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SUMMARY

In the emerging field of Post-human Studies, extensive debate has been formulated on what is Posthumanism. The main focus has been directed towards the contents and meanings of a posthuman paradigm shift, while the methodology employed to reflect upon has hardly been disputed. This statement argues the potential of Posthumanism as a research method, presenting the reasons why posthuman theorists should reflect on methodology, and which methodological risks they can encounter. It addresses what it entails to adopt a posthumanist methodology, and how a posthuman approach can be employed in applied philosophy and normative ethics, ultimately turning into a way of existential inquiry.

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Transmuting Humans: Genomics, Nomad Sience, and Kim Stanley Robinson's *Mars* Trilogy

TOM IDEMA

"The whole evolutionary saga of how species originate and how they extinguish may be the greatest tale ever to be told. It is everybody's story."

Lynn Margulis and Dorion Sagan

Introduction

> *...fast-growing lichens. Radiation-resistant algae, Extreme cold fungi. Halophylic Archaea, eating salt and excreting oxygen. Surarctic mosses. An entire taxonomy of new kinds of life, all partially adapted to the surface of Mars, all out there having a try at it. Some species went extinct: natural selection. Some prospered wildly, at the expense of other organisms, and then chemicals in their excretions activated their suicide genes, and they died back until the levels of those chemicals dropped again. So life adapts to conditions. And at the same time, conditions are changed by life. That is one of the dimensions of life: organism and environment change together in a reciprocal arrangement, as they are two manifestations of an ecology, two parts of a whole. (Stanley Robinson, Red Mars 205)*

In Kim Stanley Robinson's critically acclaimed *Mars* trilogy[1], a group of one hundred scientists is sent on a mission to explore Mars. Well before they even reach Mars, a number of scientists develop plans that go far beyond the goal of exploration, envisioning a wholesale transformation of the planet's atmosphere in order to make it more hospitable to human life. The above sequence, in which the narrator describes how genetically engineered microorganisms ("new kinds of life") bring more oxygen into Mars's atmosphere, captures a tension between two fundamental ideas that cut across the life sciences, and by extension, all thinking about life in the latter half of the twentieth century. On the one hand, there is the special significance of genetic coding in the evolution of life: the fact that these microorganisms are endowed with "suicide genes," indicates that life is not just regulated by genes, but can even be "turned off" by genes. The genome, on this account, is the final arbiter of life. On the other hand, this sequence presents a strong notion of *ecology*: the idea that life evolves in a web of relations. The two moments in Stanley Robinson's text express a historical movement in which life, as perceived from the lived reality of the organism, becomes simultaneously smaller (molecular) and bigger (ecological or planetary). The paradox that emerges is that while the life sciences have raised the prospects for human control over life, they have also increased awareness of life's astonishingly complex (and thus unpredictable) processes pervading the body and connecting it to an increasing number of outsides.

The epistemological tension between molecular and ecological approaches raised in the *Mars* trilogy is highly personal and political. What was first pictured as a purely scientific project turns out to be the advent of a radical transformation, not just affecting the lives of its participants, but the lives of future generations, as well as of the planets. When the scientists arrive on Mars, celebrity astronaut John Boone (who had been the first man to land on Mars) already intuits that they have become "fundamentally different beings" (Stanley Robinson, *Red Mars* 4). In the negotiations over what line of action should be taken, Arkady Bogdanov, a Russian scientist with anarchist sympathies, proposes "We must terraform not only Mars, but ourselves" (89). As the narrative progresses, new generations of humans adapt to the gravitational, climactic, geological, social, economic and cultural forces on Mars, becoming a new *Homo ares*, "creatures tall and slender and graceful and utterly at home," as one character describes them (Stanley Robinson, *Red Mars* 592). The introduction of gerontological (anti-aging) treatments is a crucial element in this process of adaptation, synchronizing human life with the long-term projects of terraformation and climate change. Whether this evolutionary event should be qualified as a leap into the posthuman or rather as an adaptation of humans to new environments, is a somewhat arbitrary question — what matters is that in becoming part of a new dynamic constellation of social, technological, biological, and physical forces, humans cease to be the stable, autonomous agents Western culture has long held them to be.

Interweaving multiple scientific views, the *Mars* trilogy provides a welcome alternative to those more common transformation narratives that narrowly focus on genome sciences — for example, the works of Michael Crichton and Margaret Atwood. The latter narratives tend to envision human transformation mainly as a dystopian prospect, a result of experiments with life deemed dangerous or unnatural. Stanley Robinson takes a more affirmative stance vis á vis science, which is neither viewed as violating nature, nor coming "after" nature. The phenomenon of transformation is presented as the motor of life, a process in which human beings may intervene, but which they will never control. This fascination with immanent and uncontrollable change can be understood through Gilles Deleuze and Félix Guattari's concept of "nomad science." In the following I will try to demonstrate how a focus on (human) transformation, as provided in literary, philosophical and scientific texts, can contribute to our understanding of the epistemological, biopolitical, and narrative implications of the contemporary life sciences, and genomics in particular. In the conclusion, I sum up some of the possible consequences of this kind of inquiry for the (post-)humanities and their relation to science and art.

1. Stanley Robinson won a Nebula Award for the first novel, *Red Mars* (1992) and Hugo awards for *Green Mars* (1993) and *Blue Mars* (1996). The Nebula and Hugo Awards are the most prestigious prizes for SF worldwide.

Genomic Horizons

Epistemologically, genomics has played a crucial role in the past two decades, not just as a specific field of research, but as a general perspective on life. Genomics, or the study of DNA, brings forth a range of knowledges and technologies that are extraordinarily significant in the sense that they elucidate — and eventually may intervene in — the genesis of life, be it human, animal, plant, viral, bacterial, or otherwise. Many scholars, policy makers, writers, and artists have reflected on the desirability and tenability of certain ambitions in genomics. Many critics have tried to unpack the assumptions and promises of genomics on the premise that they are overtly speculative. Notably, the Human Genome Project (HGP) has often been portrayed by critics as an ethically doubtful and scientifically unrealistic effort to create an extraordinary piece of scientific knowledge — the code of life itself (Kay; Roof). Although the ambiguous and unspectacular outcomes of the HGP have urged scientists to take on a more modest tone, they also — paradoxically — justified a call for further investments to continue the (post)genomics pursuit, accompanied by new promises. Some critics of genomics argue that science's promise of progress has become severely compromised by corporate and careerist incentives. As Fredric Jameson formulates it, the concept of scientific progress functions as "an attempt to colonize the future, to draw the unforeseeable back into tangible realities, in which one can invest and on which one can bank, very much in the spirit of stock market 'futures'" (Jameson 228). Others have pointed to a dynamic between science and the media, in which fantastic ideas and desires existing in popular culture are not debunked but fueled by scientists and science managers who hope that these speculations will promote their line of research and secure their research funding (Brown; Cooper). However, despite the sometimes untenable promises, it would be hard to disagree that genomics is laying the foundations for many future applications. Genome scientists are creating the knowledge and technology that will one day, perhaps quite soon, make it possible for parents to choose to have a child with certain mental and physical characteristics. Already, genomics has made possible far more radical interventions in animal and plant bodies, for example, enabling the production of in vitro meat: animal flesh that does not develop into an organism, a possible alternative to animal suffering in the bio industry. Yet consuming in vitro meat could cause serious health problems — scientists have yet to understand its long-term effects on the body. In other words, (possible) applications of genomics raise myriad societal concerns and questions.

Critical responses like the above offer an important counter-weight to the enthusiasm that has accompanied the enormous investments in genomics and other fields. At the same time, I would argue that critical approaches have some disadvantages. First, criticizing science from an outside position without taking into consideration arguments from within science has the effect of reifying the boundaries between life sciences and the social sciences/humanities. Following such a trajectory, scholarship in the social sciences and the humanities remains unable to play the pivotal role of broker between science and society. Second, by focusing critical attention on dominant scientific developments like genomics, interesting other perspectives in the life sciences, for example in evolutionary biology and developmental biology, are left out of the equation.

I want to begin by quickly sketching one aspect of genomics that remains largely underrepresented in critical responses: the motif of complexity. While indeed this term has functioned as somewhat of a buzz-word, we can clearly observe a development in genomics and elsewhere toward more complex understandings of life (Barnes and Dupré; Zwart and Penders). Whereas geneticists have been concerned with finding direct correlations between genes and traits, genomicists seek to understand traits by bringing into focus the manifold entanglements within the genome as well as within its environment. Although genetics is still an active research field, during the 1990s genomics has become paradigmatic for the life sciences. In recent years, the turn to complexity has been continued in post-genomic research fields such as proteomics (the structure and function of proteins), epigenomics (reversible modifications of DNA that regulate gene expression) and systems biology (the interactions between genetic, metabolic, neurological, hormonal and other systems). The movement towards studying a complex network of factors in genomics and other fields of research has potential consequences for the ways in which the societal debate around genomics is held. Genetic determinism the belief in a one-to-one correspondence between a gene and a particular trait no longer appears a viable position to take or, for that matter, to pit oneself against. Indeed there are a few exceptions to the rule: the so-called monogenetic diseases (such as Huntington's disease and cystic fibrosis), where one can sufficiently couple phenotype to genotype. Generally speaking, however, the question is no longer whether a particular trait is learned or genetic; what matters is the particular role of genes in relation to other factors (Rehmann-Sutter). This being said, it is still common that, in spite of its positioning among a host of other factors, the genome

is interpreted as a kind of ground of origin, a final cause of life. One could speak here of "genomic determinism."

The move towards complex interactions is not exclusive to genome research, but rather forms a general epistemological and historical development. Various scholars have hypothesized that we are currently witnessing a transformation of thought: a movement from controlled representations of the world towards mapping the communications between complex systems (Rabinow and Rose; Shaviro; Thacker; Zwart, *Denkstijlen*). This epistemological turn is not at all exclusive to the life sciences: it is expressed in all modes of thinking, and, as Nikolas Rose has suggested, it is tied in with new forms of life and forms of living — a transformation of life itself in which the life sciences, biomedicine and biotechnology are bound to play a crucial role (Rose). The current transformation of thought is a result as well as a cause of larger historical processes: massive technologically mediated changes over the past two decades — and in a wider view, in the past two centuries — have changed not just our world but our bodies, our behavior, and our cognition. This includes not only medicine, the food industry, and cosmetics, but also non-biotechnological innovations like media technology, computers, and transport. If genomes are indeed, as biologists and philosophers Paul Griffith and Karola Stotz have phrased it, "reactive," then these changing environments communicate with and trigger responses within our genomes (Stotz and Griffiths 41) In other words, in a historical era of radical planetary change, humans and other organisms are undergoing genetic changes, *genetic* in the sense of pertaining to DNA, but also in its wider sense of changes that generate something new. Such a perspective based on ideas from the life sciences can reinvigorate scholarly and societal debates on the impact of the life sciences.

Human Transformation in SF

Literary narratives like Stanley Robinson's *Mars* trilogy, I argue, are expressions of our current era of upheaval and offer vital scenarios for thinking through the implications of the life sciences (other examples are Octavia Butler's *Lilith's Brood* [1997] and Greg Bear's *Darwin* novels [1999; 2003]). These narratives imagine a wholesale transformation of life — the development of new traits, new bodies — in which DNA and the genome sciences play crucial roles. They map the potential implications of human transmutation for individuals, groups, humanity as a whole, and sometimes for other species, focusing on the role of the genome in interaction with other developmental resources: environmental, technological, social, cultural, and so on. What I find most interesting about these narratives is that they take the life sciences seriously, yet without according too much authority to any field in particular. These novels signal a fascination with the enormous potential of genomics, but also challenge the genome-centered perspective by bringing in ideas from fields including evolutionary biology, ecology and the philosophy of biology. Moreover, they challenge the common assumption that a radical transformation of species can only occur through human intervention. In doing so, they differ from the majority of literary texts which treat the event of transformation in an obscure, reductive and anthropocentric fashion. I will now tune in on those more common literary scenarios and return to the Mars trilogy near the end of this paper.

In Mary Shelley's *Frankenstein* (1818), often counted as one of the first SF narratives, scientist Victor Frankenstein manages to build a complete humanoid being *de novo* from a vast collection of body parts gathered from "the dissecting room and the slaughter house" (Shelley 55). The reader does not witness a viable process of transformation from an inanimate to an animate body, but rather is presented with a sudden, miraculous moment when Victor sees "the dull yellow eye of the creature open" (58). In a similar vein, in H.G. Wells's *The Island of Doctor Moreau* (1896), a scientist specialized in vivisection retreats to an island where he manages to create new human-like creatures through medical experiments with animals, experiments that remain utterly opaque to the reader. More recently, Margaret Atwood's *Oryx and Crake* (2004) leads the reader into a dystopian future where genome scientist Crake has created a new species of man and killed all the "old" humans through the dissemination of a virus against which only he is protected. These stories are obscure in that they do not actually show the process of transformation, but merely the outcome. Furthermore, they are reductive in two senses: first, the transmutation occurs in a confined space (usually a laboratory), and what we see in the surrounding environment are merely the *effects* of this transmutation. Second, by attributing the potential for transformation to the (purposeful) actions of human beings, these texts fail to account for transformation as a potential inherent in life itself.

In the above literary examples, transmutation is presented as an unnatural and hazardous act, disrupting the integrity of bodies and of society as a whole. I mention these dystopian narratives of new humans because they have become ingrained in the collective consciousness, returning time and again as references in societal debates on the life

sciences. These stories have often been linked to historical examples of tinkering with human bodies, for example under the Hitler and Stalin regimes, and thus function as warnings against the dangers of new technology. They also frequently return in contemporary debates about the commodification of life, for example in genetically engineered food products (Frankenstein food) or in debates about the medicalization of the body (where Huxley's *Brave New World* and Orwell's *Nineteen Eighty-Four* are commonplaces). The suspicion and downright fear surrounding genomics, exacerbated by these literary references, have led to rather stark oppositions in public debates. While genomicists work hard to create the knowledge that will improve life in quantitative and qualitative terms, critics have warned that genomics might give rise to a *liberal eugenics* where citizen-consumers get to choose the characteristics of their future child, and, someday, may seek to improve their own bodies through gene therapy (replacement of small parts of one's DNA by foreign DNA), thus creating a society with two classes: the improved and the non-improved. Genomic technologies, so these critics suggest, may impair the very equalities that emancipatory movements such as feminism, Marxism and anti-racism have fought so hard to obtain.

In the past decades, critique of the life sciences for their tendency to stretch the limits of human life often has often taken the shape of a critique of "genetic determinism": a logic that unilaterally links human identity, behavior and disease to genetic code. In the realm of the literary, one could make a rough distinction between those novels that reproduce genetic determinist thinking — for example the bestselling medical thrillers of Robin Cook, Dean Koontz, and Tom Clancy — and those that try to reveal its potential dangers by authors like Margaret Atwood and Michael Crichton[2]. In the critical variant, genetic determinism is often portrayed a strategy or even a weapon in the hands of a small and isolated group of biotech engineers, or as the product of a more general mechanistic logic in society, an urge for absolute control most forcefully manifested by totalitarian regimes. Michael Crichton's *Next* (2006) critically represents the scientifically dubious idea of "the gene for x." While genomicists know very well that there is not such a thing as "the gene for sociality," in *Next* Crichton shows that genomics research nevertheless pursues this idea because it yields money through gene-patents. In these narratives, the scientific determinist logic and the ability to seize social, economic and political control coalesce: once an unequivocal correspondence between genes and traits like intelligence or sociality has been established, a patent of the particular gene promises revolutionary applications and a virtually endless return on investment. *Next* can be understood as a critical response to the genetic determinism in the life sciences, notably the idea that the Human Genome Project would result in a blueprint of human identity.

Although literary critiques of genetic determinism have certainly been important in displaying the adverse effects of a linear, mechanistic logic, their downside is that they tend to exaggerate the scientific dominance of this logic. As discussed above, while it is true that genomics leaves the premise of genocentrism largely intact, it does involve several trajectories towards more complex understandings of the role of DNA in development and evolution. Moreover, literary critiques of genetic determinism fail to take into account compelling non-genocentric arguments from the life sciences.

Genomics and Nomad Science

Why is it the case that narratives about human transformation tend, as we have observed above, to revel in intense hopes and fears around the powers of genome science? Furthermore, why do these narratives typically offer the change as *fait accompli* instead of actually taking the reader through a process of transmutation? The answer to these questions, I want to argue, is that biological transformation has become a neglected idea in the life sciences, especially after molecular biology became dominant in the 1950s. If we follow the lead of Hub Zwart's psychoanalytical epistemology, each science carries with it one or more archetypes, fantasies that remain hidden but all the while co-determine the field (Zwart, *De Waarheid op de Wand*). For example, a major archetype of chemistry, Zwart argues, is the explosion. Students, some

2. I should add that techno-thrillers by writers like Cook and Clancy sometimes carry explicit critical components, raising ethical questions around new technological possibilities or the conduct of scientists and medical professionals. My point here is that they do not challenge the paradigmatic centrality of the genome as a source of life.

more than others of course, may feel the desire to cause an explosion, yet in their pursuit of becoming real scientists, they are forced to leave this fundamental desire behind. I argue that in contemporary life sciences, and genomics in particular, transformation has the status of an archetype. This is in concert with the fact that in the life sciences, those fields that most explicitly think of life as a transformative process — embryology, developmental biology, and evolutionary biology — have become subservient to molecular biology, particularly genetics and genomics. Transforming life, and human life in particular, is an ultimate consequence of the life sciences, but one that is so disconcerting that it remains hidden under the surface of scientific discourse.

When we start to look at the idea of transformation as a problematic limit-case of genomics, two opposite scientific attitudes in the life sciences as well as in other scientific fields become discernible — a dominant one based on control, and a submerged one based on radical (thought-) experiments. This opposition can be elaborated along the lines of Deleuze and Guattari's distinction between "State science" and "nomad science" (Deleuze and Guattari, *A Thousand Plateaus* 398). Importantly, State and nomad science are ideal types: they constitute tendencies that can be seen in various degrees in individuals and practices. The first term denotes the standard form of modern science as it began to emerge in the eighteenth century and came into fruition during the nineteenth century, attaining the institutional shape it more or less continues to have today. For Deleuze and Guattari, science's propensity for finding solutions, for gaining control over the chaotic forces of the world, is immediately linked to the State's rise and its increasing hold over life (Deleuze and Guattari, *A Thousand Plateaus* 398-413). State science is intent on making things manageable, palpable, and predictable. In the crevices of the State system, however, individual scientists may diverge from this standard model, asking questions and testing procedures that do not conform to State science. These nomad scientists move with a certain degree of freedom between the ideas, methods, disciplines, and institutions of State science. Their key interests according to Deleuze and Guattari are (1) fluid rather than solid phenomena, (2) developing models of smooth spaces (topologies) rather than metric and statistical models and (3) problematizing phenomena rather than finding solutions (Deleuze and Guattari, *A Thousand Plateaus* 398-413)[3]. Nomad scientists are often controversial or neglected figures, straddling the boundaries of science; following an insatiable desire to test their world, including themselves, they are agents of transformation, even if their ideas do not always affect the wider society during their own life times. Resisting the scientific impulse toward absolute certainty and control, they are open to the creativity of nature — an attitude aptly characterized by what Karen Bard, paraphrasing a line from Alice Fulton's poem "Cascade Experiment," calls "meeting the universe halfway" (Barad 39).

Rather than tuning in on Deleuze and Guattari's concepts, I want to highlight the connection to the problem of transformation, especially within the life sciences. Contemporary critics of the genomic paradigm argue that it tries to reduce life to a knowable and controllable substance or code, when life is something that is always changing according to unique conditions (Goodman; Kauffman; Lewontin). I would argue that nomad life scientists are those who affirm and revel in the fundamental transformability of life, rather than refusing it[4]. One life scientist who has taken up the idea of transformation in a rigorous manner is the biologist Susan Oyama, who earned her marks as a developmental biologist in the 1970s and became interested in the wider historical and philosophical consequences of the molecular paradigm. In 1985 she published *The Ontogeny of Information*, a controversial book in which she argues that the concept of information, as used in the life sciences, needs to be reconsidered in order to reclaim the centrality of the whole organism-in-development. Her Developmental Systems Theory, which she reformulated in *Evolution's Eye: A Systems View of the Biology-Culture Divide* (2000), is an attempt to think of life's dynamics as immanent to many entangled factors within and without the cell:

3. While State science is relatively clear as a concept, nomad science remains a rather vague idea. Deleuze and Guattari present the idea in a rather *ad hoc* fashion in *A Thousand Plateaus* (pages 398-413) and do not return to it in later works. I try to provide an elaboration of this concept in my PhD thesis through a reading of (popular) science and SF novels.

4. Nomad life scientists can be placed within a (counter)tradition that Robert Mitchell has termed "experimental vitalism": rather than seeking the essence of life in some kind of force distinct from physical and chemical forces (as in traditional vitalism), experimental vitalism tries to provoke new experiences and questions around living beings (Mitchell). Nomad life scientists also continue, in a sublimated scientific way, the tradition of alchemy in which transmutation of matter was the object (with the ultimate goal of creating gold out of other metals), where the distinction between animate and inanimate was an endless source of fascination, and where

the practitioner exposed himself to obscure knowledges, substances and conditions in order to provoke this transmutation (Zwart, *De Waarheid op de Wand* 183-86).

> *As the notion of centralized control of development gives way to the developmental system, the view of heredity is enlarged beyond the germ cell to encompass other developmental means or resources. [...] this increases the number of ways in which developmental influences can act transgenerationally, altering the relationship between developmental and evolutionary processes. Think of the way a play can sometimes be "opened out" when it is translated to film, showing things the stage couldn't accommodate and moving the story forward or adding dimension to it. (Oyama,* Evolution's Eye *207)*

By including many environmental factors, Oyama suggests that the developmental paths of organisms and the long-term processes of evolution are much more profoundly related than the dominant neo-Darwinist paradigm allows. The famous nature-nurture debate is radically denounced by Oyama, who argues that traits in organisms are never caused by nature *or* nurture, neither are they *part* natural and *part* cultural. This dichotomy, so Oyama argues, represents a failed attempt to determine the causes of life as if they were attributable to given substances and/or learned habits, when causality is in fact a heterogeneous and emergent phenomenon pertaining to organisms and ecosystems (Oyama *Evolution's Eye*; "Terms in Tension"; "Boundaries"). The event of transformation thus becomes the locus of an encounter between the life sciences and the humanities, the terrain of a new "biohumanities" (Stotz and Griffiths 45).

Oyama's work is a concrete example of nomad science, problematizing trenchant ideas about life and developing, against the scientific grain, a topological model based on the continuity of development and evolution, and the unpredictability of life. There's a humbling quality Oyama's work, placing humans in a dynamic field of relations rather than at the top of the pecking order. She differs in that respect from (predominantly male) celebrity scientists in the field of genomics like James Watson and Craig Venter, who claim to have found the essence of life in DNA. If science, like literature, creates stories about life, stories in which science itself appears as an agent, then the spokespersons of genomics narcissistically allow themselves a far greater role in these stories. At the same time, Oyama is much more bold, attempting to rethink life in ways far more imaginative than the Human Genome Project could ever have achieved. Her scientific nomadism may serve as an antidote against presentism as well as against the sort of speculative claims in genomics that mechanistically project a future world of our own making.

5. Stanley Robinson is not only an SF writer, he is also a scholar (he earned a PhD under the supervision of SF theorist and philosopher Fredric Jameson), a vocal public figure concerned with social and ecological problems, and an ardent reader of scientific texts.

Nomadism in the Mars Trilogy

Scientific ideas like Oyama's in which the distinction between nature and culture becomes porous can be sensibly linked to experiments in literature, and especially to SF texts like Stanley Robinson's that stand out for their rigorous and innovative use of scientific ideas[5]. Literary experimentation with science can be theorized along lines of Deleuze and Guattari's notion of "minor literature" (minor being synonymous with nomad). In *Kafka: Toward a Minor Literature* (1986), Deleuze and Guattari take Kafka's oeuvre as a starting point for determining the function of literature. They argue that most novels are examples of major iterature, expressing the dominant forces in society. Major literature typically revolves around one or more characters, and is mostly interested in showing the psychological life of these characters. These characters may

experience extraordinary things, but their thoughts and their life-world are ultimately familiar: we can identify with them. Major literature, in short, is a personal affair, and it mostly teaches the reader how individual human beings (should) live. What Deleuze and Guattari call "minor literature," does something very different: rather than being about the interior of the subject, it moves to the level of collectivities, of the nomadic outside. The task of the writer, here, is to take a journey to the outside, to empty out the self by discovering the anonymous social, economic, physical, and other forces of which human subjects are but coagulations. This nomadic mode of narrative, I want to argue, is typical for SF narratives like the *Mars* trilogy in which the ideas of subjectivity and humanity are not taken as givens, but as begin points for test-scenarios in which humans and their habitats undergo significant changes.

I want to distinguish three modalities of nomadism in relation to the *Mars* trilogy: scientific, literary, and biopolitical. The scientific dimension is represented by the key nomadic ideas which inform the novels, as well as the role of nomad scientists in the narrative. Bringing together many fields including space science, meteorology, genomics, ecology, geology, political science, and psychology, Stanley Robinson sketches a scientific border area where life is no longer viewed through the genocentric lens. *Green Mars*, the second installment, starts with a sequence in which an unnamed colonist reflects upon the process of creating a biotic sphere on Mars:

> *Of course all the genetic templates for our new biota are Terran; the minds designing them are Terran; but the terrain is Martian. And terrain is a powerful genetic engineer, determining what flourishes and what doesn't, pushing along progressive differentiation, and thus the evolution of new species. And as the generations pass, all the members of a biosphere evolve together, adapting to their terrain in a complex communal response, a creative self-designing ability. This process, no matter how much we intervene in it, is essentially out of our control. Genes mutate, creatures evolve: a new biosphere emerges, and with it a new noosphere. And eventually the designers' minds, along with everything else, have been forever changed. (Stanley Robinson,* Green Mars *13)*

The various processes that make the creation of ecological landscapes on Mars possible include modification of soils, water distribution, climate change, technologies for solar and nuclear energy, genetic modification, but also political and scientific processes. The detailed manner in which Stanley Robinson describes these processes and their interrelations can be seen as a literary counter-part to Oyama's ideas about the reciprocity of organism and environment, her problematization of the distinction between nature and culture, and her plea for the fundamental unpredictability of life.

Apart from narrativizing nomadic ideas such as Oyama's, works like the *Mars* trilogy also flesh out the profile of nomad scientists and practices through the vicissitudes of characters, thus rendering Deleuze and Guattari's concept more concrete. An interesting example is the character Sax Russel, who in the course of the second novel experiences a sudden conversion from a quintessential State scientists to a scientist with nomadic tendencies. At first, Sax was the head of a scientific team endowed with the task of modifying Mars's atmosphere for the purpose of human habitation. He is a traditional man of science, believing in science's ability to control nature, and lacking interest whatsoever in the turbulent political processes surrounding his projects. Sax is highly skeptical of holistic views on Martian life; he rejects Arkady Bogdanov's hypothesis that in terraforming the planet, they are also transforming themselves. Yet all of a sudden, the political realities confront him head-on, with rather ironic effect: after having been abducted by a rebel group who subjected him to brain experiments, Sax's personality has changed, and he is no longer the strict scientist he used to be. Sax's character change is not just a result of altered synopses in his brain, but also of his experience of no longer being in control, of his body having been transformed. Afterwards, he ceases to coordinate the enormous projects, and, while retaining some of his learned scientific rigidity, becomes a nomad researcher traveling about in search of new ideas, a scientist more susceptible to political and other desires, including love. He develops a fascination with two nomadic models of continuity that problematize the paradigm of controlled terraformation: the "Red" movement that believes a specifically Martian spirit of place to be the basis of a new holistic science of *areology*, and a green movement that places terraformation in the context of a cosmological celebration of "viriditas"[6] (life as immanent potential) that decenters human presence while affirming a responsibility of human beings as disseminators of life in the universe.

Second, there is a literary nomadism at work in the *Mars* trilogy, which I take as an impulse to push to the limit aspects of narrativity through a consistent elaboration of nomad-scientific ideas about humans and their world. Whereas for Deleuze and Guattari minor literature is about shaking our habitual sense of humanity and the world by experimenting with language (grammar, syntax, vocabulary),

their own analyses already suggest that an equally intensive kind of experimentation can take place on the level of narrative (Deleuze and Guattari, *Kafka*; Deleuze). If narratives by definition revolve around human or anthropomorphic characters and their psychological lives, this basic narrative schema can be opened up by bringing to the fore the connections between humans and other life forms as well as the potential for human transformation into something else. The *Mars* trilogy, in performing this opening up, attains evolutionary and planetary proportions, becoming a world-narrative or *worlding* (Haraway), a mere episode in the saga of evolution. The trilogy is replete with descriptions of natural processes (recall the sequence on microorganisms at the beginning of this paper) in which the fascinated scientists lose themselves — mentally and physically. It is as if the writer nomadically follows the idea of transformation without being able to stop its flow, to reveal its origin or end-point. The characters are in a sense the medium of this transformation. They realize that they do not control the ramifications of their new lives on Mars, but that they need to act affirmatively if they want to survive and prosper. They give up many of the certainties and comforts of their Earthly lives to become nomadic pioneers of a new life, a new humanity no longer presented as the center of the universe but rather as an ongoing journey.

Thirdly, the nomadism exhibited in the novels is biopolitical. The problem of life is not primarily an existential-psychological problem concerning a limited number of characters. Instead, life is always already a collective problem and a (partly) biological problem, encompassing issues such as health, security, mobility and mortality that affect human society as a whole as well as other living beings. The *Mars* trilogy experiments with ways of living and forms of life not just by recounting the fates of a few individuals, but by sketching the long-term developments of populations and communities. Biopolitical dynamics in the novels can be analyzed along a rough distinction between biopolitics of control, based on modern ideas about maintaining healthy populations and a safe, orderly society, and a nomad biopolitics (or *micropolitics*) that creates alternatives to dominant biopolitical regimes. In the *Mars* trilogy we see biopolitical strategies of control dispersed over large corporations, states and the UN, who aim to exploit Mars's resources and use Mars for solving overpopulation on Earth. In the meanwhile, an assemblage of individuals and small groups — most of whom were born on Mars venture to create a viable and just society from the bottom up. Against the short-term interests of the prevailing powers, John Boone proposes a "seven-year rule" — "thinking seven generations back and seven generations forward" — in order to secure a livable world in which human and other elements are mutually sustainable (Stanley Robinson, *Red Mars* 379). The trilogy is thus biopolitically relevant in two senses: it registers the dynamics of biopolitical control and resistance, and constitutes, in and of itself, an attempt to imagine new biopolitical strategies of resistance.

Conclusion: Cross-breeding Literature, Science and Philosophy

Experimentally testing how much science and how much "world" a narrative can take without succumbing to their weight, Stanley Robinson's dense and stupendously elaborate SF work (totaling over 2300 pages) is a true limit-case of literature. The idea of a co-evolution of organism and environment is pushed to its extremes, collapsing evolution and history to such an extent that the realms of the sciences and humanities begin to overlap and connect. Stanley Robinson offers no unilinear scenario for (post)human transformation, but a repository of future mythologies: holistic stories about the unfolding relationship between humanity and life. As in all myth, this relationship is a very personal one, touching every aspect of the characters' lives. However, there is also a sense in which this SF narrative opens up our familiar sense of humanity to the anonymous forces that pervade and modify our bodies. As such, the *Mars* trilogy is a concrete example of what all art, according to Deleuze and Guattari, can and should do: to reach the "outside" and by passing through a series of "non-human becomings" (Deleuze and Guattari, *What is Philosophy* 183).

6. Stanley Robinson borrows the term "viriditas" from the twelfth-century German mystic and writer Hildegard von Bingen, for whom the term denoted the divine forces as expressed in natural phenomena. Stanley Robinson refers to viriditas as "a holy greening power" inherent in the universe (*Green Mars* 20). The character Hiroko is the great instigator and symbol of the greening of Mars. By the end of the novel, it is suggested that she is travelling to a planet in another solar system to disseminate life even further.

Ever since the French writer and philosopher Émile Zola proclaimed that writers ought to become quasi-scientific experimenters, exposing characters to new conditions and testing their responses, scholars have claimed that literature can fruitfully complement scientific knowledge about the world (Zwart, *Understanding Nature*). In order to bring the sciences, the humanities, the arts, and society closer together, it is imperative to approach them not as objects of research, but as partners. My joint analysis of the *Mars* trilogy, Developmental Systems Theory, and the concept of nomad science was designed as a cross-breeding experiment actualizing latent potentials in each. Rather than interpreting texts, or applying concepts, I have tried to think with texts on the event of human transformation in a way that, hopefully, contributes to the development of an interdisciplinary, post-anthropocentric humanities.

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SUMMARY

Genomics, a dominant paradigm in the life sciences today, promises applications that will modify humans and other organisms at the genetic level. Still, the prospect of human transformation remains something highly controversial, and cannot be articulated openly within the dominant scientific discourse. In this paper I look at two alternative sources: Susan Oyama's Developmental Systems Theory and Kim Stanley Robinson's *Mars* trilogy. These texts bring transformation into focus not narrowly as a human project, but as immanent to life. The specificity and significance of these texts can be understood through an elaboration of Deleuze and Guattari's concepts of "nomad science" and "minor literature."

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