrate the neighborhood relationships between plant cells. Later on, this system was extended to describe higher plants and complex branching structures." (Prusinkiewicz, 1996:n.p.).

symbols, an initial "axiom" string from which to begin construction, and a mechanism for translating the generated strings into geometric structures" (Kottwitz, 2011: n.p.). Fibonacci sequences are "constructed by choosing the first two numbers (the "seeds" of the sequence) then assigning the rest by the rule that each number be the sum of the two preceding numbers. This simple rule generates a sequence of numbers having many surprising properties." (Simanek, 2008: n.p.)

It is perhaps important to note at this stage that there are many terms, genres and processes that are derivative, interchangeable and coupled with generative art and ideology. Evolutionary art for example, as previously mentioned, forms a branch of the generative art family. Evolutionary art employs the process of selection, (similar to natural selection), in which one or more parent codes (which ultimately have visual expression) pair up, cross breed (figuratively speaking), and mutate to form children bodies. In sophisticated models of this nature, only the fittest examples will survive and express themselves, and go on to reproduce. The system is designed to be autonomous and offspring generations are formed entirely through evolutionary algorithms. Rademeyer (2011: n.p.) explains how he employs an evolutionary model:

> Richard Dawkins proposed in his book *'The Blind Watchmaker'* (first published in 1986) that it is possible to simulate evolution in a basic symbolic system using computational mathematics. The generative algorithms that I have used operate in a similar manner, in that they are developed over time, and altered or mutated by me to get specific visual results. Here the selection process is driven by my visual and aesthetic preferences. In this regard the algorithms have an overall relationship, in that they all obey a logical system, but each contains unique strings of definitions and instructions that defines or inhibits specific visual characteristics, much like DNA would do in living forms. For me this is an opportunity to participate in a simplified way with the creative force of natural systems and get a sense of the dynamics involved in the creation of species diversity and ultimately ecosystems.

"Genetic art" is also a term which sometimes populates texts referring to generative art practices. This is an entirely computer based art form and is closely linked and sometime indistinguishable from evolutionary art (it is really a synonym). Genetic evolutionary algorithms drive an evolutionary process in image creation. Also related to the genetic evolutionary algorithms and art is the term "organic art" which points to the process of mutation through which code (expressed as graphic) morphs from an original formula into new forms derived from the original.

Stefanus Rademeyer

Stefanus Rademeyer's 14 May 2011 *Resonant Structures* exhibition displayed at the Goodman Gallery, Johannesburg, comprised a variety of works that explored generative processes. These works represent the latest development along a course through which Rademeyer has moved progressively towards exploring more and more complex engagements with generative language. I will firstly focus on the digital prints that were produced for this exhibition. These prints are the manifestation of algorithms-at-work, and as Rademeyer (2011: n.p.) comments: "They are static images, because I've stopped the innovative process at some point. It's like a river flowing and you take a snapshot of it. They're residual of a process"). The prints sometimes depict and sometimes resemble plant structures (in many cases they actually emulate the growth patterns of particular plant species which are found in the Overberg region of the Cape). They look like aerial shots of estuaries or deltas; they involve a complex system of diverging lines that start off at a 'trunk,' branching into smaller increments toward a periphery. Every branch that stems from the primary structure in turn branches off itself and the procedure is repeated until twig-like ends branch again and shrink. Eventually this process of shrinkage and bifurcation is repeated so often that cloud-like formations of lines result at the end of the branching stems. The following extract taken from the press release for *Resonant Structures* captures the thought process behind the construction of these structures:

> Stefanus Rademeyer expands on his interdisciplinary approach to art-making; intersecting the seemingly unlikely fields of art and mathematics. In works that use algorithms for natural structures as a starting point, Rademeyer alters and grows these structures through digital processes […] "In nature you have a code," Rademeyer says. "Richard Dawkins explains this, saying that essentially genes are like instructions." Another of Dawkins' theories to influence Rademeyer is that it is possible to simulate evolution in a basic symbolic system using computational mathematics. The generative algorithms that Rademeyer has created were developed over an extensive period of time, and altered or mutated by him to get specific visual results. He has not only tried to imitate nature, but also attempted to create novel, complex and bizarre structures that are still the result of a logical system. The title of the exhibition suggests that these structures are not representations or abstractions, neither mimicking nor simplifying natural forms, but rather paralleling them. (Goodman Gallery, 2011:n.p.)

Apart from a few comments in web releases on the internet there is not much writing that frames Rademeyer's work specifically as generative art. In examining the development of his work over the period of his three solo shows held up to this point, namely *Surface Depth* (2004), *Ideograph* (2006) and *Resonant Structures* (2011),[17] Rademeyer's movement into the territory of generativism is evident. However, to say that he is exclusively a generative artist would be false and to see his progression into this field of work as being a deterministic and linear development would also be wrong. Rather, it features more like a parallel trajectory alongside other concerns.

In examining the development of Rademeyer's work, mostly between 2000 and 2011, I will point out some of the consistencies in his conceptual applications that can be identified as being typical of generative art practice. This chapter therefore serves to expose such traces in his work as well as track his progression in his engagement with generative art practice. In doing this I focus on Rademeyer's 'processual' concerns and his interest in generative language, system theory, code, complexity theory, structural analysis and natural systems. I will highlight the works in which the generative process is directly evident, intentional and specific, most notably in his 2011 *Resonant Structures* exhibition where the generative process seems to have come to fuller fruition.

[17] *'Surface Depth'* introduces the basic principles of dimensionality and dimensional transitions. *'Ideograph'* introduced the notion of translation, specifically from 'idea' into form or 'graph'. It explores language in the broadest sense and postulates that ideas might be to a certain extent independent of language, and that language can be expanded to include exotic symbolic systems such as geometry. So geometry can be regarded as a 'language'. *'Resonant Structures'* is a term that is poetically used to describe forms that have a 'resonant' relationship to other forms or structures, to the natural world and to algorithmic languages. (Rademeyer, 2012:n.p.).

Part 1

The development of the generative process in the work of Stefanus Rademeyer

Language as generative process

Enrica Colabella (2008: 207) speaks about a particular approach toward syntax which has come to be known as 'transformational generative grammar' when he says:

> We can use in evolutionary way the verbal substantive generativism, coined by Chomsky in 1953 in his great systematic work about the semiotic rules of language. For the reason that the G.A. process is strongly connected in similarity to a generative process of language in: 1.It is similar to a sound that we memorize in connections of sequences, outlining differences in a not linear schema. 2. It is linear, adapting the memorized sequences to the linear schema of writing, in different versus up/down, right/left and vice versa.

The theory pointed out above which has been partially accredited to Noam Chomsky posits that human language systems are principled on a finite set of rules which are governed by predictable syntactic arrangements. Colabella (ibid) further notes: "A significant break in linguistic tradition came in 1957, the year American Noam Chomsky's *Syntactic Structures* appeared and presented the concept of a 'transformational generative grammar.' A generative grammar is essentially one that 'projects' one or more given sets of sentences that make up the language one is describing, a process characterizing human language's creativity." According to the online *Encyclopedia of Language and Linguistics* (2005), generative grammar theorizes that the intent and meaning which emergences through logical sequence in sentence structure, is in fact an emergent property which is determinable through calculable formulae, prescribed by the grammatical rules of particular language structures. These rules provide a framework for all the grammatically possible sentences in a language, excluding those which would be considered ungrammatical (Nordquist, n.d.:n.p.).

Colabella's analogy drawn between the generative process in language and in art underscores the kind of exploration into discourse and syntax that Rademeyer has engaged in throughout his career and through which he has allowed visual modalities to emerge. In the press statements released by the Goodman Gallery for his 2011 *Resonant Structures* exhibition, this alignment between art, mathematics and language is expressed as "an ongoing explorative pursuit to find a visual equivalent for language […]

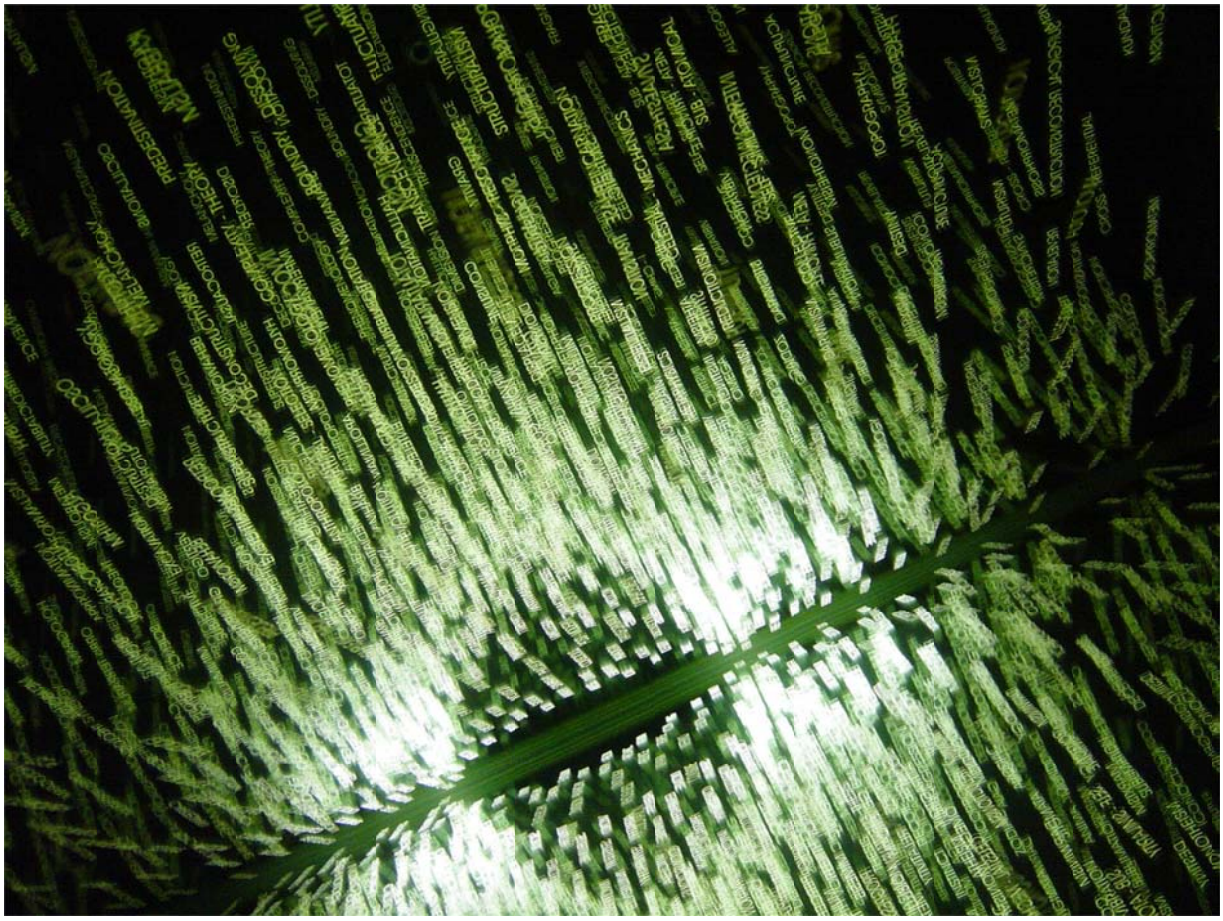
In *Resonant Structures*, Rademeyer considers the language of mathematics, which, he explains "is also a symbolic system, so you can call it a language" (Anon: Goodman Gallery, 2011:n.p.). Writing on his *Surface Depth* exhibition held at the *Warren Siebrits Gallery: Modern and Contemporary Art* in 2004, Frikkie Eksteen[18] (2004: 4) highlights the emphasis Rademeyer places on exposing inter-disciplinary links. Furthermore, he unearths some crucial ideas which align perfectly with generative art principles:

> If Rademeyer's works are mock-ups that freeze-frame the structural movements inherent in semiotic systems this explains the one thing that remains a constant: their composite make up. Modular elements can be many things from digits, pixels and bytes, to words, phonemes and graphemes. There is no reason to stop here; atoms, molecules, cells, chromosomes, and other kinds of combinational micro particles would also make sense, but what is more significant is that a sense of structural coherence is noted. What happens to these elements and their unpredictable swarming can now be put into some context. With *mimetic reconstructions* the composite atoms are words.

Colabella's (2008: 207) declaration that "the G.A. process is strongly connected in similarity to a generative process of language" is demonstrated through Rademeyer's key interest in modularity and complexity in language systems, as outlined in the extract above. Commenting on his 2001 work titled *Mimetic Reconstructions*, Rademeyer reflects Colabella's observation when he says that "single words and phrases" create intersections that "are planned as well as open to the laws of chance, so the work in a sense acts as an information generating machine" (Siebrits, 2004: 2). There is a structural dynamic in language syntax which Rademeyer loves to evoke and throughout his work he can be seen to nurture a relationship between language and mathematics. This interest is exemplified in *Mimetic Reconstructions* presented on his first show at *Warren Siebrits: Modern and Contemporary Art*. In *Mimetic Reconstructions* we are presented with a box. On the top panel we are able to look through a viewfinder into an interior space consisting of two facing mirrors positioned at oblique angles to each other. Words etched into the surfaces of these mirrors create a swarm of reflected phrases seemingly suspended in a dark void. Here the words sandblasted onto facing mirrors are illuminated by soft green light, and reflected off opposing mirrors which are conversely crowded with similar arrangements on

[18] Eksteen was born in Pretoria in 1973. Lives and works in Pretoria. Received his BA(FA) from the University of Pretoria in 1995 and his MFA from the University of Pretoria in 2000. Major exhibitions: UNISA Art Gallery, Pretoria; Bell Roberts, Somerset West; Royal Overseas League exhibitions, Edinburgh and London. Awards and scholarships: SASOL New Signatures (runner up in 1995 and overall winner in 1997), Ekurhuleni (runner up in 1994), Absa l'Atelier (top five merit winner in 2009). (Spier-contemporary, 2010.:n.p.)

their surfaces. Reflected off each other, the words are multiplied creating endlessly new syntactic configurations. Here the matrix of words etched onto the mirrors move toward a point of convergence only to be swallowed by a gaping black hole at a vanishing point. The density and flocking of words becomes thick and illegible, just before the point where they are subsumed into the void. The dense masses of teaming words 'hanging' in space are reflected endlessly in the double mirror surfaces, and through this constant replication they are juxtaposed and reconfigured, creating the impression of a starry sky in which the words have taken the place of astral entities.



[Fig. 1. Stefanus Rademeyer, *Mimetic Reconstructions,* 2001]

In his (2006) catalogue essay titled *The Originality of Translation*, Frikkie Eksteen elaborates extensively on Rademeyer's prevailing interest in language and in the same catalogue the artist himself expresses his interest in structural theory. Rademeyer's interest in structuralism can be seen as a formative influence in the development of his generative processes. Eksteen explains how Rademeyer 'translates' theory as linear abstractions which are generated in a digital process and presented as digital prints (featured on his 2006 show *Ideograph*). In the series of works presented on *Ideograph* Rademeyer

responds to the writings of selected authors, philosophers, artists, architects and musicians through a form of visual paraphrasing. Eksteen (ibid: n.p.) speaks about this as "equations, if not translations, of specific texts." He further notes that "the artist's recourse to the specific selection of authors, whose work either directly or obliquely engages with semantic structures, becomes a pretext for showing the scope of the problem." Eksteen identifies the "problem" as one inherited in the process and debate differentiated firstly by the concept of translation and secondly by the concept of representation. On the point of representation not merely being a form of replication, Rademeyer's (Personal communication, 31 January 2010) says the following:

> The challenge for me, over the years, has been to articulate the true depth of complexity in a visual format that is not merely a 're-presentation', (i.e. a photograph), but develops processes that give rise to complexity.

Rademeyer's interest in how his images could reflect literary and philosophical complexity is best exemplified in the digital interactive works presented on *Ideograph*. Many of these works share an interest in various morphologies in structural processes. Rademeyer (2006: 1) says about the authors /philosophers associated with these works: "Each person I have selected works with ideas conveyed through writings which encompass and make sense of complex structures. This conceptually lent itself quite well to my aesthetic preferences, which are often characterized by structural geometry." Rademeyer's deliberate thematic choices align "a range of intertextual connections, a model of a universe narrative structure, or a system of recurrent patterns of motifs" (Barry, 2002: 39-40) and, to quote Raman Seldon (2005: 76), "everything that is written seems to be governed by specific rules, or a 'grammar of literature.'" In other words, these comments coincide with what Gallanter (2002: 2) says in that "generative art refers to any art practice where the artist uses a system, such as a set of natural language rules, a computer program, a machine, or other procedural invention."

How Rademeyer's images in the *Ideograph* series deal with "intertextual connections, a model of a universe narrative structure, or a system of recurrent patterns of motifs" (ibid) is perhaps best illustrated in his description of his work titled '*knots*,' a computer generated image which engages with text, taken from a short story by R.D. Laing. The print depicts text shown on a grey background derived from R.D, Laing's parody of Jack and Jill. Here the story progresses along a slight upward diagonal. Rademeyer has algorithmically mutated the text and the line from which the script is made is subjected to a process of deconstruction where it is then reconstructed into knotty formations. It is important to

note that in Rademeyer's account of the story he traces a complexity in the narrative on which he models his computer generated image:

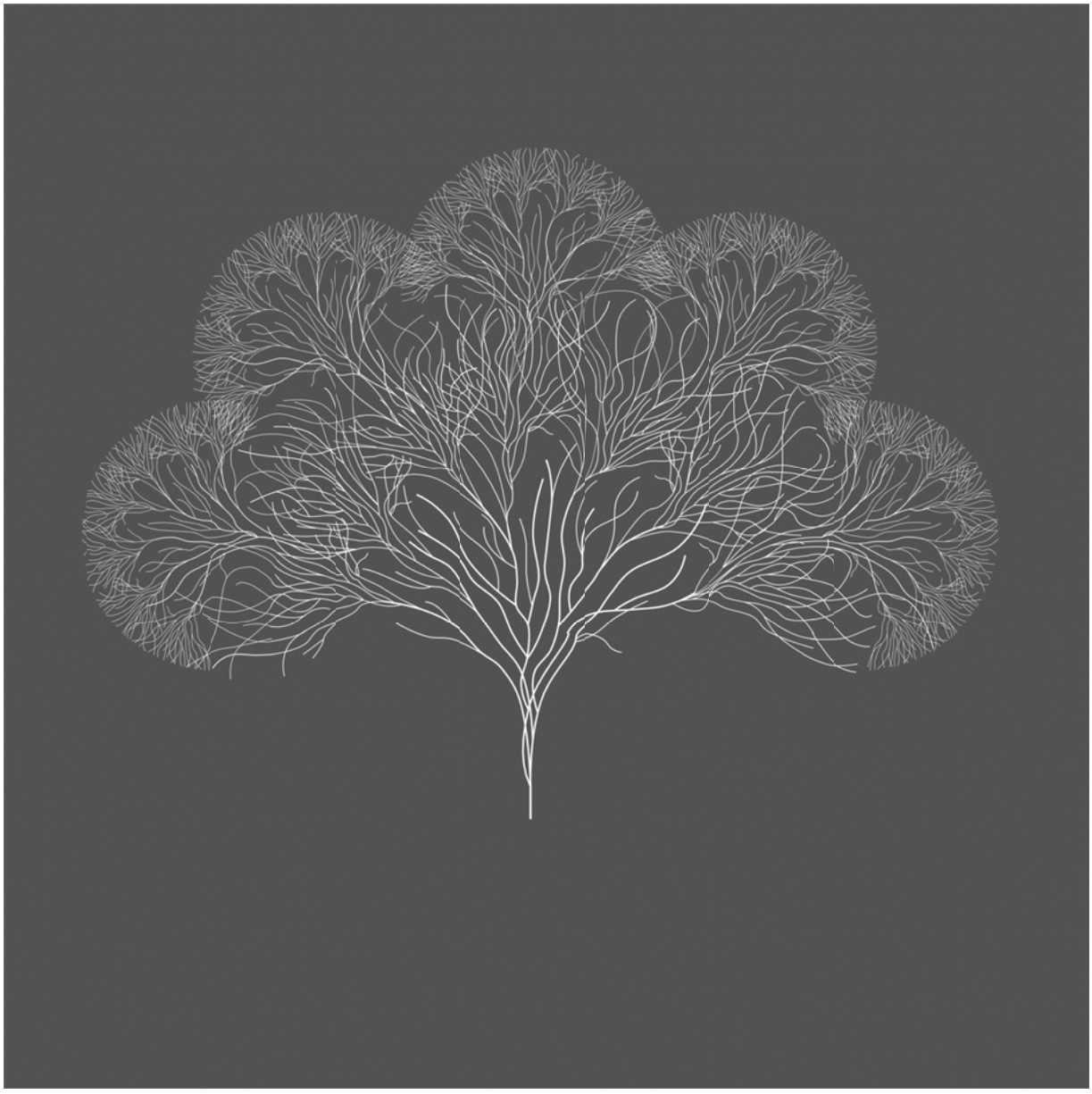
> Laing took the monumental task of mapping out the intricacies, paradoxes and complexities that play out in interpersonal relationships. In a very poetic style Laing used two generic people, Jack and Jill, and traced their convoluted interactions. One area of exploration is the notion of how the self is constituted in a network of reflections and relationships, and how an encounter with the other creates, reinforces and perpetuates identity. The self, which is a link in a complex chain of social interaction and family structures, is often placed in situations where identity is characterized by a distorted self-reflection or perception; it is within these terms that the human drama plays out. I really enjoyed creating this work […] Secondly, If one looks at the perceptual experience of this text, the test is not only mirrored but can also be read from two angles . This for me represents the perspectives of both Jack and Jill and their different perspectives of the same situation. I've then gradually distorted the text as it progresses. This distortion represents the breaking away from symmetry to abstraction, and the contortion of Jack and Jill's relationship. For me this work became a successful illustration of a movement from phonetic language to an ideographic language. '*knots*' for R.D. Laing is therefore a key work in helping the viewer understand the translation from phonetic to ideographic language, where both phonetic and ideographic elements remain contained in the same image (Rademeyer: 2006. 3).

Rademeyer's preoccupation with semantic structure is demonstrated in his work *Branches in Time*. Here he responds to the writing of Argentine author Jorge Luis Borges, more specifically to his 1941 short story *The Garden of Forking Paths*. Borges' short story presents a multifarious narrative that can be read in various ways; it's a hypertext, a structural labyrinth that forks into different directions as the story progresses. The artist employs the metaphor of a tree to illustrate the process of bifurcation (splitting) inherent in the narrative structure. He comments on this idea as follows:

> Borges was an interesting and prolific writer who mainly wrote stories in an academic style. He explored very interesting situations and paradoxes in his work. I did not want to produce a representation of a tree, but rather a diagram where the actual notion of bifurcation would be more visible and better articulated. This bifurcation can be extrapolated from many examples in our environment including rivers deltas, trees, arteries and nervous systems (Rademeyer, 2006: n.p.).

The artist responds to Borges' story and its enigmatic and multifarious plot with a computer rendering of a tree-like structure drawn in a white on a grey background. The endlessly branching drawing is arranged centrally in the composition and starts at the base from a central trunk. This suggests an interpretation of Borges' narrative of *The Garden of Forking Paths* as starting off at a single and defined point and then branching outward. Continual processes of splitting progresses as the paths extend outwards; multitudes of divergent trajectories erupt in plumes at the end of the stems. Rademeyer (ibid) describes this computer generated drawing as an "arborescent" structure, one that is essentially 'hierarchical' and linear, the central trunk being connected to all parts of the super structure and all stems being traceable back to one point. Eksteen (2006: 4) reveals how Rademeyer utilizes a biomimetic metaphor posited in the notion of bifurcation and presents us with a model of how he achieves this visual translation of Borges's story:

> [T]he artist presents a metaphor in the image of conjoined river-like deltas, which is equated with Borges' characteristic way of unfolding and spatialising time in his writing. The symmetry of the structure disguises its internal density however. This image could just as emphatically be a tree, a growth pattern, a nerve or a computer network, or a schematic of a fireworks display. The title finally gives it away, but if one can look beyond it at an open-ended structure that does not describe inasmuch as it prompts the viewer who knows something about Borges' literary idiosyncrasies […] This image is not a literal word-for word translation, but a diagram related to a plan, which like others in this section of the exhibition look beyond the descriptive and at underlying concepts and causes.



[Fig. 2 Stefanus Rademeyer, *Branches in Time,* 2006]

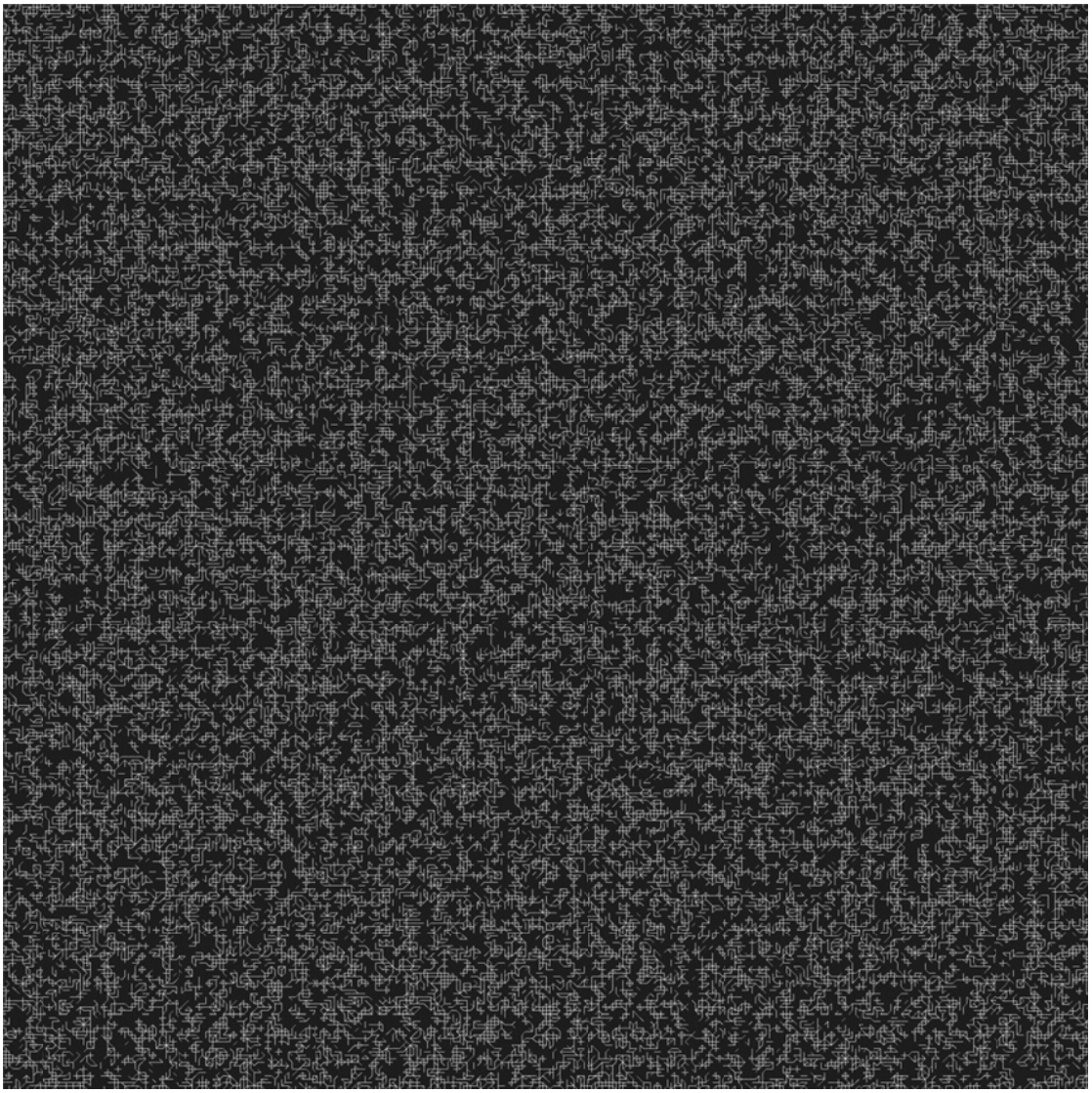
In the work *Rhizomatic,* the opposite of a tree-like or arborescent form is presented; this juxtaposition of rhizomatic and arborescent structures is taken from Deleuze[19] and Guattari's[20] *A Thousand Plateaus*.

[19] Gilles Deleuze 8 January 1925 – 4 November 1995 was a French philosopher who, from the early 1960s until his death, wrote influentially on philosophy, literature, film, and fine art. His most popular works were the two volumes of *Capitalism and Schizophrenia*: *Anti-Oedipus* (1972) and *A Thousand Plateaus* (1980), both co-written with Félix Guattari. His metaphysical treatise *Difference and Repetition* (1968) is considered by some scholars to be his magnum opus. (Anon, n.d.; http://www.amazon.com/Gilles-Deleuze/e/B000AQ3UM4)

[20] Pierre-Félix Guattari April 30, 1930 – August 29, 1992 was a French militant, an institutional psychotherapist, philosopher, and semiotician; he founded both schizoanalysis and ecosophy. Guattari is best known for his intellectual collaborations with Gilles Deleuze, most notably *Anti-Oedipus* (1972) and *A Thousand Plateaus* (1980), the two volumes of *Capitalism and Schizophrenia*. (Anon, nd.: http://www.newworldencyclopedia.org/entry/Felix_Guattari)

Rademeyer responds to texts by Gilles Deleuze in which the author posits a philosophical structure based on the biological root system of the Rhizome. Deleuze and Guattari's rhizomatic modality is, in essence, one which negates hierarchical postulation. Their model is especially applicable to data representation and interpretation, and in the case of rhizomatic structures, access is gained into data structures through planar connectivity rather than through linear entry points. In Rademeyer's graphic drawing *Rhizomatic* planarity is represented in a composition that lacks hierarchy and focal point. *Rhizomatic* is reminiscent of a Jackson Pollock or Mark Rothko field painting; all areas of the composition are treated with equal intensity. Here a veil of lines consisting of tiny marks positioned at either right angles or at fourty-five degrees crisscrosses the length and breadth of the format. The effect is somewhat like a creeping fungus covering the full area of the page. Deleuze and Guattari propose two philosophical structures based on biological metaphors imagined in the form of a "Rhizomatic" and an "Aboresent" structure. According to Eksteen (2006:28), Deleuze describes these modalities as an "image of thought" and Rademeyer (2006: 2-3) speaks about how he gives form to these organic imaginaries in his own computer generated drawings.

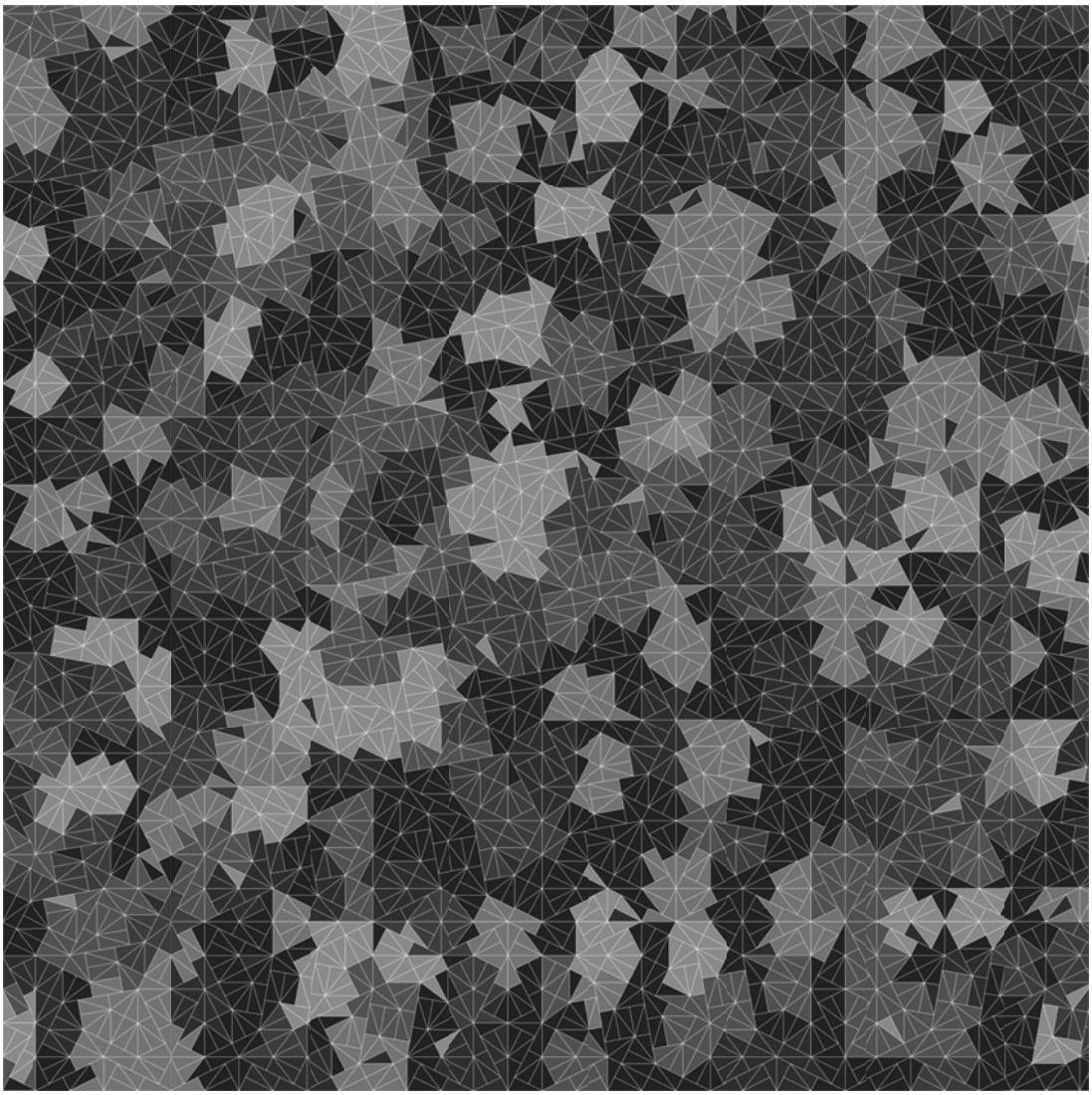
> I decided to deal with two key concepts which are intimately related. 'Rhizomatic' works in opposition to 'aboresent,' or tree-like structures. Deleuze maintained that the organization of history, society, literature and classification was done according to an arborescent system where there is a central core with branches. It is therefore a structure that is hierarchical and is defined by very specific boundaries. It is also vertical and this represented for Deleuze a hierarchical ideology. In contrast the 'rhizomatic' structure is horizontal and consists of a series of nodes that are links into a network that is decentralized. I worked with a computer algorithm to grow a 'rhizomatic structure using very specific variables. These variables consist of four lines, one horizontal, one vertical, one diagonal from left to right and the other from right to left. It is through variation and the various relationships between these lines that the work is created, never forming a single area of repetition. For Deleuze a 'rhizomatic' system was a distributive, decentralized structure that can connect different ideas. The 'rhizomatic' is also a good example of the strong aspects of synthesis in his thinking, often taking diverse sets of ideas and linking them together.



[Fig.3. Stefanus Rademeyer, *Rhizomatic,* 2006]

In the work *Smooth and Striated*, Rademeyer paraphrases Deleuze again. In what is not a geographical theory but a philosophical metaphor, Deleuze defines 'smooth space' as a conception of spatiality that can be understood through directionality. In other words, spatiality is conceived through vectored trajectories, pathways and points. Smooth spaces are defined by arrival points that can only be coordinated through retroactive retracing of a preceding path or journey. *Striated*, on the other hand, presents coordinated spaces, intervallic, rhythmical and segmented. Rademeyer responds to this idea with a computer generated print in which we see a crystalline surface made up of triangular polygons which are interwoven across a grid. The surface looks three-dimensional and is rendered in delineated

planes toned in different shades of grey. This effect gives the appearance of a kind of virtual typography of undulating mountains as if viewed from above.

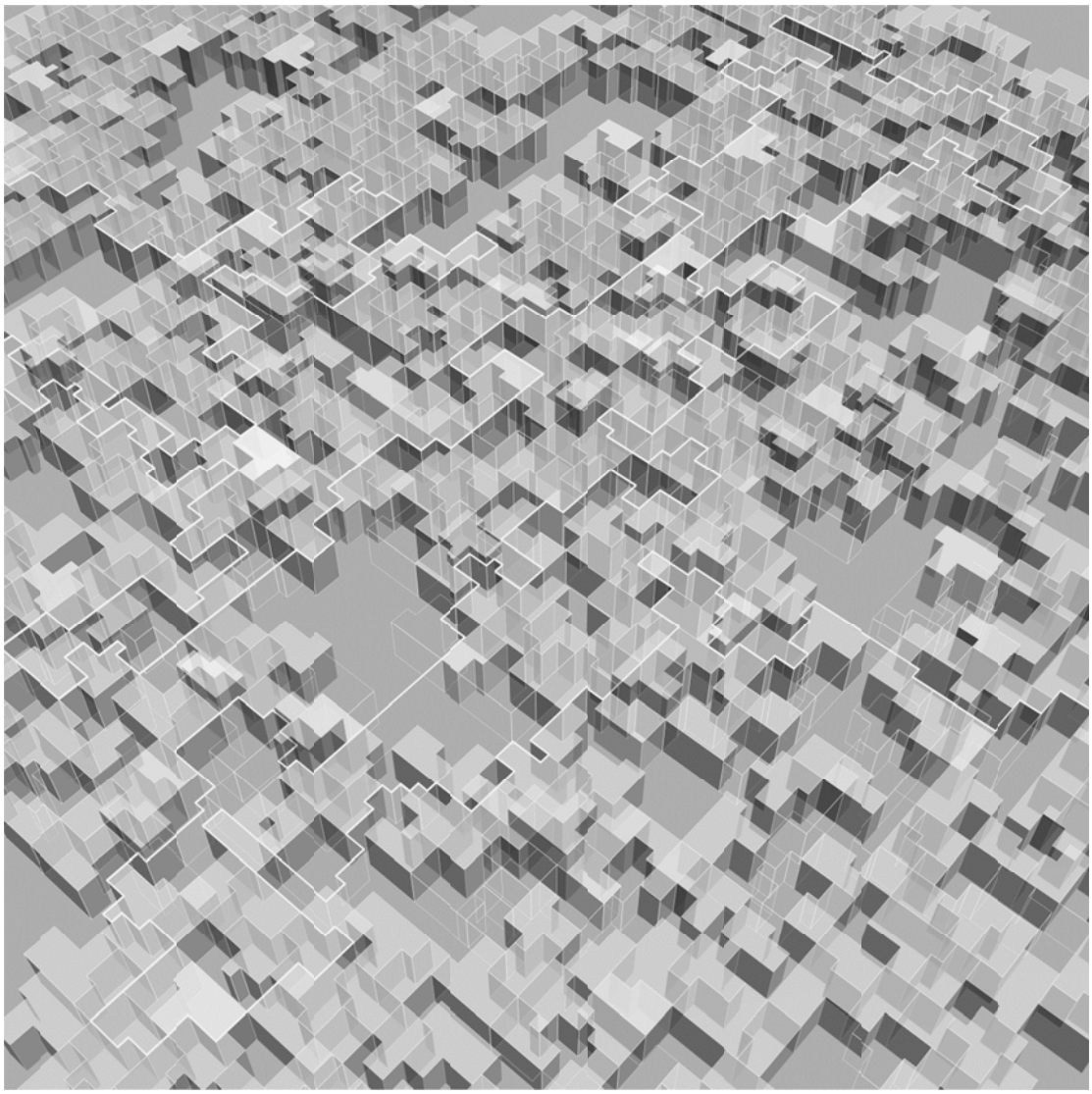


[Fig.4.Stefanus Rademeyer, *Smooth and Striated*, 2006]

Smooth and Striated is compositionally similar to *Between the Lines* which is essentially a response to the architectural philosophy of Daniel Liebeskind (reading between the lines of his Jewish museum design in Berlin).[21] As in *Smooth and Striated, Between the Lines* presents a kind of typography, albeit one that is more like a city grid seen from above and at an oblique angle. Here we are reminded of the

[21] The Jewish Museum Berlin, which opened to the public in 2001, exhibits the social, political and cultural history of the Jews in Germany from the 4th century to the present. […]The new design, which was created a year before the Berlin Wall came down was based on three conception that formed the museum's foundation: first, the impossibility of understanding the history of Berlin without understanding the enormous intellectual, economic and cultural contribution made by the Jewish citizens of Berlin[…](Studio Daniel Libeskind, n.d.:n.p.).

labyrinthine drawings by M.C. Escher[22] as thousands of passages intersect the packed grid made up of blocks varying in height and depth. The tiny blocks are rendered in varying shades of grey, giving the impression of a cyber-city depicted in a primitive form of computer graphics. One line drawn through the virtual streets and rooftops appears in this composition as if to suggest a route which is mapped out onto the topography. Through this gesture of 'outlining' Rademeyer is perhaps mirroring Liebeskind's memorialization as a kind of historical walk through the city of Berlin.

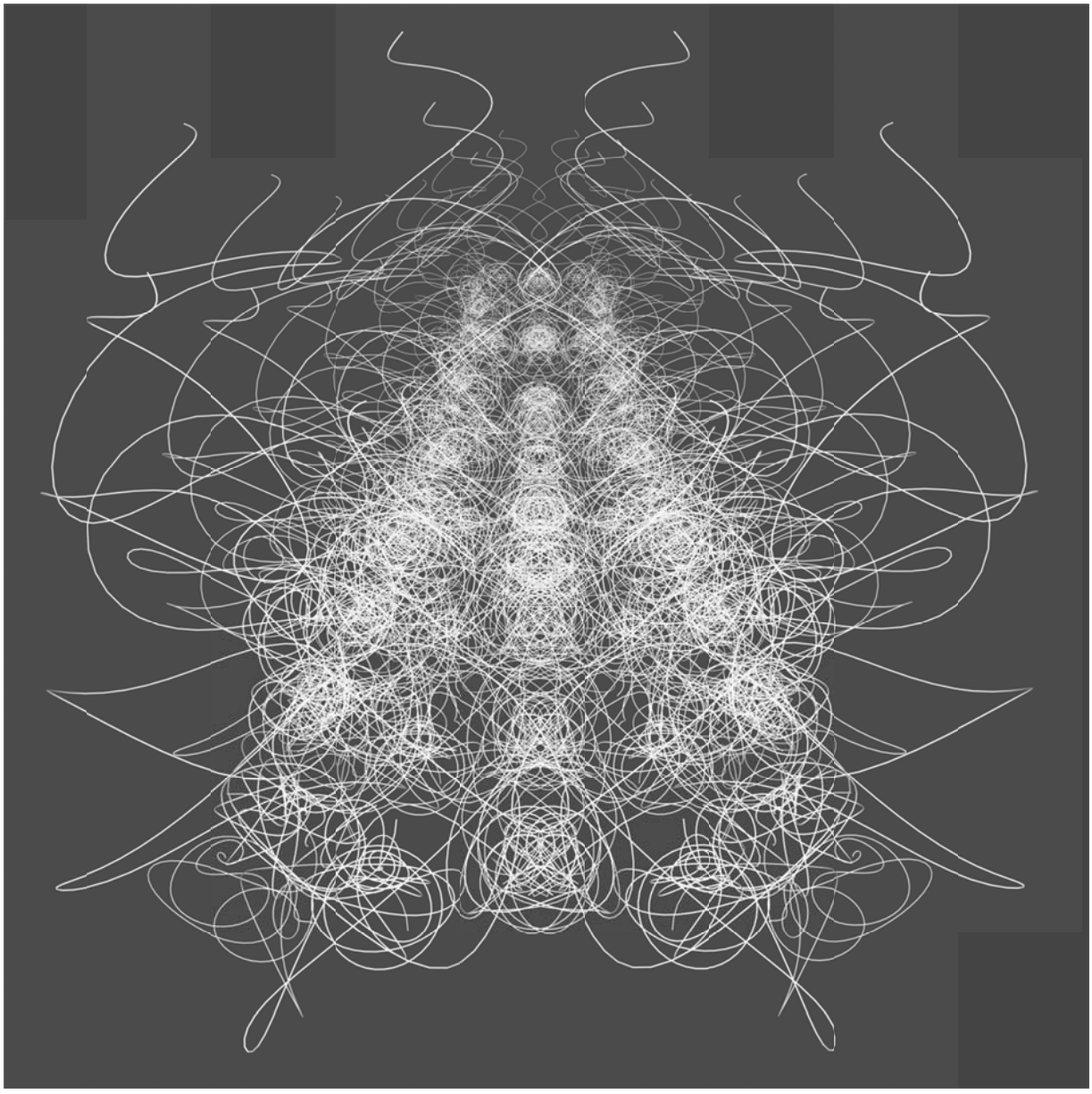


[Fig.5. Stefanus Rademeyer, *Between the Lines* ,2006]

[22] The Dutch artist Maurits C. Escher (1898-1972) was a draftsman, book illustrator, tapestry designer, and muralist, but his primary work was as a printmaker. The national Gallery of art (The Collection, National Gallery of Art, nd.:n.p.).

Symmetriad, based on Stainslaw Lem's [23] science fiction novel *Solaris*, shows a linear 'scribble' much like a Rorschach drawing's fold to create a vertical symmetry, a bilateral mirror projection. Rademeyer uses bilateral symmetry here to illustrate the psychological principle of 'projection.' Solaris, in Stainslaw Lem's science fiction novel, is essentially a planet which has the sentient capability of presenting those who dwell thereon with projections from their own minds. Stainslaw Lem engages with the idea of self-reflection which Rademeyer interprets and represents as a symmetrical entity.

[23] "Stanislaw Lem, a Polish science-fiction writer who, in novels like "Solaris" and "His Master's Voice," contemplated man's place in the universe in sardonic and sometimes bleak terms"(SIisario, 2006:n.p.).



[Fig.6. Stefanus Rademeyer, *Symmetriad,* 2006]

Eksteen's catalogue essay accompanying these works is largely concerned with Rademeyer's translation of language into image, not in the literal sense but rather in a way in which the original text becomes a (generative) catalyst to a new kind of visual output, i.e. through a process of abstraction. As the image is processed and departs from the source, it is rewritten to become its own entity with little relation to a referent. Eksteen (2006: 25-29) points out how Rademeyer's work departs from the literary referent to

form parallel entities rather than simulations of the original texts.[24] The process, by which Rademeyer's artworks depart from their literary source, brings into focus the notion of 'mutation.' In dynamic processes it might be expected that entities that are lunged into motion, their molecules or units jostling, colliding and merging, mutating through dynamic interaction, would inevitably lead to new entities dissimilar from earlier forms. The same analogy can be applied to language (aptly posited in the notion of morphology), and still the same can be applied to processes of digitization. Eksteen (2006: 26) notes how the process of digitization acts as a key player in transforming Rademeyer's visualizations as they move from the referent or the source into artworks or "targets" as he puts it, but he problematizes this translation, carefully unpacking the mechanically calculated and systematic way in which the mutation takes place from the organic into the digital:

> With digitization we have something that is much more like a uniform current or pattern, than a language. And unlike language, which is structurally considered a fickle thing - notorious for unlikely syntactical and grammatical exceptions there is something much more regulated and stable about digital encryption of information. The uniformity of the message – comprised of homogenous patterns of zeros and ones- assure its translatability, and the data stream can be easily converted into analogous configurations. In other words, do not be deceived by the immediacy of the voice recording. It has no more substance than the obviously digital simulation which resonates with its every move. Although it might once have registered someone's actual words, it now literally exists as something insubstantial: as 'nothing but patterns and numbers.

From Rademeyer's exhibition *Ideograph* (2006), the works titled *Branches in Time, Rhizomatics*, *Smooth and Striated*, *Between the Lines* and *Symmetriad* can be seen to deal with a process through which philosophical schema are re-written, modified and mutated into entirely new forms. The resultant visualizations that Rademeyer arrives at exist autonomously from their referent and in this respect they are not referential works but evolutions and mutations of the original. They are governed by self-contained systems that are vital, autonomous and exclusive, separated from their literary reference points. These dynamic qualities, which are concerned with the reconstruction and mutation of systems of meaning, are in line with a generative philosophy, and have interested Rademeyer for much of his

[24] Eksteen sees this as an indictment to Jean Baudrillard, who, in an attempt to "reverse Plato," claims that we have entered a phase where the image has "no relation to any reality whatsoever" and has "become its own simulacrum." Eksteen assures us though, that Rademeyer's works "have come into being not with the purpose of placating their origins, but transgenic mutants that have exited the atmosphere to generate a reality beyond the supremacy of traditional referents" (Eksteen, 2006: 27).

career. This kind of thought process appeared for the first time in Rademeyer's early work *Mimetic Constructions*. Eksteen (2004: 4) points out that in *Mimetic Constructions,*

> [u]ltimately one comes to suspect that the aim is to create a self-enclosing sphere of reference that refuses direct citation. If considered as a language, it is a meaning machine that achieves perpetual motion by reprocessing its own structural possibilities. And consistent with this line of thinking, if any reference is made to something outside of this system, it is oblique and through metaphor, and not through overt or intended similarity.

From Eksteen's comment above it is evident that the translation process in itself forms one of the necessary drivers in this process of mutation (mutation could be seen as an emergent property of generative process). Furthermore, since Eksteen has established that Rademeyer's translation process is not one of simulating the referent or of providing the visual equivalent of the referent but rather creates a parallel response to the structural concerns inherent to the referent, the resultant works should be seen more as 'emergent properties' rather than simulations. Rademeyer's works are created through concepts that are sieved through a translation filter. They are recoded and ultimately, as Baudrillard (1994: 125) claims, they begin to "silence the sign." Mutant structures in this case are born out of the process of translation. Here we are speaking about a process of abstraction (this is if we follow Mondrian's logic through which the referent 'trees' are processed into an arrangement of grids, colours and patterns over time) (Eksteen, 2006: 26). Citing a process of abstraction through the example of Mondrian, Rademeyer's process can be seen to produce its own abstractions through the channel of translating information from a referent into an image. This idea sits well with Michael Whitelaw's (2005: 1) proposition that an abstraction of sorts is the inevitable conclusion of a generative process. Noting Whitelaw's theory, we need to consider that Rademeyer is in fact using the translation process in two distinct ways, firstly, that he genuinely wants to commit to understanding the complexity of the texts he likes to reference, and secondly, that through the understanding of the structural composition of these texts, an opportunity arises for generating new aesthetic modalities through an interdisciplinary conduit (Eksteen, 2006: 25-29).

In cases such as *Branches in Time, Rhizomatics, Smooth and Striated, Between the Lines* and *Symmetriad*, the way in which the relationship between a referent (source) and the artwork (target) is negotiated might provoke the question that calls for representational and generative processes to be singled out and separated. If cited as part of a generative process it could be said that a referent could become part of the source code that generates new formations, in other words the referent is usurped

into the processual aspects of generativism. Equally, it could be said that the referent is merely subject matter, but in this case I think not. In the instance of *Branches in Time, Chance Operation, Rhizomatics, Smooth and Striated, Between the Lines* and *Symmetriad*, a specific algorithm has to be designed from scratch and must produce a visualization that equates to (not re-presents) the theoretical construct which Rademeyer is trying to evoke. This is not a process whereby Rademeyer is mimicking the original; rather he is designing and processing in response to an ideological canon.

The actual translation process observed in Rademeyer's prints seems cumbersome to define in generative terms and is not known unless one is given direct access to the technical process of algorithmic programing which Rademeyer purports to have employed. It is simpler to explain the generative patterns suggested in the video animation work entitled *Audiograph III* because here we are able to see 'process' and 'mutation' as it takes place in real time. With *Audiograph III* we are presented with an audio voiceover in the form of a conversation between John Cage and Marcel Duchamp, and in this case the audio can be considered as the referent. For the sake of explaining the processual sequences I will call this audio the 'primary input value' symbolized as input A. This value (A), after being processed through a series of digital mutations, is outputted as an image which I will call 'the auxiliary output value B' (B). In the course of digital mutation, A mutates into B, therefore A=B. In this case we cannot distinguish when or where A mutates into B and (we might thus deduce that they are part of the same system). However, in the case of a representational model, B (image) stands in for A, essentially B is a simulacrum of A. This simple equation essentially illustrates the basic difference between a representational process and a generative one. In the following extract Eksteen explains how in *Audiograph III* we are presented with a simple monochromatic animation where soft undulating waves ripple from the screen center, vibrating and reacting in respond to the voices of John Cage and Marcel Duchamp. Herein we see how referent mutates into image, fortifying this work's place in the generative tenet. Eksteen (2006: 26) elaborates:

> Rademeyer presents a fictional conversation between John Cage and Marcel Duchamp, created from a series of unrelated sound clips, which is algorithmically plugged into the substance of the image. Sometimes the sound registers as ripples on a liquid surface, and at others, as a crystalline solid, triggering the vertical displacement of elongated three-dimensional pixels in wave-like forms. The close correspondence between sound input and visual output creates results that are surprisingly abstract, but unmistakably causal. Both sound and image, source and target, irrespective of which of the two the viewer identifies as the origin, speak a digital or programmatic language comprised of that most adaptable, and according to some, most volatile of mediums: binary code.

> Both the source and the translated message are presented at once, and the visual relates to the sound in much the same way as a seismograph would record geological activity, except that the inflection and modulation of the voices are what registers within the matrix.

When tracing the development of Rademeyer's concern for generative processes it is notable how he draws from diverse fields in which systems-based and generative processes are ubiquitous. Eksteen sites Rademeyer's preoccupation with language syntax as one such example, in this sense, dialectal formations become carriers of the generative processes. In the case of his work *Branches in Time*, for example, Rademeyer engages directly with the content of texts (which he references from Borges *The Garden of Forking Paths)*, by paraphrasing the syntactic structure of the story through a computer graphic. Perhaps Rademeyer is suggesting in this gesture that syntax is an interchangeable entity between visual and language-based systems. Matt Pearson's (2011: xxxviii) statement: "Rules exist, they're for breaking […] but not the rules of programming syntax" points to this too. If we replace the word "programming" in Pearson's statement above with "English" or "Zulu," for example, the proposition still rings true, thus illustrating the structural connectivity between spoken languages and computer languages. This is indeed the case in Rademeyer's work *Branches in Time.*

In the following passage taken from an interview with Warren Siebrits, Rademeyer (2004: 2) explains how he interweaves discourse with formulae in his work *Smooth and Striated*, demonstrating how he initiates an idea which allows for an interactive visual dynamic to be made possible through computational processes, i.e. one in which mathematics, language and art intersect:

> In his book *A Thousand Plateaus* there is a chapter, smooth and striated, where he (Deleuze) entertains the notion that an ideologically oppressed and organized society can be compared to a grid, with specific boundaries where everything within those boundaries can be located and controlled. This grid is defined as 'striated space,' which Deleuze contrasts to smooth space. I've created a visual metaphor for the relation between these two structural understandings of society: using a geometric sequence created by Texan mathematician Charles Radin, I complicated it further by overlaying and building in another level of determinate symmetries. So this aperiodic tessellation can distribute along the x and y axes in all directions and there will be no periodic repetition along the surface. This ideograph for Deleuze represents the infinite variation and the 'rhizomatic" nature of smooth space, punctured by territories of 'striated space.' What I have done is create a kind of landscape that has the characteristics that are defined by control and boundaries along with notions of free distribution.

Part 2

The development of the generative process in the work of Stefanus Rademeyer:

Code and modular processes

With specific reference to virtual and digital design realms, Soddu Celestino (2000: 293) claims that generative art relies on the "existence of a code, of an identifiable and designed DNA that represents the idea," and Whitelaw (2005: 1) similarly claims that generative art relies on the "processual relations of coding and aesthetic output." Rademeyer's work has moved increasingly towards territory in which the hallmarks of generative art have become more pronounced. It has been a slow and steady acquisition of the pieces that form the basis of an art form that is truly generative. Key to the design of a generative artwork is the existence of programs, code drivers, algorithms or sequences through which entities can grow autonomously, morph and change. Albeit that the process of designing these algorithms is a laborious one, the artwork is built automatically from the subsequent design. Rademeyer (Personal communication, 31 January 2010) comments on this process:

> In the case of digital drawings or 'prints,' I spend months refining my algorithmic code to create a structure of sufficient detail and complexity. This also involves repeatedly printing out the images at very high resolutions, looking at them carefully, returning to the digital drawings and altering the code. By translating the images into a printed format, I can work in large formats and high resolutions that are currently impossible on screen displays. Archival paper and pure pigment inks also bring it back to the world of rich contrasts, textures and nuances.

Rademeyer's computer generated images are relatively recent developments in his oeuvre. This type of production featured for the first time in his second show, *Ideograph*. However, these explorations into fully automated computer generated images are predicated on prior investigations exploring the concept of modularity. Rademeyer (ibid) comments that "nowadays my drawings are almost all digitally based. Computers give one an advantage in testing out models or what I call 'modular processes'." He adds that "most forms in the natural world are created through complex repetition, and lots of it! So with a computer I can create a model or two-dimensional drawing that contains a large number of repetitions." As Eksteen (2004: 6) notes, "[m]odular elements can be many things from digits, pixels and bytes, to words, phonemes and graphemes," and in many of Rademeyer's works he vacillates between

virtual, physical and mental expressions of this modularity, claiming that "most of the work that I do involves transitions from one dimension to another."

Throughout Rademeyer's work the modular element can be seen in various forms. In his 2004 sculptural works such as *Fracture* and *Tremor* the modules or units appear in the form of laminated wooden segments which together form composite, monolithic structures presented on wooden tables/supports. They appear solid and imposing in their mass, but as Eksteen (2004: 4) points out, "too many clues about construction processes come into view to allow one to assess them as solid, coherent units." The digital or modular fragment is what "fractures their monolithic confines" and "interrupts the surfaces of their otherwise stoic bulks." Eksteen further points out that "as a viewer one cannot help but re-enact the manufacture of these composite structures in reverse," the stacking and interlocking of units "produces innumerable geometric possibilities."[25] A code fixes a specific pattern of mutation in each of these works which were in fact initially designed on computer, i.e. it is through a "process of complexification" that the individual modules were, as it were, imbued with behavioral qualities to achieve the resulting "controlled agitation of the surfaces." Rademeyer (Personal communication, 31 January 2012) he comments:

> In the wooden sculptures, this phase is usually characterized by cutting and shaping a few modules or 'building blocks' that can assemble in complex ways. This assembly is determined by the structure and dimension of each individual module […] The next step involves visual perception, optics and a tremendous amount of labor, physical and mental. With the earlier wooden pieces, this phase involves assembly of modules, which usually involves an additive process, where the structure gradually emerges as a three dimensional form.[26]

The work *Tremor* is described by Eksteen (2004: 5) as "agitated and jagged, aggressive and hostile, a wave-form landscape that is at once sublime and inhospitable, but in spite of its severity a regulating geometry returns, creating block-like compartments of bundled L-shaped units that tower from and

[25] When I asked Rademeyer to comment on the fact that one reads many of his works as having been made up of segments over time and as engaging in a sequential form of making he replied: " This relates to process, and involves what I would call 'complex temporal repetition.' The temporal dimension is folded or translated into a spatial dimension. One can trace the 'growth,' accumulation of modules over time by looking at the final structure. A tree and its rings, or a coral and its growth are worthy comparisons." (Personal communication, 31 January 2012)]

[26] When asked to comment on his choice of material for these sculptures, Rademeyer (Personal communication, 31 January, 2012) said that he had worked in a range of materials including "light, paper, steel, Timber, glass, 'sound' … it really depends on which material is best suited for the expression of an idea and process. Timber is relatively easy to process and translate into specific form or module that is assembled into an accumulative structure." And asked whether the works of South African sculptor Willem Boshoff (known for his collecting and use of varieties of wood in his conceptual sculptures) had made any significant impression on him, he replied: "I have been admiring Boshoff's work from an early age, and the translation of language into form. I do however think it is more a case of both of us sharing the same influences … Conceptual art and American minimalism from the 70s."

recede into its unstable bedrock. Much more compartmentalized and less organic than its predecessor [*fracture*], the result reminds of a cityscape. A city in ruins might, however, be even more apt. The titles of this group of works, *Utopia, Fissure, Fracture, Tremor*, all point to a focus on process, as Eksteen points out, not just a state of being. Besides connections to geological features, they could also reference processes connected with "acoustics, biology, physics, chemistry, computer science, information science, economics, sociology, psychology, anthropology, communication theory etc. No specified reality is abstracted or distilled. The structures are not that forthcoming […] [a]t base, the artist presents the viewer with a structural transformation where some kind of interference unsettles matter or substance, but what kind of matter, and what kind of process we are dealing with, is not clear." Eksteen goes on to say "I would venture to say that it is language, but this suggestion doesn't make things any easier, since all complex systems seem to possess a language or at least a kind of logic, of their own" (ibid: 6).



[Fig.7. Stefanus Rademeyer, *Utopia*, 2004]

In the subsequent sculptures of this group the module (a single wooden unit) might have previously been thought of as an inert or passive component, possessing no internal dynamic and having no influence over the larger structure. However, since these works were initially designed digitally, Rademeyer was able to conceive of the module, by way of a "structural computation that generates its own model," as an active entity (ibid). In this respect, the module no longer functions as a brick in a wall through which the lay and direction becomes the result of an outside-in design process. Rather, the

module acts more like a living cell and it contains a complete instructive sequence (like DNA) that is ultimately imbued with a sense of 'purpose.' A module of this nature would therefore be capable of effecting change in the larger structure; the module might influence the whole while still keeping it intact. We might think of these units as having a co-operative 'conscience.' Early works such as *Fracture* and *Tremor* demonstrate Rademeyer's awareness of how life works like this - that is from the inside out, from the neutron, to the atom, from the atom to the molecule, from the molecule to the cell, etc. In the monumental wooden sculpture *Tremor* we witness a disruptive force that generates from the innards of the wooden bulk.



[Fig.8. Stefanus Rademeyer, *Fissure,* 2004]

The works *Utopia, Fissure, Fracture, Tremor*, are four wooden monoliths on solid wooden plinths that stand roughly one meter high (plinth not included), two meters across and 400mm deep. The plinths serve as a form of stand for his laminated structures but they also suggest themselves as work benches where the cut and arranged blocks we see on top seem to have been shaped on the surface of the table.

Together with the plinths, the proportions of these sculptures somehow address something fundamentally corporeal. There is an account about Tony Smith's 1962 work titled *Die* that speaks of such a relationship to human scale. The work is a "six-foot cube painted black and is considered a classic minimalist sculpture. When Smith was asked "why didn't you make it larger so that it would loom over the observer?" he replied: "I was not making a monument." When asked, "Then why didn't you make it smaller so that the observer could see over the top?" he replied, "I was not making an object." (Tony Smith, quoted in Robert Morris, "Note on sculpture, Part II," (Artforum October 1966), cited in Risatti, 1989: 45), *Metaphysical Implications of Function, Material, and Technique in Craft*). As Risatti (ibid) points out:

> What Smith was making was a sculpture. The size, six feet high, is very significant; it is the size of the ideal human body. Leonardo da Vinci's universal man, a standing figure with outstretched arms circumscribed within both a circle and a square, would fit in this cube. This was Smith's reason for insisting on a height of six feet. The important point is that the body relates to this sculpture, even though it is an abstract sculpture, as to another body in space; it is not a relationship between the body and something that extends or adorns it, something that can be held like an applied-art object. This body-to-body relationship also occurs with figurative sculpture. A statue of a human figure is conceptually engaged by the viewer as one would engage another human being, not as one would an object.



[Fig.9. Stefanus Rademeyer, *Fracture,*2004]

Rademeyer's wooden forms seem to have a similar dimensionality to them and when asked about why this sculptural dimension was important to him and how he sees the two dimensional and the three dimensional interrelating, he (Personal communication, 31 January 2010) commented as follows:

> Regarding dimensionality, most of the work that I do involves transitions from one dimension to another. There is a logic to this process which makes it possible to construct extremely complex forms very systematically. This relates closely to the concept of modeling, where one would create a simplified model of a process existing in the real world, maybe the crystallization of a rock formation, and first articulate this with a series of

> lines, which are then extruded into planes, volumes and multiplied in aggregates. Hence the title 'surface depth.'

On his *surface depth* exhibition several computer drawings (in the form of grid patterns) accompanied the sculptural works identifying the original computer design towards the construction of each of the works and thus provided insight into how Rademeyer had used computerized design processes as a visualizing tool for the sculptures.

In the digital works that recall biological structures such as *Branches in Time*, Rademeyer imbues modularity (in this case vectors) with more 'free will,' so to speak. Here the outcome of the arborescent structure is a lot less controlled than in the case of the module presented as wooden blocks in *Tremor* and *Fracture*. In *Branches in Time* we witness a surprising myriad of abstraction that reflects a more complex form of generative thinking. But this only becomes possible since branches in time is a computer generated work which is uninhibited by physical space and organic human computation. As Eksteen (2006: 7) notes:

> Generating or making changes to an image (digital) is not, as it used to be, a cautious form of imitation, but a structural computation that generates its own model. Images are algorithmically translated and encoded into composite elements that have little if any tangible relation to an external source and appearances are not matched but calculated. The digital image might give the impression of resemblance, but similarity is an add-on of the clustering of fragments that follow the rules of a code. To understand this kind of simulation, a specific operational configuration has to be invoked where the smallest indivisible elements in a system, like subordinate constituents in a composite eye - which, paradoxically, are again divisible into even smaller cells - serves as a model of generating the whole. What is key to the whole exercise is the fact that these nuclei can be tampered with to achieve a new kind of synthesis. I obviously have Rademeyer's model in mind here, since like atoms in a crystal, they are independent entities that cluster into a bigger structure determined by the micro physiology. Another revealing example of this kind of operational model is DNA, a cellular program which is no less a mirror of the entire organism, and which if distributed, produces unlikely mutations.



[Fig .10. Stefanus Rademeyer,*Tremor*, 2004]

In much of Rademeyer's hand crafted works, the evidence of modular dynamics can be seen to the naked eye. This is particularly evident in *Utopia, Fissure, Fracture, and Tremor;* however in his digital prints this process is less exposed. Through the delicate and intricate calculative ability of computers, modularity is subsumed into a microscopic world that speaks of an extraordinary level of order. `For Rademeyer (Personal communication, 31 January 2010), "order refers to degrees of symmetry. Symmetry is popularly regarded as a bilateral mirror reflection, but the word actually refers to any structure that exhibits a degree of order, of 'design' if you will." He continues: "My oeuvre in general can

be seen as an exploration of different orders of symmetry. Geometrically and mathematically my later works are definitely more complex. But this is part of a developmental process, once I have familiarized myself with a system that exhibits specific symmetrical properties, I can use that knowledge to create works that exhibits more complex symmetries." He further explains how his conception of symmetry is linked to modularity: "If I throw a hand-full of sand onto the ground, the pattern in which all of the sand particles fall can be described as having symmetrical properties. The more complex the symmetry, the more information it takes to describe the exact geometric properties of that system. Very complex structures exhibit what is sometimes called 'deep-symmetry'." Rademeyer's conjuring of modular units exemplified by the use of sand particles in this case, can be seen to illustrate processes in which modular behaviors are observed in dynamic contexts.

Part 3

The development of the generative process in the work of Stefanus Rademeyer:

Complexity, order and chaos, biomimesis

> A Complex System is any system which involves a number of elements, arranged in structure(s) which can exist on many scales. These go through processes of change that are not describable by a single rule nor are reducible to only one level of explanation; these levels often include features whose emergence cannot be predicted from their current specifications. Complex Systems Theory also includes the study of the interactions of the many parts of the system (Kirshbaum 2002: 1).

If, as Enrica Colabella (2008: 206) claims, "the word generativism can describe the process of gaining the result of complexity," Stefanus Rademeyer's work is certainly exemplary hereof. He is interested in the notion of complexity through which predictable behavior of simple entities is rendered unpredictable, and where systems behave in ways that their designers cannot anticipate. This is not to suggest that Rademeyer is interested in the complete disembodiment of form through the unpredictable forces of chaos and entropy.[27] Rather, it is to suggest that he embraces reconstructive properties of forms which emerge through the subtle interplay between predictable and unpredictable systems, or as he (Personal communication, 31 January 2012) puts it, "in order to create forms that resemble the natural world more closely, I am employing random structuring principles more frequently within the work. This is probably the only way to get variegated, fractal, serrated, labyrinthine, circuitous, organic properties." This interplay between randomness and organization, however, is seemingly not so much designed into

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[27] en·tro·py

noun

1. Thermodynamics.

a. (on a macroscopic scale) a function of thermodynamic variables, as temperature, pressure, or composition, that is a measure of the energy that is not available for work during a thermodynamic process. A closed system evolves toward a state of maximum entropy.

b.(in statistical mechanics) a measure of the randomnessof the microscopic constituents of a thermodynamic system.

2.(in data transmission and information theory) a measure of the loss of information in a transmitted signal or message.

3. (in cosmology) a hypothetical tendency for the universe to attain a state of maximum homogeneity in which all matter is a uniform temperature (heat death)

4.a doctrine of inevitable social decline and degeneration

(Dictionary com, n.d.:n.p.)

his process of programming and building than it is the result of millions of compounded actions which start to generate random occurrence. It may sound illogical to say that computers engage in random processes, yet through the visualizations presented in generative graphics of fractals, as has been observed in the Mandelbrot set[28] properties of 'chaos,'[29] this is so much so as to have generated an entirely new field of mathematical study known as Chaos theory. Rademeyer (ibid) comments:

> In ancient Greek culture 'chaos' was regarded as a state of matter without form, formlessness. Nowadays, in theoretical and applied physics and mathematics, when they speak about chaos they usually mean 'deterministic' chaos. Deterministic chaos refers to systems and processes that are in theory deterministic but which cannot be accurately predicted given the initial set of conditions. In terms of our discussion, I think the word 'chaos' would refer to indeterministic or random properties embedded in the processes used to generate the artworks.

Matt Pearson (2011: xxxii) points out that "[o]rder and chaos, simplicity and complexity, the mechanical and the organic, aren't necessarily at opposite ends of the spectrum. They are symbiotic, intertwined." As a general rule, the reiterative actions and slight changes in command sequences in algorithms that generate visual effects can result in visualizations which reveal chaotic elements. Rademeyer (Personal communication, 31 January 2012) explains how, with regard to his elaborate arborescent prints exhibited on *Resonant Structures,* "random elements are really integrated into the symmetrical structuring principles that govern the work. One could say that order and chaos is really dovetailed within my work."

Commenting on features of order versus chaos in his work, Rademeyer (Personal communication, 31 January 2012) points out that:

> In order to create forms that resemble the natural works more closely, I am employing random structuring principles more frequently within the work. This is probably the only way to get a variegated, fractal, serrated, labyrinthine, circuitous, organic properties. However, as I have explained, these random elements are really integrated into the symmetrical structuring principles that govern the work. One could say that order and chaos is really dovetailed within my work.

[28] The Mandelbrot set, named after Benoit Mandelbrot, is a fractal. Fractals are objects that display self-similarity at various scales. Magnifying a fractal reveals small-scale details similar to the large-scale characteristics. Although the Mandelbrot set is self-similar at magnified scales, the small scale details are not identical to the whole. In fact, the Mandelbrot set is infinitely complex. Yet the process of generating it is based on an extremely simple equation involving complex numbers. (Dewey, n.d.: n.p.)

[29] "The name "chaos theory" comes from the fact that the systems that the theory describes are apparently disordered, but chaos theory is really about finding the underlying order in apparently random data" (IMHO, n.d.:n.p.)

As Rademeyer notes above a random factor or 'chaos' seems to produce structures that closely resemble natural formations. Such is the case in Rademeyer's *Arborescent Geometries* in *Resonant Structures* series which features computer rendered drawings inspired by Fynbos[30] plant species. Rather than looking towards models of complexity in mathematics and science, Rademeyer has invested in a kind of complexity which presents itself in local biomes, in particular Fynbos biomes found in the Overberg region. Commenting on this connection to a uniquely South African plant form he (ibid) says: "I think my work, [...] has a very 'local' feel to it, I spend months studying indigenous plant species such as 'Fynbos' and developing algorithms that describe those specific structures. Technology and creativity can be a very effective combination if it is custom tailored, uniquely applied in the context that one is living in. Otherwise it becomes homogeneous or stereotypical." In this way Rademeyer thus sees his work as contributing in a unique and authentic way to similar explorations by artists in history who validate empirical studies of the natural world. Rademeyer (ibid) describes his investigation into the complex forms in nature as a "dialogue with historical works such as Leonardo's nature studies."

[30] It is the term given to a collection of plants (a vegetation type) that are mainly shrubs and is comprised of species belonging to South Africa's southwestern and southern Cape. (Encounter South Africa, n.p.:n.d.)

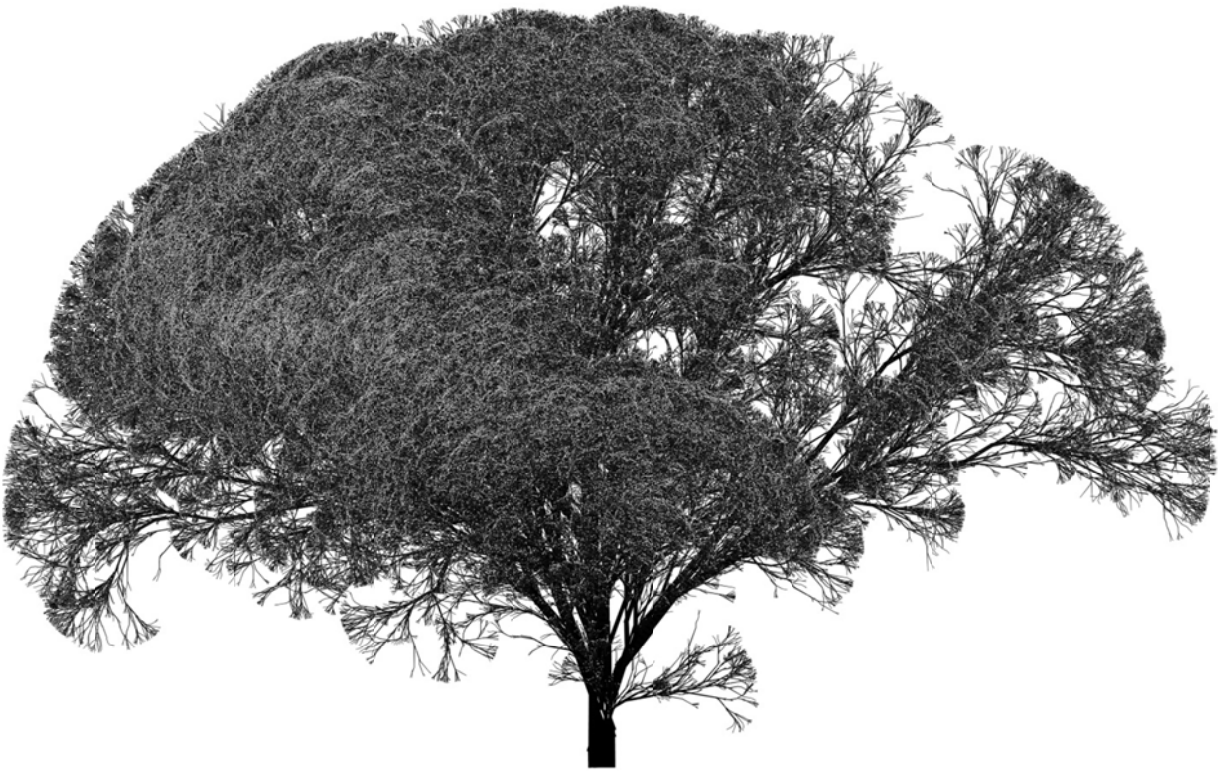


[Fig 11.Stefanus Rademeyer, *Arborescent Geometries II,* 2011]

In his blog 'ecomimetic blogspot' Rademeyer's algorithmically grown drawings *Arborescent Geometries* are confirmation of a generative process that has been developed to an extraordinarily complex level of realisation. Algorithms are "a set of rules that precisely define a sequence of operations" (Stone, 1973: 4) and through the implementation thereof Rademeyer's is able to 'cede' partial control over the outcome of his creations. In his series exhibited on *Resonant Structures* Rademeyer evolves his work to simulate the plant growth patterns of at least 700 known plant species found in the Overberg region. He

(ibid) claims that "[t]he organic complexity of these works […] follows a selection of 31 algorithmically generated images rendered under 200 dpi for internet viewing. The entire database consists of over 700 illustrations, rendered and printed in ultra-high resolutions (true 1440 x 2880 dpi), revealing microscopic details in the structures." He continues: "Some of the structures that I draw consist of twenty million different shapes that come together in one structure, so it is physically impossible to do it manually" and the resulting images "almost have personalities, because they're so complex you imbue them with certain qualities" (Rademeyer,2011:np.). In the case of his *Arborescent Geometries* appearing on *Resonant Structures,* these 'qualities' are as specific as to represent the actual growth patterns of plants. Rademeyer explains:

> Over a three year period I used computer based modeling to recreate plant structures, building up a very large database of the mathematical structures of a spectrum of flora, including those found in the Fynbos regions of the Overberg. In the working process a specific algorithm can be adjusted and expanded to yield different results in the visual representations. In the data-bank of plant-structure algorithms there are often sections of code that is shared by many algorithms, and in such a way creating parallel relations between different plant structures or 'species'. In much the same way, an ecosystem contains many shared genes distributed amongst different species of the same genus or order (ibid).



[Fig.12. Stefanus Rademeyer, *Arborescent Geometries III,*2011]

On defining the parameters of an algorithm capable of producing these highly detailed images; Rademeyer explains the design in generative programing that enables this biomimetic process to take place. He (Rademeyer 2012: n.p.) talks about introducing a value into equations that "could fall within a specific range," that effectively "introduces parameters into an algorithm," thus limiting the range of activity in the growth patterns which would result in specific configurations, which closely resemble Fynbos plant types. This rigid application of coding does not, however, produce rigid structures. Reiterated action reveals structures that are quite organic in nature as is the case with many of the

Fynbos structures Rademeyer has made for *Resonant Structures*. In the following extract Rademeyer (Personal communication, 31 January 2012) provides an example of how the process works.

> In the schematic representation of a tree there are deterministic and indeterministic processes that give rise to the form. The angle of each branch could fall between 15 and 20 degrees in relation to the angle of the previous branch. The distance between two bifurcation nodes (where branches split) could decrease in percentage as the tree 'grows', and the decreasing values could fluctuate within a specific range, let's say between 80 and 70% relative to the previous branch from node to node. If, however, this process is repeated hundreds of thousands of times, as in some of the digital drawings, all those slight variations add up to create a form that has strikingly organic properties. But this happens in nature all the time. It is microscopic processes that create mesoscopic and macroscopic structures.

Biomimesis as a prevailing characteristic is not employed exclusively in the *Arboressent Geometries* presented on *Resonant Structures*. We see the foundation of Rademeyer's interest in biomimesis in his early work such as *Branches in Time, Rhizomatics* and *Smooth and Striated*. Essentially though, the philosophical foundations on which these earlier works are based are, in turn, premised on the biological modalities of arborescence, rhizome root structures and topographical features. In this way we see how many of Rademeyer's works are rooted in empiricism as much as they are in conceptual frameworks of philosophy. In his more recent works, as in the case of his *Arborescent Geometries*, Rademeyer seems to be moving closer to empirical and biological models of reference. In the following passage he (ibid) explains how he assimilates such modalities into his artwork:

> I have always done a fair amount of what Bridget Riley called 'outside reading.' In the natural world, forms and structures are an embodiment, one could even say an 'expression' of their inherent processes […] In my work I have tried to find ways to simplify these processes and to re-create the visual complexity one sees in the natural world using 'artificial' or simulated processes. In this way one can create tremendous visual complexity with staggering detail.

Rademeyer's biomimetic processes acknowledge complexity as it unravels in nature. Over the years his work has gained in complexity through the evolution of his ideas and has increasingly engaged with more intricate formats of image production and experimentation with computational programs. Again, as he (Personal communication, 31 January 2010) comments: "I think the 'awareness' of complexity has

always been there. The challenge for me, over the years, has been to articulate the true depth of complexity in a visual format that is not merely a 're-presentation', (i.e. a photograph), but develop processes that give rise to complexity." His works have become more complex in terms of their internal structuring and mechanisms of production. There has been a shift from an earlier focus on heavy, solid materials (notably in the wooden structures made for his *Surface Depth* (2004) exhibition and subsequent wooden light boxes) to virtual animations but he also revisits these solid materials and reverses the focus at times, building "sculptural pieces that have the ephemeral and material qualities of virtual space" (as, for example, in *Gestalt*). (Stevenson Gallery, 2011:n.p.).

Commenting on his work on his *Surface Depth* (2004) exhibition, Rademeyer (2004: n.p) points out the process of "complexification" that developed through the process of making the group of four sculptures titled *Utopia, Fissure, Fracture and Tremor*:

> Firstly they were conceived as a narrative progression from first to last. The first sculpture in the progression[31] is entitled *Utopia* and has a straight forward symmetry, being symmetrical along a vertical axis, the horizontal axis as well as back and front. In starting with an absolute geometric form, what I have tried to do is take that form and introduce a process of transformation where each work in the progression becomes more complicated, where the symmetries become more complex. This creates an increasing level of entropy through the narrative of the progression of the four sculptures […] this level of indeterminacy and complexity was escalated in the last of the quartet of wooden sculptures titled *Tremor*.

Rademeyer's use of the term "entropy" in his comments above implies a process whereby he may no longer be in full control in suggesting that the forms may be seen to undergo a deconstructing and/or reconstructing in complex and unpredictable ways (perhaps also oscillating between order and disorder). This process, which seems to suggest some kind of kinesis, posits such sculptural forms to be viewed somewhat differently to the modular works of minimalist artists such as the works of Donald

[31] It is interesting to note that Rademeyer conceived of these works as a narrative progression and thus as a development in an evolutionary process. Greg Jalbert (n.d.: 2) proposes a definition of generative art practice as just that, i.e. he defines it in terms of such evolutionary progression as follows: "One might define generative art as art where the main technique of development within a piece or series of pieces is an evolutionary process, like biological or physical evolution, or the evolution of ideas. This might mean that the intent of the work is to make evolution the primary message. Evolution involves a complex process of development with many possible influences. Much of art involves generative processes of development, selection of work for various reasons. These reasons include everything from emotional impact, to beauty, to commercial appeal, to personal fulfillment, to social propaganda, and more." (http://www.soban-art.com/definitions.asp)

Judd.[32] As monolithic and intrinsically abstract forms, *Utopia, Fissure, Fracture, Tremor*, could be considered alongside the formalist rubric of 1960's minimalism of Donald Judd or Eva Hesse, but as Eksteen (2004) notes, the introduction of complexity reframes them antithetically to the modernist reductionism we have come to associate with 60's minimalism. Eksteen (ibid: n.p.) says: "It would be a mistake to confuse the minimalist appearance of these structures with the process of formal reduction. Instead, if made aware of the order in which the individual pieces came about, "a process of complexification is revealed." In fact, the progression within Rademeyer's works can be seen to reverse the modernist process of distillation in opening up form to endless series of mutations.

Eksteen identifies dynamic qualities in the monolithic forms and comments that their engagement with complexity avoids them from being easily summed up. In the modernist sense a reductive way of looking at form (in this case the monolith), viewed as a distillation to the essence of form or a reduction to formlessness, suggests a paring down where the parts of a composite whole are scrutinized in isolation from other parts. The converse applies in complexity theory, which evokes the idea that the whole is indeed greater than the sum of its parts. Eksteen's (ibid) identification of a dynamism in the monolithic structures of Rademeyer is expressed as follows and reveals their complex matrix:

> And where light describes its agglomerate of geometric keys, its enantiomorph disappears into shadow. Visual qualities exist only as a displacement of what is inside of the system with what intrudes from the outside, suggesting that these objects might even be formless receptor screens; flat, conceptual seismographs that only acquire more complex aspects as external forces send waves through their nerve endings. The strange monolithic structure in Stanley Kubrick's 2001: *Space Odyssey* (1968) keeps coming to mind. It might be for the simple reason that it seemed to have a sentient presence, as if silently observing, its polished geometrical shape reflecting, but possibly also recording, its innocent surroundings. Rademeyer's objects seem equally conscious, but it is a different kind of sentience altogether that is, on the contrary, not deduced from their monolithic silence but from their structural complexity. Where Kubrick's monolith is taut with a postponed potential, these objects are in flux. What animates them is a computational force that discovers itself in a process of structural mutation. It is hard to think of a system of such intricacy as just an instrument […] it starts with a subtle shiver that grows in strength and finally quakes through the surface in a trembling squall. With the first in the series, utopia, the disturbance is hardly noticeable, a subtle seismic flutter which the object's optimistic architecture easily accommodates.

[32]Modular works such as those made by Donald Judd point to the minimalist impulse to create literal objects, i.e. objects that are neither paintings nor sculptures (to paraphrase Judd), and are in a sense "atomic ontological entities that start and end with themselves" (Galanter: 2006 n.p.)

> But in fissure it is clear that what I am seeing is the tectonic movement of some inflexible crust forcing its way out of the mathematical confines of the template.

Lev Manovich (Whitelaw, 2002: 1) comments on abstraction and complexity in generative art as following a scientific paradigm shift where the visual arts pursue "new types of representations adequate to the needs of a global information society, characterized by […] new levels of complexity. Many of Rademeyer's works, such as the prints that involve biomimetic processes like *Branches in Time, Rhizomatics* and *Smooth and Striated, Between the Lines* and *Symmetriad,*[33] indicate a strong move away from a minimalist aesthetic towards using more complex computational means. We see this especially in the arborescent works (his computer generated drawings that recall tree and plant forms) that we associate more typically with generative art. These works involve a much greater aptitude for programming compared to earlier works. In works like *Branches in Time, Rhizomatics* and *Smooth and Striated, Between the Lines, Symmetriad* the prints presented reveal a complexification so intense that only computers are able to calculate the mathematics involved in building these structures. Through the facility of programing, Rademeyer is able to achieve a level of complexity that would otherwise be impossible to achieve in a manual process. He (2006: 4) comments about the computational process in this regard:

> What I am also finding more and more interesting are organic open ended structures like *Rhizomatic*, and *Symmetriads*, which invariably reach a level of complication where they do begin to take on a life of their own. The way I do this is to create algorithms and then introduce random elements so that certain characteristics of that structure no longer remain under my control in the final schematic. This relates very strongly to *Chance operation* where I am working with a structure that is not entirely under my control. In doing this one discovers possibilities that are way beyond what you originally conceived.

[33] *Branches in Time, Chance Operation Rhizomatics* and *Smooth and Striated, Between the Lines* and *Symmetriad*, "were presented as prints. The material or subject matter if you will was developed in conjunction with the animation series. So they were developed around one another. Technically, the animations are low complexity, low res expressions of the algorithms or digital drawings. To compute for a print size image at that resolution takes heavy processing power" (Rademeyer:, Personal communication, 31 January 2012)

My own practical component

Prior to the work exhibited for my Masters submission I did not engage much with what could be termed generative art processes. Having qualified with a National Higher Diploma in sculpture in 1995[34] I focused mostly on painting ever since and over the years there have been moments of experimentation where I have unknowingly worked in generative territory. During that time my experimentation with generative practice was mainly in the form of performance-based art works (works involving an element of performativity in the process), rather than computer generated work. Having recently also explored the field of digital arts, my focus in this area has been more towards design and illustration than programming as it relates to generative practices. Much of the work I made as a painter over the last 12 years dealt with landscape as theme and in some ways the sculpture *Mine*, that is shown as a central work towards my MA submission, connects to such explorations. In a review of my 2004 show '*untitled,*' Robyn Sassen (2004: 81) commented that "[l]andscape [...] defines and supports our very existence. As a genre in South African painting, it has served as a tool of beauty and propaganda, before apartheid through its heinous history, (and) in its aftermath." It was always my intention to critique such depictions of landscape and to problematize it in my paintings.

[34] Much of my interest in landscape can be attributed to the teachings of my lecturer Jeremy Wafer. I have also taken a lot from the modular techniques of Andries Botha, who was my senior lecturer at the Natal Technikon in 1995, while Virginia MacKenny and Lola Frost have also played an enormous role both in my development as a painter, and in my understanding of artistic discourses.



[Fig.13.*Untitled Landscape,* 2004]

Commenting on the complexities associated with the genre of landscape, Miriam Aronowic (2009: 1) writes in her paper *Terra Nulla: Contesting the South African Colonial Landscape*:

> Essentially always an "instrument or agent of cultural power,"[35] landscape is now accepted as an active rather than passive entity. The postmodernization of the field has demonstrated that issues of race, class, and gender are always interwoven and encoded into the physical terrain. Thereby, any image of landscape is always a representation of itself and simultaneously an image of something else.

South African landscape painting has been associated with the dark legacy of apartheid and colonialism and much critique has been leveled against landscape painters who have perpetuated such political ideologies. Artists are still coming to terms with its historical associations with National Party politics of

[35] Mitchell. WT., 2002. Landscape and Power "*Imperial Landscapes*," in *Landscape and Power*, ed. W.J.T Mitchell .Chicago: Chicago University Press .Pp 8.

the apartheid era. Two such landscape artists whose works have been linked to Afrikaner nationalism of the past are Jan Ernst Abraham Volschenk (1853 - 1936) and J.H.Pierneef (1886 – 1957), Pierneef being a politically involved, card-carrying member of the National party. Aronowic (ibid: 2) comments on their portrayal of landscape as being in accordance with their political ideologies:

> Considered the fathers of South African landscape painting, the canonical works of J.H. Pierneef and Jan Ernst Abraham Volschenk epitomize the height of this colonial tradition. Pierneef's altered cubism and Volschenk's naturalism both present the South African landscape as visions of pure, idyllic nature, and more significantly a land with no trace of history and empty of inhabitants. Hence, the absence of the native from its land reinforces Mitchell's assertion of the landscape as a construction directly associated with European imperialism.

The legacy left by such engagements with landscape has meant that landscape painting still struggles with issues associated with the 'colonial gaze.' This is also the topic of discussion in David Bunn's essay "*Our Wattled Cot": Mercantile and Domestic Space in Thomas Pringle's African Landscapes* (1994). Bunn focuses on similar problems of representation but with reference to an English colonial gaze as it features in the landscape paintings by the English settler Thomas Pringle. Pringle's landscapes clearly differ from Volschenk and Pierneef's depictions but they are imprinted with a typically Anglo centric[36] quality, recalling the pastoral themes of Constable and Gainsborough. These landscapes are as removed from the anthropomorphic realities of African life as Volschenk's and Pierneef's. As a painter attempting to engage with these histories relating to landscape I felt increasingly frustrated by what seemed to have become an endless debate around landscape painting. It led me to explore other ways of approaching landscape depiction and so I drew on my sculptural training for an alternative to the highly problematized area of landscape painting.

I only started to read up on generative art about a year ago and only then noticed a generative signature in some of the performance-based works that I had started to explore. In Works like *Virus* 1997 (see Fig. 12), a situational performance piece, I was unknowingly working with code/instruction, biomimicry and autonomy, all being signature features of generative art. In realizing this piece I instructed a group of collaborators to 'spread' their inked thumbprints onto attendees of exhibition openings by shaking hands with them. In a gesture designed to highlight the clandestine and insidious nature of viral spread, the 'carriers,' armed with inkpads in pocket, were encouraged to keep 'loading' their thumbs with ink

[36] See David Bunn 's essay "*Our Wattled Cot": Mercantile and Domestic Space in Thomas Pringle's African Landscapes* (1994) in W .J.T. Mitchell, "*Imperial Landscapes*," in *Landscape and Power*, ed. W.J.T Mitchell (Chicago: Chicago University Press, 2002), 8.

before greeting unsuspecting gallery attendees. Though not typically generative in the digital sense, some of the hallmarks of generative process could be identified in this performative work, namely its capacity to be performed without my direct involvement, the biological metaphor it employs and the idea of 'growth' and 'spread' as designed to be part of its function. Another was the fact that the entire sequence was predetermined through a set of instructions, thus bringing it in alignment with some key generative principles.



[Fig.14.*Virus,* 1997]

Another performance-based work which could be readily associated with generative process was *Red Tape*, a collaboration piece with Alti Fouché in 2010. This piece was essentially a response to a brief set by some of my work colleagues at Inscape Design College where I teach. The brief was quite abstract in that it consisted of an equation written as: 1x10 2x10 3x10 followed by the word "brand." My initial feeling was that the brief was quite restrictive and vague; hence the notion of 'red tape' came to mind as an apt theme and title for the work. My response was to buy a large bundle of red insulation tape. On the day of the event I rounded up a group of students to help me cut the tape into strips of 10, 20 and 30 centimeter lengths. Starting from the college logo situated at the front door to the college, I instructed students to stick the cut pieces to the wall, joining them in a specific sequence using only

right angles. The resulting worked looked somewhat like 'geometric' creeping ivy spreading through the building. *Red tape* operated generatively in that it assumed a biomimetic metaphor carried out through strict instructions independently from my direct involvement.



[Fig.15. *Red tape* performance, 2010]

Mine is a central piece to my submission for the master's degree both in its scale and in its open process of accumulation. It is a suspended construction made from segments of match wood glued together to form a schematic rendition of a mine with its various shafts and tributaries. As such it represents a three-dimensional model of an underground mining tunnel network beneath Johannesburg. This 'negative space map' is derived from schema in the form of maps and diagrams which detail some of the tunnels under the city of Johannesburg. Such maps were the initial blueprints for the sculpture, however, during the making process I started to digress from the specificity of the maps and to build intuitively, allowing the form to grow organically. Effectively the process itself began to usurp the goal of achieving a representational schematic of the tunnels and in this way I had stumbled into the territory of generative art practice almost by default. As a lattice-like form suspended in mid-air this work may recall three-dimensional computer modeling in its open construction format, i.e. it is not unlike 'wire-frame'

drawings that are frequently carried out on computers in rendering 3-D forms. As such it carries the appearance of a 'virtually sculpted' form and its suspension in space reinforces this aspect of depicting a cyberspace image. As a suspended work it does function as a kind of 'landscape of the imagination,' but as a growing form that extends directly into the viewer's space it also very clearly 'takes charge' of public space. Viewers are able to see through the work in its complex intricacy and thus see it as 'occupying' the space in which they encounter it. In this sense there is a highly tactile and embodied interface between the viewer and the work.

The conceptual impetus of *Mine* is based on an interest in exploring the theme of landscape and identity, more specifically as manifest through the metaphor of the mine. In *The Frightened Land* by J Benningfield (2006), W.J.T. Mitchell's *Landscape and Power* (1994) and David Bunn's *Our Wattled Cot* (1994), the authors suggest that representations of landscape are integrated with a political ideology and history. Indeed this idea is applicable not only to the representations posited in artistic depiction, but also in the way that landscape itself is changed by the people who inhabit them. The overhauling of the natural environment through human settlement and urbanization and the way in which urban sprawl alters the landscape and how industry deposits specific features such as mine dumps and sludge dams (notably in and around Johannesburg), reflects a broader form of socio-political expression. Mine dumps, sludge dams and acid mine drainage[37] are the detritus remains of ruthless profiteering. The resultant features carved into the Witwatersrand landscape over decades of gold mining are the primary result of an aggressive consequence of a capitalist ethos. The scars left on the Witwatersrand landscape as a result of this have featured prominently in the works of leading South African artists such as William Kentridge[38] and David Goldblatt[39]. Their depictions of the Johannesburg landscape, its terranean and subterranean world, stressed by the impact of mining, are well documented. The following Guggenheim

[37] "The gold mining industry in South Africa (principally the Witwatersrand Goldfield) is in decline, but the post-closure decant of AMD (acid mine drainage) is an enormous threat, and this could become worse if remedial activities are delayed or not implemented. For example, acid mine water started to decant from defunct flooded underground mine workings near Krugersdorp on the West Rand in August 2002, leading to polluted surface water. Randfontein and the Wonderfontein Spruit are also problematic. These cases have received substantial media attention, which has been critical of the efforts so far to address the problems. In the absence of remediation, there is likely to be substantially more decant in future, with potentially severe implications for aquatic systems" (CSIR, 2009: 1.).

[38] Kentridge is perhaps best known for his animated films and drawings that explore the emotional distress in South Africa, caused by apartheid and racial reconciliation. His choice of medium, dark imagined charcoal drawings, occasional color, and his style of rendering make his artwork even more distressing then the already apparent topic."(Collectiveartisan, nd.:n.p.).

[39] "David Goldblatt has been photographing and documenting South African society for over 50 years. Born in Randfontein in 1930 to parents who came to South Africa to escape the persecution of Lithuanian Jews in 1890, he was simultaneously part of privileged white society and a victim of religious persecution and alienation. Motivated by his contradictory position in South African society, Goldblatt began photographing this society, and in 1963 decided to devote all of this time to photography" (Goodman Gallery,n.d.:n.p.)

website addressing the work of Kentridge illustrates the link between trauma in the landscape and how it is felt in the body (ostensibly as a gesture to evoke empathy):

> In Felix in Exile, the fifth film of the series made between September 1993 and February 1994, Kentridge depicts the barren East Rand landscape as witness to the exploitation of and violence against both natural and human resources. Isolated in a hotel room, Felix peruses the survey charts of Nandi, a young black woman who maps the history of the terrain. Figures and structures are subsumed into the landscape or night sky, allegories for how the land can bear the scars of crimes against humanity.

Kentridge's animated films are "populated with characters whose psyches are as scarred as the landscapes they inhabit" (guggenheim.org.2000.n.p.). In *Mine* I tried similarly to draw a connection between conditions of body and those of landscape by way of correlating the image of the mine metaphorically with the idea of a cancerous growth. The notion of mining as an invasive process below the surface of the earth seemed appropriate to this idea of a malignant growth, especially considering the environmental and social problems it leaves in its wake. Cancerous cells employ their own generative process, displaying similar properties to the idea of autonomous growth as defined by Galanter on generative art processes (2003 n.p., n.d) The following passage points this out:

> The change from a normal cell to a cancerous cell is called transformation […] Transformed cells exhibit two heritable characteristics: anaplasia and autonomy […] Autonomy refers to the fact that cancer cells are independent of the normal mechanisms that control the rate of cell division. (mhhe.com, n.d. np.).

On reading up on various definitions of cancer, especially tumorigenesis[40] I came across several features that display such similarities between the way in which cancer cells grow uncooperatively and autonomously from programmed cellular function (therefore considered autonomous) and the notion of autonomous process as found in generative art, albeit that in the case of cancer the process has run awry.[41] The use of language in the following definition is also noteworthy where the author speaks about the "programming" of cellular structures in the context of cancer:

[40] The process of initiating and promoting the development of a tumor (Medical Dictionary, nd.:n.p.)

[41] With reference to artificial intelligence running 'awry' " in his 1942 story "Runaround," Isaac Asimov offered his now-famous Three Laws of Robotics: A robot may not injure a human being or, through inaction, allow a human being to come to harm; a robot must obey orders given to it by human beings except where such orders would conflict with the First Law; and a robot must protect its own existence as long as such protection does not conflict with the First or Second Law. Most of Asimov's stories deal with things going awry because these laws don't equip robots to tackle real-world situations". (Merriam-Webster.com, n.d.:n.p.)

> Cancer is ultimately the result of cells that uncontrollably grow and do not die. Normal cells in the body follow an orderly path of growth, division, and death. Programmed cell death is called apoptosis, and when this process breaks down, cancer begins to form. Unlike regular cells, cancer cells do not experience programmatic death and instead continue to grow and divide. This leads to a mass of abnormal cells that grow out of control.(Medical News Today, n.d.: n.p.)

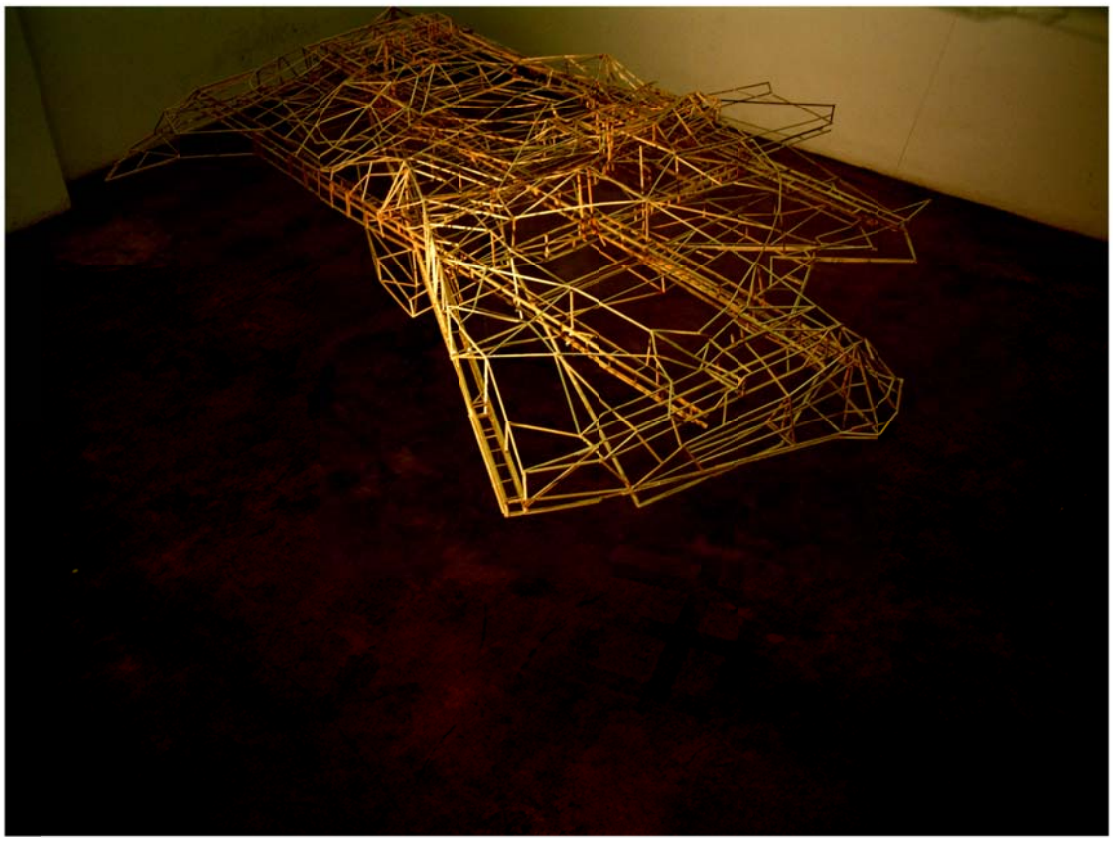
This reminds me of Eksteen's (2004: n.p.) comments on Rademeyer's works *fracture* and *tremor* where he says that modules (cells) become a "structural computation that generates its own model […]" In the case of cancerous cells the programming has been corrupted and the cells no longer cooperate with the body. As I noted earlier in my text, the module (cell) no longer functions as a brick in a wall through which the lay and direction becomes the result of an outside-in design process. In Rademeyer's *tremor* and *fracture* the modular wooden segments essentially conform to the quadrangular, monolithic super structure that they participate in creating. In thinking of this composite model of *tremor* as a metaphor for landscape we are reminded, for example, of the hexagonal rock formations at Giants Causeway in Ireland, where rocks developed into pristine crystalline formations as a result of extreme heat and pressure exerted by volcanic forces millions of years ago. It is a spectacular display of interlocking hexagonal steps that together make up a flawlessly tessellated[42] super structure. The precision of this highly ordered display gives the impression that the resulting rocky outcrop was artificially manufactured. Such precision of interlocking forms is also seen in healthy cells in the body where units cooperate to the benefit of the larger organ. Cancer cells, on the other hand, are rogue cells, inflamed and out of sync. Tumors erupt as a result of such inflamed[43] growth patterns that are out of control (Arias, 2007: n.p.).

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[42] A tiling of regular polygons (in two dimensions), polyhedra (three dimensions), or polytopes (dimensions) is called a tessellation. Tessellations can be specified using a Schläfli symbol. The breaking up of self-intersecting polygons into simple polygons is also called tessellation (Woo, 1999: n.p.).
"Periodic tessellations have translation symmetry, and so they look the same at different points in the plane. Periodic tessellations form patterns with symmetry given by one of the seventeen wallpaper groups. […]A non-periodic tessellation is a tessellation which is not periodic. That is, a tessellation which has no translation symmetry. Escher's free form prints Mosaic and Mosaic II are examples of non-periodic tessellations, but they only cover a portion of the plane. Escher could certainly have extended these to cover more of the plane, but he would have had many decisions to make in order to continue. It is not hard to imagine a tessellation of the entire plane consisting of tiles which are all different. However, most of the mathematical interest in non-periodic tessellations comes from the search for examples that use a limited number of tiles" also see 'Voronoi tessellation'.

[43] "The link between inflammation and the development of cancer has been recognized since 1863, when Rudolf Virchow discovered leukocytes in neoplastic tissues and made the first relation between inflammation and cancer. Since then, a number of cancers have been linked to inflammatory origins and in many cases it has been considered how the tumor microenvironment highly resembles an inflammatory site. Nowadays, the causal relationship between inflammation and cancer is widely accepted." (Arias, 2007:n.p.)

Two features in the construction of *Mine* could be compared metaphorically to the generative process as seen to occur in cellular mitosis of the body. The first could be likened to a malign mitosis in which the growth activity is disorganized, irregular and corrupt. The other shows a more organized growth pattern that could be compared more to the natural mitosis occurring in normal cellular mitosis. Here there is a sense of regularity and consistency. The overall appearance of *Mine* is a bit like the former in which the construction of the wooden sticks seems haphazard and where modularity seems non-existent in the overall design. Match sticks are cut to varying sizes and there is no apparent order in the way in which the tunnels of the mine crisscross each other. The tunnels are constructed to be representational of a mine structure but the generative aspect of this structure does not 'progress' in the sense of an organizing principle (as in Rademeyer's works). Instead, it develops like an additive knot where there is not any determined sense of direction and flow. This is, however, contrasted by the upper register where wooden triangles represent an element of landscape covering the mine below. Here there is more of a sense of fluidity and directionality. The landscape is constructed out of wooden isosceles triangles cut from pieces from 30 cm match wood. The principle of creating an undulating landscape out of triangles was derived from computer generated 3-D triangular modeling. Using this computer method of constructing it is possible to create flowing surfaces by juxtaposing triangular elements and altering their pitch, yaw and roll in a Euclidean space. I thus adapted such computer imagery to a handmade version of constructing in wood.



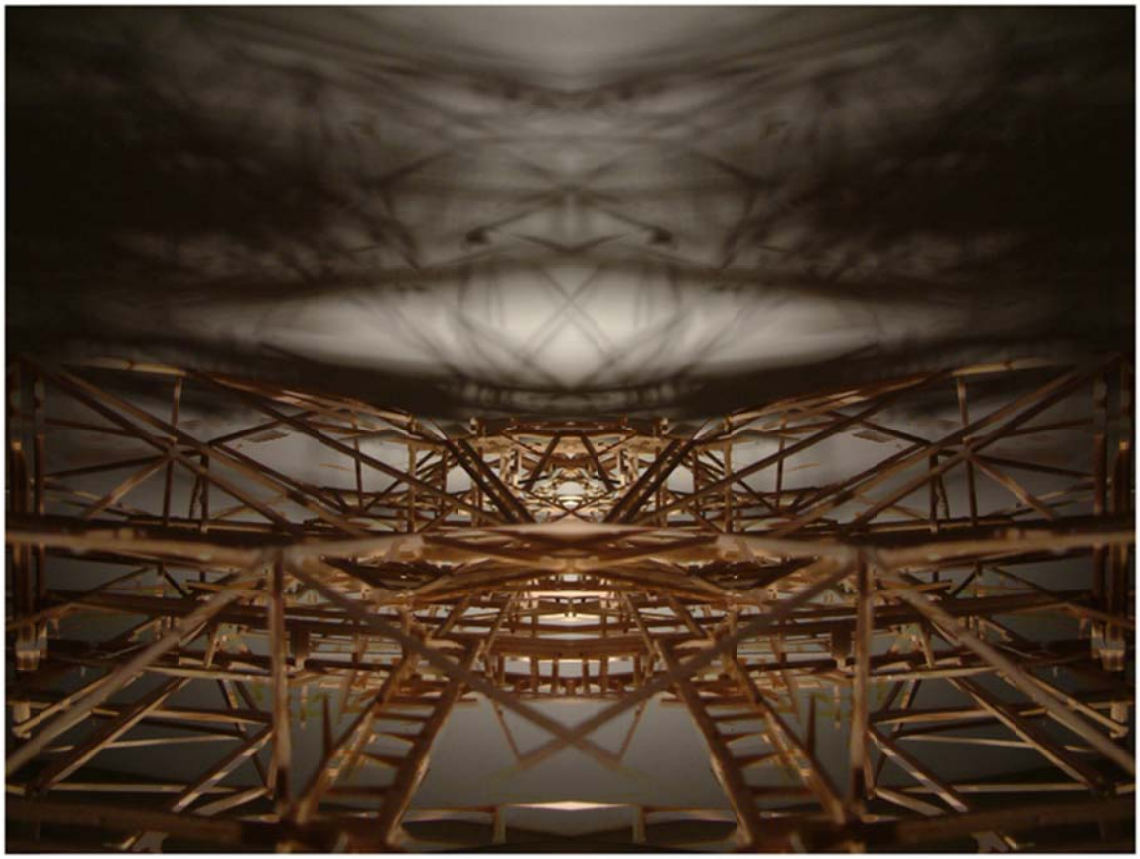
[Fig.16. *Mine* (work in progress) 2008-2012]

In *Mine* two qualities of modularity are juxtaposed, one chaotic (malignant) and disorganized, the other ordered, organized and harmonious. The former is built into the part of the sculpture representing the mine structure while the latter is denoted by the triangular polygons that represent the natural landscape above the mine. This juxtaposition seemed appropriate in speaking about two qualities of landscape that exist in the Gauteng region. One aspect is represented by the ideal of natural but threatened savannah grassland biomes that are characterized by order and symmetry. The other is characterized by disorder and irregularity and represents industrial imposition onto the natural environment. In this way I identify with Rademeyer's use of environmental rather than anthropological metaphors as a vehicle of socio-political expression. He (Personal communication, 31 January 2012) explains his position in this regard:

> With my exhibitions and talks I like to raise awareness of the natural world and ecosystems and its immanent collapse. Currently the majority of contemporary artists

> are really preoccupied with the social dimension of life, I do however think that it is important to also escape that anthropomorphic bubble sometimes; I do believe that it is possible to interact with and experience the rest of the non-human world around us. I also think it is important to restructure our living environments, because an environment influences the way we see the world, the way we relate to one another, and the way we relate to other living things on the planet. Currently and in the future I will be working more often in applied fields of interactive design, architecture, ecosystemic design, biomimesis and its applications.

Mine adheres to a generative process; this means that it is constantly changing and growing. The sculpture has already been exhibited in three different forms since I started building it, and interesting spinoffs are emerging from tampering with photographs of the sculpture (see Fig.17). For now the environmental and biological metaphors seem appropriate to my work but I am becoming interested in the possibilities of new meaning emerging as the process of building progresses. I intend to keep this process alive and remain open to changes and new directions that it may lead me to.



[Fig. 17. *Mine Symmetry* 2012]

Conclusion

According to Gallanter's notion that generative art "uses a system, such as a set of natural language rules, a computer program, a machine, or other procedural invention," many of Stefanus Rademeyer's works perfectly embody the characteristics of generative art. To say that Rademeyer's work is focused on systems orientated practices is only half true, for not only are many of his works system orientated in the way that they are physically constructed, but they are simultaneously concerned with the working systems and structures of thought, of language, of architecture, of mathematics, music, geology of writing and of biology. I have demonstrated his concern with structural theory systems as posited in the philosophy of Deleuze and Guattari, this being evident in works such as *Smooth and Striated* which acts like a "visual metaphor for the relation between these two structural (arborescent and rhizomatic) understandings of society: using a geometric sequence"(Rademeyer, 2006: n.p). In *Branches in Time* he is concerned with the structure of the literary narrative in Borges' *The Garden of Forking Paths* in which the branching story line is equated to an arborescent structure. Rademeyer interprets *The Garden of Forking Paths* by creating a work built through algorithmic programming in which bifurcation occurs as vectors are projected into Euclidean space. I have shown how he interprets complex systems as 'deep-symmetries,' exemplified in the work *tremor* which ostensibly freeze-frames a moment of violent seismic activity. He observes and replicates the systems of plant growth and claims that "[t]he natural world has had billions of years to refine those processes, so there is a lot that one can learn from the structures in nature." I have attempted to show how intertwined his modular processes are with what he calls 'complex temporal repetition' in which "the temporal dimension is folded or translated into a spatial dimension. One can trace the 'growth', accumulation of modules over time by looking at the final structure. A tree and its rings, or a coral and its growth are worthy comparisons."(Personal communication, 31 January 2012). For all intents a purposes Rademeyer's work prioritizes systemic process intrinsically and technically in the way that it is built, and extrinsically through the themes that it reflects.

To what degree these systems and processes allow Rademeyer's works to function autonomously is perhaps debatable, as I have indicated in the opening chapter. I pointed out that Galanter's (2003, n.p.) reference to autonomy suggests it as being applied in the building processes of artworks, i.e. as distinguished from the design process involved in "refining […] algorithmic code." If we are to see autonomy in this respect, then of course Rademeyer's works do demonstrate a degree of autonomy, especially in the case of the computer generated prints. These prints are essentially the result, or more

accurately, the 'emergent property,' of an algorithm which governs the functioning of a computer. In this case then, the physical process of making the work is not the result of direct control. In many cases this task is automated through computer programming and algorithmic design.

In the course of this paper, I have also argued that while Rademeyer seems averse to the idea that his work is governed by systems that teeter between order and chaos, he most certainly embraces the idea of 'deterministic' chaos. In this sense Rademeyer acknowledges the 'ghost in the machine,' and the random properties that are generated through repetition, even in computers. In this sense Rademeyer's practice can be seen to align with insights deriving from the fractal mathematics by Benoit Mandelbrot. In addressing random properties as they manifest in generative artworks, Mat Pearson (2011: 6) states that "the second hard and fast rule must be a degree of unpredictability. It must be possible for the artist to be as surprised as anyone else" and "in doing this one discovers possibilities that are way beyond what you originally conceived" (Rademeyer, 2006: n.p.). This can certainly be said of Rademeyer's explorations in this field of work.

Rademeyer's particular focus on local Fynbos ecosystems in South Africa frames him squarely in relation to key ecological debates which prioritize the need to view ecosystems on microscopic, mesoscopic and macroscopic levels. Rademeyer also notes that his work has a "very 'local' feel to it" but while it certainly does, it is by no means parochial in its design and in its meaning. Rademeyer's work can be seen to raise awareness of 'ecosystemic'[44] properties, meaning that it "describes a view that parts of nature integrate into each other at various levels. Parts of nature are not completely separate entities but are related to each other in one form or another" (ecosystemic-psychology.org.za.n.d.:n.p.). In this way Rademeyer can be regarded as a South African artist who is engaged in a socio-ecological discourse which is both locally and internationally relevant.

[44] An ecosystemic awareness is not new. This thinking [and living] has been common in China at least 1400 years ago with Fa-tsang a commonly referred thinker in this regard amongst others (Cook, 1977). It has been present in and around India well over 2000 years ago. Thus, this thinking or more correctly, this epistemology has been available since early times.(Ecosystemic-Psychology. n.d.:n.p.)

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