TECHNOPHANY
A Journal for Philosophy and Technology

Technophany Vol.2 No.2

Entropy's Critical Translations: Following Serres's Path through the North-West-Passage

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Abstract:

It is, according to Serres, the "greatest discovery of history that entropy and information are connected"—a line of thought he pursues throughout epistemological questions, aesthetics, cultural analysis, and a theory of differential mattering. By following Serres's work, one finds negentropy, entropy, chaos, local orders, the "soft," and the "hard" almost everywhere in his writings. The intellectual context and sources that Serres draws on are an important support in understanding the coupling of informational and thermodynamic entropy, and how it becomes a key operator of entropic differentiation. This text draws a combinatorial map of how Serres connects entropies across a range of areas of knowledge. In this specific context, Serres's path of translation harnesses the so-called "hard" and the "soft" forms of entropy in his investigations of literature and art, but also in order to discuss social phenomena and the formations of societies. By drawing attention to the negative spaces in Serres's connective path of translating entropies and in the course of reading his work in context with other philosophies of entropy, this essay aims to explore Serres's translations in the way it both *connects* and *leaves gaps*. Approaching Serres's criticality in this way brings one to the critical, difficult, icy landscapes of the North-West-Passage. The North-West-Passage epitomises a method to conceive the difficult path between the natural sciences and the humanities—exactly the kind of path that entropy often meanders on. In fact, entropy itself plays an important role regarding the icy landscape's ecology, e.g., to the degree to which the passage is melted or frozen, and thus, to the possibility of the passage as such. Bringing these lines of thought together, entropy appears as a condition to think Serres's method of translation. By considering these multi-layered aspects of entropy as a material, aesthetic, and critical factor, this contribution places Serres's approach to entropy as an eco-critical path in the face of the melting of icy landscapes.

Keywords:

entropy, Serres, North-West-Passage, translation, transdisciplinary, environment

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ISSN 2773-0875

1. Entropy in Translation

During the last Ice Age, a glacier pushed forward a massive flow of material in an area that is close to what is now Emmen in the Netherlands. The quarry, deposits of sand and gravel in multiple colours and a lake filled with jade green water carry a geological history that tell of these ancient glacial movements. In the 1970s, American artist Robert Smithson became interested in the site, and just after realising his famous *Spiral Jetty* (1970) in Utah, USA, he carved *Broken Circle/Spiral Hill* (1971) as an answer to the Dutch site of the sunken landscape with its cone-shaped hill.[1]

It stages Smithson's thinking about entropy in a site-specific artwork. Entropy as a concept has developed in the course of the artist's working and thinking about time, sites, decay, and creativity, which he has made productive by writing *about* art, that is, engaging with what he calls a new monumentality;[2] as well as by integrating it *into* his own artistic practice. Smithson's work on entropy can be read as one way to translate the concept into a form of knowing that is different from its disciplinary origins. It is an attempt to make the concept of entropy tangible, experienceable and to switch registers of abstract knowing, verbal understanding and sensual experience. Taking Smithson's *Broken Circle/Spiral Hill* as an entry into entropy's translations, we encounter that, in general, the concept has been mobilised in many ways, and has been historically open to being translated from its formulation in thermodynamics into many other realms, such as information theory, biology, economics, history, art, and literature.

Within the numerous approaches to transfer and reformulate the meaning of entropy into other areas of knowledge, it seems particularly interesting to see how exactly these shifts take place. I turn to Michel Serres in this context for two reasons; firstly, due to his simultaneous scientific and poetic engagement with the concept of entropy; and secondly, because he has developed the idea of translation as a philosophical and critical method. What it means to translate is mostly demonstrated in his theory-practice rather than explicated in a meta-theory. In some places, such as in the first pages of *Hermès III. La traduction*, he gives some insights into his method of "traduction," which differs from both "deduction" and "induction."[3] Translation is oriented by "traduction" and, for Serres, follows the passages or interconnected knowledges across different ways of understanding, which itself is strongly informed by his reading of Leibniz and mathematical structuralism.[4]

1 https://holtsmithsonfoundation.org/broken-circle-and-spiral-hill-having-entropy-dutch-way

2 Robert Smithson, *Robert Smithson: The Collected Writings*, ed. Jack Flam (California: University of California Press, 1996).

3 Michel Serres, *La Traduction* (Paris: Éditions de Minuit, 1974), 9.

4 Michel Serres, *Le Système de Leibniz et ses modèles mathématiques* (Paris : PUF, 1968); Lucie Kim-Chi Mercier, "Michel Serres's Leibnizian Structuralism," *Theory, Culture & Society* 24, no.1 (2019): 3–21.

In this context, translation cannot be abstracted from being a form of communication, which, due to noise and miscommunication, can be successful as well as unsuccessful.[5] It raises questions of trans-disciplinarity similarly as "a- and pre-disciplinarity" and the relations between philosophy and science that have been historically heterogenous.[6] Translation in Serres, as Chris Watkin notes, imply the many substitutions and non-linear analogies involved and suggests a "non-trivial isomorphism as opposed to a simple correspondence."[7] What remains important overall and especially also in the context of entropy is that Serres's translations refrain from employing a centre of origin, which is why they explicitly do not hold an "ultimate key" to a universal model, neither do they proceed by "umbilical thinking" with an ultimate source.[8]

Having started from Smithson's *Broken Circle/Spiral Hill* in the Dutch landscape, I will in the following move through Serres's combinatorial maps of entropy, to then take the passage through the material and symbolic Arctic landscapes or what Serres calls the North-West-Passage as a metaphoric multidisciplinary environment. Serres's reading of Leibniz shapes much of his topological operation—it is not only Leibniz's *ars combinatoria* that informs Serres's structuralism and that inspires his method of translation; but also a topological map of connection in a fluid landscape that grounds important aspects of his theoretical practice: it is his explicit wish to "finish drawing this navigational map, this inventory–fluctuating and mobile–before I die."[9] The North-West-Passage appears as a thoughtspace, as one might call it, accommodating Serres's critical translations between the sciences and the humanities in a difficult, icy, and moving landscape. Within this setting, the concept (or concepts) of entropy plays an important role for, on the one hand, a paradigmatic interdisciplinarily shaped function; and, on the other hand, the idea of entropy shapes decisively the ecology of the landscape in which these critical translations take place.

Throughout Serres's work, from his earlier to his later writings, we encounter an engagement with entropy through the history of physics and information theory, yet, also in his readings of literature or

5 Steven Brown, "Michel Serres: Science, Translation and the Logic of the Parasite," *Theory, Culture & Society* 19, no. 3 (2002): 1–27; Michel Serres, Josué V. Harari, and David F. Bell, *Hermes. Literature, Science, Philosophy* (Baltimore: Johns Hopkins University Press, 1982), 80.

6 Lucie Mercier, "Introduction to Serres on Transdisciplinarity," *Theory, Culture & Society* 32, no. 5–6 (September 2015): 38; Michel Serres, "Transdisciplinarity as Relative Exteriority," *Theory, Culture & Society* 32, no. 5–6 (2015): 41–43.

7 Christopher Watkin, *Michel Serres: Figures of Thought* (Edinburgh: Edinburgh University Press, 2020), 406.

8 Watkin, *Michel Serres: Figures of Thought*, 38–43; Vera Bühlmann, *Mathematics and Information in the Philosophy of Michel Serres* (London: Bloomsbury, 2020), 53, 145; Serres, Harari, and Bell, *Hermes. Literature, Science, Philosophy*, xiv.

9 Michel Serres and Bruno Latour, *Conversations on Science, Culture, and Time* (Ann Arbor: University of Michigan Press, 1995), 105.

the history of art. In fact, entropy and entropic differences are a key to understanding Serres's work more broadly.[10] His writing on various issues is imbued with the language of entropy, that is terminologies of decay, dissipation, reservoirs, temperature differences, homeorrhesis, chaos, local orders, negentropic islands, and most significantly, the "soft" and the "hard." The latter two are terms with which Serres articulates two meanings of entropy, that is the thermodynamic (hard) and the informational (soft), the particular relationship of which has sparked much interest in the literature on Serres.[11]

In negotiating entropy and negentropy, Serres approaches a multiplicity of phenomena, and, in fact, world views. He develops a negentropic epistemology, a negentropic subject, and extends these entropy-related figures into his ideas of religion and social theory. The interpretation of entropy is not necessarily that of decay, but takes it from its potential of beginnings, as *La distribution* narrates: the beginnings of knowledge, of life, of time, of signals, of the world.[12] Serres's philosophical reflections take into account phenomena such as "energy reserves according to Brillouin," "differences according to Carnot," "dissipative structures in the sense of Prigogine," or "metastable equilibriums according to Wiener."[13] As shown elsewhere, this entropic difference is an operator that drives Serres's thinking at large; namely, a difference which can be understood as a deviant differential and as a processual distribution of chaos and order as co-dependent categories.[14]

It seems worthwhile to pay particular attention to the theoretical path and the combinations Serres's work on entropy establishes. In doing so, I will mark decisive orientations and sources that define a conceptual net of connections, as well as look at some of Serres's writings to trace entropy that might be a bit off the radar, namely those that concern theories of social relations and social phenomena. His translations between history of science and art seem to have been more broadly received, such as on how J.M.W. Turner's paintings translate Carnot's thermodynamics, or how Émile Zola's fiction epitomises a steam engine.[15] Yet, Serres also expands his entropic translations through the "hard" and the "soft" into cultural and social theory more broadly. To give an example: the entropic difference is even present in

10 Lilian Kroth, "Entropy and Entropic Differences in the Work of Michel Serres," *Theory, Culture & Society* (2023): 1–15.

11 Bernadette Bensaude-Vincent, "Connecting the World and the Word: The Hard and the Soft in Michel Serres's Philosophy," *Technology and Language. Introductions* 1, (2020): 12–15; Bühlmann, *Mathematics and Information in the Philosophy of Michel Serres*; Connor, Steven. "'The Hard and the Soft,'" *Available at Http://Www.Stevenconnor.Com/Hardsoft/*.

12 Michel Serres, *La Distribution* (Paris: Éditions de Minuit 1977).

13 Serres, *La Traduction*, 48.

14 Kroth, "Entropy and Entropic Differences in the Work of Michel Serres."

15 Serres, Brown, and Paulson, "Science and the Humanities"; Serres, Harari, and Bell, *Hermes. Literature, Science, Philosophy*; Serres, Michel, *Feux et Signaux de Brume* (Paris: Grasset, 1975).

Serres's theory of religion. The interplay between the hard and the soft explains what Serres calls "hot spots," "those places where, at a given moment, another world manifests itself in ours."[16] This other world, as Serres calls it, "abstract, virtual, possible, whatever else it may be, sometimes manifests its existence in our world by suddenly emerging in places of exceptional heat that, once they have cooled, are so long-lasting that their traces lie outside the boundaries of historical time."[17] In these moments and places of "hot spots" Serres is concerned with how these interfere with "vertical binding," that is, how the religious bounds of individuals and collectives is described as equivalent to the coming together of the "'hard' and the 'soft'"[18]—which is one of the examples of Serres's usage of terminology of thermodynamic and informational entropy in contexts that are conceivably different from their disciplinary origins.

2. A Combinatorial Map of Entropies

How does Serres arrive at his translations of entropy, what are his sources, and how does he connect these different occasions of entropic thinking? And, within these many connections, what does he *not* connect in pursuing entropy's translations? Within the broad disciplinary scope of translatability, it is particularly insightful to pay attention to some of the gaps, and negative spaces regarding how entropy can or has been translated in his work.

Let us start with Serres's approach to entropy as it emerges between thermodynamics and information theory. It is, according to him, the "greatest discovery of history that entropy and information are connected, in epistemology as well as in the theory of matter."[19] The intellectual context and sources that Serres draws on are an important support to understanding the way in which the coupling of informational and thermodynamic entropy takes place. His early *Hermès*-series is imbued with a broad range of topics and histories, notably a theory of communication and information, as well as the history of thermodynamics. Serres follows, amongst others, Clausius, Boltzmann and Carnot and their contributions to understanding the transition from dynamics to thermodynamics, the arrow of time, motors, and more generally, the concept of entropy from the 19th century onwards. In his historical approach, he reformulates the relevance of this history for philosophy and how it fundamentally reconfigures conceptions of time and space that are implicitly oriented by dynamics, towards a philosophy

16 Michel Serres, *Religion: Rereading What Is Bound Together*, trans. Malcom DeBevoise (Stanford University Press, 2022), 5.

17 Serres, *Religion*, 4–5.

18 Serres, *Religion*, 11–13; 21; 27–29; 54–66.

19 Serres, *La Traduction*, 71.

that integrates temperature differences and irreversible time. Similarly, he introduces a notion of communication which goes against the grain of fundamental classical philosophical frameworks of subjective existence and respective forms of interaction; and he proposes a deeply relational philosophy that is grounded in differentiating noise and information.[20]

When drawing the combinatorial maps of Serres's translations of entropy, there are different sources to be considered, which range from Lucretius—whose natural philosophy Serres formulates in terms of a language around entropy and therefore reads the history of ideas connected to the concept of entropy somewhat recurrent—as well as 20th century thinkers, such as Léon Brillouin, Henri Atlan, Ilya Prigogine, Isabelle Stengers, and Jacques Monod. In order to understand how Serres is able to couple entropy in the thermodynamic sense with that of information theory—an endeavour which others have pursued in relatable ways[21]—we need to understand Serres's combinatorial map of connections.

In information theory, Serres refers, for example, less to the work of Shannon whose use of the term entropy points to an average level of information in a message, but to that of Brillouin: in *Science and Information Theory,* Brillouin reversed the notion of entropy and negentropy that made it compatible with entropy and negentropy as in the thermodynamic notions of chaos and organization.[22] The important contribution that Serres adapts from Brillouin is the connection between negentropy and information. By stressing that exactitude comes always with costs, Brillouin came up with an economic conception of entropy and a critique of determinism that also proved to be highly influential for Serres; namely, that negentropy comes with a price to be paid.[23]

Connected to that, Serres holds strong ties to research on the concept of entropy in the context of far-from equilibrium thermodynamics from the 1960s onwards; that is, respective notions of chaos which are not simply opposed to order, but which provide a potential ground for order. Crucial for that is

20 Serres, *La Communication*; Serres, *La Traduction*; Serres, *La Distribution.*

21 Terrence Deacon, "Shannon – Boltzmann – Darwin: Redefining Information (Part I)" *Cognitive Semiotics* 1, no.1 (2007); Jeffrey Wicken S. "Entropy and Information: Suggestions for Common Language" *Philosophy of Science* 54, no. 2 (1987): 176–93.

22 Léon Brillouin, *Science and Information Theory* (New York: Academic Press Inc., 1962); Serres, *La Distribution.*; Bühlmann, *Mathematics and Information in the Philosophy of Michel Serres*, 34–42.

23 "A very large amount of information", he writes, "shall cost a very high price, in negentropy. An infinite amount of information is unattainable. An infinitely short distance cannot be measured, and a physical continuum in space and time is impossible to define physically." Brillouin, *Science and Information Theory*, 303. Bühlmann notes that what Brillouin means by the price of information is not only metaphorical. In mathematical physics, the Price of Information can be quantified precisely; it can be indexed even with a number (10^{-16} in Brillouin's 1956 book, a number which by the state-of-the-art particle physics of today has reached 10^{-32})" Bühlmann, *Mathematics and Information in the Philosophy of Michel Serres*, 41.

Prigogine's work on "dissipative structures" as well as Prigogine and Stengers's collaborative work *Order Out of Chaos.* These approaches have not only been ground-breaking for research between physics and chemistry, but also entail crucial insights for philosophical approaches to questions of decay and the emergence of orders. Research in far-from-equilibrium thermodynamics discovers entropy as a potential for order, which Serres regards as an important task to be integrated into philosophy more broadly. It is in this sense that Serres develops philosophical conceptions of structure, locality, and globality through his engagement with the sciences.

Prigogine and Stengers notably share less fascination for influences on Serres such as Brillouin[24] and his concept of negentropy. Yet the two authors of *Order Out of Chaos* and Serres prove to have been reciprocally familiar with and influenced by one other's work.[25] Prigogine, Stengers, and Serres share an interest in Lucretius, in the history of thermodynamics and the meaning of an entropic world vision, as well as in contemporaries such as Jacques Monod. There are further crossovers in terms of the readjustment of the human-nature-relationship towards a pact or alliance with nature, a critique of disenchantment, the emphasis on uncertainty and contingency, as well as an understanding of nature which is built on concepts such as self-organization, spontaneity, temporality, multiplicity and complexity.[26] What is crucial in this respect, however, is that Serres relates to an understanding of entropy which is not equivalent to decay, but which comprehends a potential for organization exactly within processes of dissipation.

We can see how this differs from the networked maps others have drawn of the concept of entropy. In many cases, this also depends on the sources harnessed, and the connections that are made possible with respective takes on entropy. Thus, Serres's approach differs from other philosophers who have mobilised entropy in French thought, such as, for example, Bernard Stiegler or Gilles Deleuze. Serres does not identify entropy with decay only, but as a potential for order, which is why the notion of it having to be "overcome" (Deleuze) did not find entry into Serres's philosophy, neither did a diagnosis of entropy's application into terms such as "hyper-proletarianization and a generalised form of automatic

24 Ilya Prigogine and Isabelle Stengers, *Order out of Chaos* (New York: Bantam Books, 1984), 216.

25 The points of contact between the authors are manifold: Serres directly refers to Prigogine's "dissipative structures" (Serres, *La Traduction*), and he wrote a review of *Order out of Chaos* for *Le Monde* in 1980; and vice versa, Prigogine and Stengers come back to Serres in *Order Out of Chaos* several times (Stengers and Prigogine, *Order out of Chaos*, 141; 303–5).

26 Henry Dicks, "Dossier: Le Groupe Des Dix, Des Précurseurs de l'interdisciplinarité – Physics, Philosophy and Poetics at the End of the Groupe Des Dix: Edgar Morin and Michel Serres on the Nature of Nature," *Natures Sciences Sociétés* 27, no. 2 (April 2019): 169–77"; Stengers and Prigogine, *Order out of Chaos*, xxvii; 22; 32; 165–67; 304.

piloting" (Stiegler) take place in such form in the translations Serres pursues.[27]

In his translations of entropy, one can see further contrasts to other approaches and generally highlight that Serres is interested in art history, yet less in relations with more recent or contemporary art practices. The same holds true for literature: whereas there has been a notable interest in entropic literature or the application of concepts related to entropy in literary studies in the later 1980s and 1990s,[28] Serres seems to somehow participate in this historically situated momentum of interest himself, yet the literary sources he works with, Zola or Woolf, for example, indicate that his research seems rather directed towards an established literary canon and not necessarily concerned with contemporary works.

Many passages between entropy and social theory are possible, many of which Serres does not choose to take. For this reason, firstly, I would like to acknowledge a gap in respect to the absence of translation into a wide range of possible "social" dimensions. Serres does, unlike others, not make use of figures or expressions such as "social entropy" to explain or criticise social crises or society as "ungovernable."[29] Furthermore, Serres does not mobilise Prigogine's "dissipative structures," thermodynamic decay, or the idea of auto-poietic systems for a naturalised understanding of social regulation. His naturalism follows along different lines and is particularly sceptical of such direct applications of scientific terms into social theory. In that, Serres's implementation of entropy into a theory of hominization differs from, for example, Hayek's application of entropic vocabulary. Hayek referenced not only Spencerian evolutionism, but exactly the idea of "dissipative structures" to give his theory of the market quasi-scientific underpinning.[30] Hayek would have "claimed natural science foundations for his own theory of spontaneous order, aligning his project with "autopoesis, cybernetics, homeostasis, spontaneous order, synergetics, systems theory" and claiming the far-from-equilibrium thermodynamics of Ilya Prigogine as support for his work."[31] Serres's naturalism, by contrast, does not claim *such* continuity between the

27 See Deleuze's take on entropy in *Difference and Repetition* (London: Athlone Press,1994), and Stiegler's approach on the concept in *The Neganthropocene* (Open Humanities Press, 2018); for a more detailed analysis of the comparison between Serres and Stiegler and Deleuze, see Kroth, "Entropy and Entropic Differences in the Work of Michel Serres."

28 Katherine Hayles, *Chaos and Order: Complex Dynamics in Literature and Science* (Chicago: University of Chicago Press, 1991); Katherine Hayles, *Chaos Bound: Orderly Disorder in Contemporary Literature and Science* (Ithaca, N.Y.: Cornell University Press, 1990).

29 Wolfgang Streeck, "The Post-Capitalist Interregnum: The Old System Is Dying, but a New Social Order Cannot yet Be Born" Juncture 23, no. 2 (2016): 68–77

30 Geoffrey Hodgson, "Hayek, Evolution, and Spontaneous Order," in *Natural Images in Economic Thought: Markets Read in Tooth and Claw*, ed. Philip Mirowski (Cambridge: University Press, 1994), , 408–48.

31 Jeremy Walker, *More Heat than Life: The Tangled Roots of Ecology, Energy, and Economics* (Singapore: Palgrave Macmillan, 2020), 321.

natural and social world. The continuity runs differently, with a caution for the difficulty of taking (transdisciplinary) passages and with a sensitivity for scales.

Keeping in mind these differences and disruptions on a map of connections, one can further follow the paths with which Serres establishes relations between entropy and a theory of the social. The influence of René Girard is not to be underestimated, especially in regard to the question of how social order may emerge out of disorder.[32] The 1981 Stanford conference on "Disorder and Order in the Human Sciences" organised by Girard and Jean-Pierre Dupuy is an outstanding example for the search for a dialogue between the physical and the human sciences, which numerous intellectuals such as Henri Atlan, Francisco Varela, Edgar Morin, Cornelius Castoriadis, Heinz von Foerster, Ilya Prigogine and others took part in.[33] Serres is clear about his reservations towards a specific idea of a universal law of entropy—he refrains from universalist explanatory models and tries to establish entropy as locally global rather than globally local, as it were.[34] The attempt to refrain from such universalism makes Serres develop a particular concept of the global, notably active in an idea of "global intuition" and his dedication to a "new universal humanism," encompassing non-human life and the "whole universe."[35]

Particularly in regard to his thinking of the global in alignment with entropy in the realm of social theory, Serres reads as a patchwork: he remains interested in the human condition (with its multiple genesis as "locally global"); yet still, he often inhabits an authorial voice of a non-specified we/us—which presents a broader topic of discussion with different approaches to reading his work.[36] In the following, we shall now grasp those skeins in Serres's work that seem particularly productive in his combinatorial map of entropy, that is, in the parts that are involved with social theory.

In following Serres's conception of such human condition, we discover the language of entropy as a key

32 Massimiliano Simons, *Michel Serres and French Philosophy of Science: Materiality, Ecology and Quasi-Objects* (London: Bloomsbury Academic, 2022), 149; 155.

33 William Johnson, "Frères Amis, Not Enemies. Serres between Prigogine and Girard" (Ann Arbor: University of Michigan Press, 2005), 37. Serres aspiration to find passages between the sciences and the humanities stands out of question, yet the passages are not to be regarded as direct, insofar as, for instance, there remains a conditionality of science. "Serres has been situating science as unconditional but conditioned: entropy will always increase in a closed system, but individual societies will deploy their science according to different values." Johnson, "Frères Amis, Not Enemies," 43.

34 In this respect, my reading here differs from Hayles's criticism of Serres (Hayles, *Chaos Bound: Orderly Disorder in Contemporary Literature and Science*).

35 Michel Serres and Bruno Latour, *Conversations on Science, Culture, and Time* (Ann Arbor: University of Michigan Press,1995), 115; Christopher Watkin, *French Philosophy Today: New Figures of the Human in Badiou, Meillassoux, Malabou, Serres and Latour* (Edinburgh: Edinburgh University Press, 2016), 141–42.

36 Michel Serres, *Hominescence* (London: Bloomsbury Academic, 2019); Michel Serres, *The Natural Contract* (1995). On this point, see also Watkin in regard to Serres's "Great Story" (Watkin, *French Philosophy Today*, 166–70).

to a non-deterministic philosophy: living beings, life as such, and the human condition is in Serres's picture a process between thermodynamic necessity and open contingent future. "Hominization", for him, "consists in this contingent sequence of new deviations, of different equilibriums and new habitats."[37] In his almost cyborgian approach to what can be regarded of the human condition as an emergence out of changing equilibria, his understanding of human existence follows a mixture of the "hard" and "soft" entropies as a "bouquet of times."[38] How does Serres combine and translate entropy here? He explains *processes of globalisation* through "soft" and "hard" entropies, as well as changes in the human condition through his diagnosis that the negentropic "soft" technologies gain dominance over the "hard" entropic decay. In his view, human conditions and societies are formed through negentropic and entropic processes on multiple scales. They emerge in interconnection with technologies, and in doing so, create a movement of "loops" shaping "society."[39] It all revolves around a sensitivity for scales—there are translations and interferences between the (neg)entropic processes on the level of cells, living bodies and co-domestic companionships.[40]

On Serres's theoretical path, however, these intersections of entropies are not to be translated *directly* into a theory of society as "entropic"; rather, it grounds a translation of entropies as operators of difference in historically heterogenous loops and scales of societal formation. "Hominization" describes (neg)entropic processes between cells, "new bodies," "new houses" and "new globalities," revealed through a structural analysis of their relationships. Through a first loop of hominization that Serres calls "exo-Darwinian"[41] and a cyborgian understanding of bodies as "bio-techno-structures,"[42] he maintains that the question running from biology to technological objects is "humanist" or "new humanist."[43]

It is the figure of a spiralic "loop" with which Serres characterises "hominescences" and the emergence and stabilizations of respective organizations. In this respect, the temporalized loop transforms how we might understand the boundaries of groups; yet that does not necessarily lead to a (liberal or neoliberal)

37 Serres, *Hominescence*, 35.

38 Serres, *Hermes,* 75.

39 Serres, *Hominescence*, 213, 232, 246.

40 Serres, *Hominescence*, 108, 176, 215–16.

41 "Exo-Darwinism", Serres explains, is what he calls "this original movement of organs towards objects that externalize the means of adaptation. Thus, exiting evolution with the first tools, we entered into a new time, an exo-Darwinian one. So this original duration affected these tools in return. Plunging in their turn into another evolution, they transformed in our stead. So instead of sculpting our bodies, duration fashions these objects through the intermediary of our expert hands and our big brain." Serres, *Hominescence*, 39.

42 Serres, *Hominescence*, 47.

43 Serres, *Hominescence*, 45–46; 196.

argument of societal self-organization as a whole. The relationship between these different scales of systems thus conceived is marked by keeping its grounding in the coupling of information and matter. Serres stresses that "we are slices of the world"[44]: the social field is not governed by other laws than the physical world. This does not, however, say that societies simply have to be understood as entropic as a whole. It is important to stress that Serres's combinatorial maps do not employ an ideological scientificity in thinking social relations, nor would they apply entropy in a merely speculative manner—it is exactly about working out a how entropies *matter* on different scales of organization forming societies.

3. Making Theory Through the North-West-Passage

The North-West-Passage is a fractal landscape, less under control than an adventure, it is the critical landscape that will concern Serres throughout decades of his work.[45] The North-West-Passage has notably different meanings: (1) it refers to the sea route between the Atlantic and Pacific oceans through the Arctic Ocean, (2) it is the title of the fifth and last volume of *Hermès*, and (3) it epitomises the concrete passage of a method. As this fifth volume of the *Hermès* series addresses methodological aspects of how the passage between different areas of knowledge can run, the book, as Sydney Lévy has noted, "could also be thought of as a meta-hermes where Michel Serres studies the very activity which he has been practicing in the first volumes."[46] Serres appears as an "itinerant theorist" in presenting "a route, a record of a journey, a guidebook," in which he seeks to "weave together the fabric of knowledge."[47]

The task is to follow what it means to navigate, with Serres, in a critical and multidisciplinary environment. Taking the North-West-Passage in its metaphoric sense means to be on the spatiotemporal journey of critical translations; it helps him to conceive the difficult path between the natural and social sciences, and to think the relationship between world and thought. The concepts of entropy play a crucial role in this; and my concern here is that Serres not only shows how the concept of entropy is translated, but how entropy in both the "soft" and the "hard" sense relies on entropy, which is itself a *condition* for translation.

44 Michel Serres, "Temps, Usure: Feux et Signaux de Brume" In *Cahier de L'Herne Michel*, ed. François L'Yvonnet and Christiane Frémont (Paris: Editions de L'Herne, 2010.), 212.

45 Serres and Latour, *Conversations on Science, Culture, and Time*, 70.

46 Sydney Lévy, "Review of Hermès V. Le Passage Du Nord-Ouest, by M. Serres," MLN 97, no. 4 (1982): 990.

47 Paul A. Harris, "The Itinerant Theorist, Nature and Knowledge/Ecology and Topology in Michel Serres," *SubStance* 26, no. 2 (1997): 37.

Navigating the North-West-Passage requires passing through different state territories, as well as—imagined as a landscape of transdisciplinarity—between the blurry and changing territories of disciplines of knowledge. The North-West-Passage urges Serres to think disciplinary boundaries in the context of the relationship between natural and social sciences; and these boundaries themselves are formally put into question: in terms of their temporality, their states of matter, and interferences between world and mapping. Limits and boundaries in the North-West-Passage are subjected to temperature, and therefore, changes of states. The passage is bound to the effects of freezing and melting. As Yusoff notes, in Serres, "heat" is the (atmospheric, oceanic, terrestrial and solar) "messenger" and as "a form of interference in cold geographies," like a "hot knife," it makes the passage "open up."[48] Ingold and Simonetti, who also refer to Serres to emphasise the continuity of fluidity and solidity in a "world of becoming," incorporate the role of formal and metaphorical aspects of ice between concrete and fluid in a relatable way.[49]

These considerations provide a framework for the critical work of transdisciplinary translations in Serres's North-West-Passage, itself taking into account the second law of thermodynamics, and more broadly, entropy. As shown earlier, entropy is for Serres a condition to think translation in terms of both communication and miscommunication; here, on the other hand, it becomes clear that entropy as a thermodynamic concept is crucial in understanding the conditions of the icy landscapes, which provide Serres the translation space par excellence.

The North-West-Passage is, in Serres's words, the "complicated zig-zag line in between bays and channels, basins and straits, through the tremendous, fractal arctic archipelago," a combination of "disorder and lawful regularity," a "labyrinth of deception and precision." It is a dangerous and difficult route for the ship that navigates the North-West-Passage: the "patterns drawn by the ice" makes the ship "move forward, tumble, turn, stand." The North-West-Passage is, for Serres, therefore exemplary of the fluctuation and interdependence of space and time. He understands the temporal dimension as central to the icy landscape as "a freezing and thawing of time." "Time," in Serres's

48 Kathryn Yusoff, "Navigating the North-West-Passage," in *Envisioning Landscapes, Making Worlds*, ed. Stephen Daniels, Dydia DeLyser, J. Nicholas Entrikin, and Douglas Richardson (Oxford: Routledge, 2011), 301–2.

49 Cristiàn Simonetti, and Tim Ingold, "Ice and Concrete: Solid Fluids of Environmental Change," *Journal of Contemporary Archaeology* 5, no. 1 (2018): 29. In a way that recalls Serres's methodological North-West-Passage, they show how in the history of philosophy, states of matter have a profound impact on concepts of change, or, how for instance, the history of glaciology deals exactly with these difficulties of understanding motion of ice between solidity and fluidity (Simonetti and Ingold, "Ice and Concrete," 22–23).

words, is "starting to resemble space, in a way that ice resembled the map."[50] This also gives a first impression of the complicated relationship between ice and criticality, in this case, mediated by an integration of thermodynamics and the arrow of time, as well as a textual strategy that is characterised by metaphorical shifting. This shifting of meaning related to the metaphor is, in Serres's understanding, strikingly strong, as it enables the transferral of meaning in both directions.[51]

Furthermore, Serres's "methectic" approach, as Watkin calls it, in which thought participates in the world and its materiality rather than mimicking it,[52] makes the metaphoricity of Serres's North-West-Passage read as an explicitly integrative and non-reductionist approach in regard to the materiality and discourse of ice. It is an offer, as Yusoff points out, "to see how differing sets of relations move across space and through time […]. While these sets of relations are understood as exclusive topographies, be that of science, politics, or myth, they remain at an incommunicable distant, like far-off shores. Serres' work suggests how travel between these shores might be possible."[53]

The relationship between the North-West-Passage and criticality resonates in this respect with the research fields of the *blue humanities* and the *ice humanities* on multiple—yet not all—fronts. For instance, concrete geopolitical embeddedness is less in the focus in Serres's approach than a wide range of other aspects, such as materiality and textuality, and its significance as an epitome in the philosophy and history of science and the politics of disciplines. Serres touches on the history of discoveries which left their traces in the narrative of the North-West-Passage,[54] yet, his strongest considerations turn out to be his reflections on the politics of disciplines, the history of mapping, and its inherent imaginaries. His multifaceted understanding of the North-West-Passage proves particular theoretical potential in respect to the humanities' perspective on ice. The language with which it has been and still is described, is itself a field of debate discussing the imbrication with colonial, racialised and gendered imaginaries and marking tensions between, for example, Western and indigenous descriptions of the landscape.[55]

Since Serres published *Le passage Nord-ouest* in 1980, the passage has not lost any of the challenging character that makes it hard for humans to pass through, but it now, more than ever, has come to be one of the more important changing landscapes affected by the process of changing climate. The

50 Michel Serres, *Le Passage Du Nord-Ouest* (Paris: Editions de Minuit,1986), 16–18.

51 Serres, *La Distribution*, 253.

52 Watkin, *Michel Serres: Figures of Thought*, 250.

53 Yusoff, "Navigating the North-West-Passage," 300.

54 Serres brushes the dimension of historical attempts to explore North-West-Passage with McLure (later, Sir Robert Le Mesurier) or Roald Amundsen Serres, *Le Passage Du Nord-Ouest*, 19.

55 Dodds, "Geopolitics and Ice Humanities: Elemental, Metaphorical and Volumetric Reverberations," 1121–23; Bravo, 'Voices from the Sea Ice: The Reception of Climate Impact Narratives'.

"opening" of the Northwest Passage, in the way the European Space Agency satellite has envisioned it in 2007, "emerges now as the hot underbelly of that dream of expansion; a line seared through the ice, illuminating global heating".[56] The North-West-Passage's history and presence is not only a technically challenging navigation through icy waters, but also a politically difficult navigation through shifting political territories. At the same time, it is one of the manifestations of the so-called Anthropocene: the passage was last open 8900 years ago, and the emission of greenhouse gas plays an important role in the more recent melting of the ice in this region.[57]

One cannot stress enough how importantly categories such as temperature and the behaviour of ice between fluidity and solidity feeds into the framing of Serres's criticality. Serres's understanding of the North-West-Passage has also been taken up in literary studies as one of the rather rare examples of an ecopoetic approach focusing primarily on *northern* islands,[58] and it is this Arctic setting that requires further conceptual consideration. It is striking how Serres's language particularly seems to resonate with the one of Arctic journals, as Riquet notes: "His difficult and highly poetic style is shaped by this close attention to the material world and the search for a language that corresponds to it to open up thought and generate new ways of thinking; in the process, both the physical world and language become more complex."[59]

The North-West-Passage is Serres's answer to thinking entropy, as a concept that lends itself to translations; yet not necessarily as easily travelable paths. Serres stresses that the icy landscape is the metaphor for a split between natural and social sciences exactly for the reason that it cannot be overcome in a smooth passage—it has to be recognised that its passage is critical, difficult and troublesome. This recalls Anna Lowenhaupt Tsing's idea of friction in the relationship between local and global in an anthropological-theoretical context. Her claim that "global nature both facilitates and obscures worldwide collaborations" takes into account the making of different scales, the relation between local and global movements and the unmasking of a "global dream space"[60]. It displays the challenge for the actual "friction" of theory with its matter. Where Serres navigates through the icy waters of the North-West-Passage, Tsing finds "friction" where "the rubber meets the road." Friction is, in Tsing's understanding, not only an attempt to grasp "how things slow down," but also imbedded in the possibilities of roads that "create pathways […] making motion easier and more efficient, but in doing so they limit where we go."[61]

56 Yusoff, "Navigating the North-West-Passage," 299.

57 Turney, "The Northwest Passage," 78.

58 Johannes Riquet, "Islands Erased by Snow and Ice: Approaching the Spatial Philosophy of Cold Water Island Imaginaries" (2016), 145.

59 Riquet, "Islands Erased by Snow and Ice," 147.

60 Anna Lowenhaupt Tsing, *Friction*, (Princeton, N.J.: Princeton University Press,2005), 99, 124.

61 Tsing, *Friction*, 6.

In this respect, it is of crucial importance how Serres's depiction of the icy landscapes of the North-West-Passage and a philosophy of entropy inform one another. This manifests not only in the difficulty to find a passage, the continuous challenge to map a changing landscape or to think an interrelation between the local and the global; it also shows in the narrative conceptualisation of a critical landscape that profoundly considers thermodynamics, irreversible time, and energy differences. To translate entropy with Serres means to search for and identify similar patterns of thermodynamic-informational entropy across distinct sets of knowledges, rather than speculatively applying them to different domains. With entropy, in particular, these analyses—such as of the social—are grounded in information-mattering. Rather than asking, how would we think society as if it was entropic? Serres's translations follow up on loops of formation that involve entropy, from cells, to bodies, their relationship with technologies, groups, and societies.

The impact and visibility of climate change in the Arctic makes Serres's model of the North-West-Passage a prolific case for eco-criticism and a criticality that attempts to integrate the natural sciences and the humanities. Serres's strong understanding of metaphor, not as an embellishment, but accommodating meanings which can shift in both ways, paths the way for thinking the entanglement between entropic terminology and the North-West-Passage. By bringing these multi-layered aspects of entropy as a material, temporal, and aesthetic factor together, Serres's approach to entropy appears as an eco-critical path within melting, icy landscapes.

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