

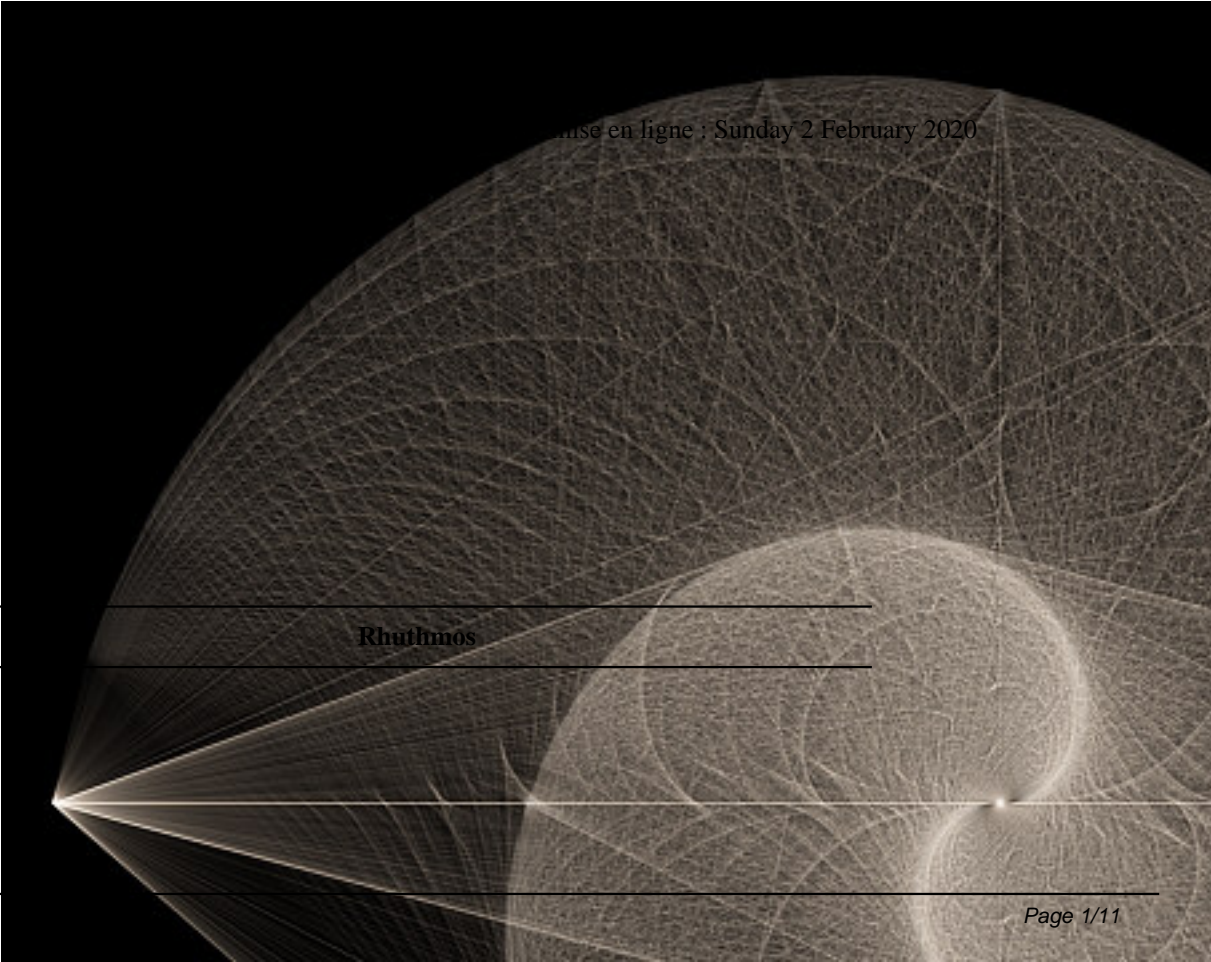
Extrait du Rhuthmos

<http://rhuthmos.eu/spip.php?article2507>

Edgar Morin and the Rhuthmoi of Nature - Part 1

- Recherches
- Le rythme dans les sciences et les arts contemporains
- Physique
-

mise en ligne : Sunday 2 February 2020



Rhuthmos

Table of contents

- [Modern Rhuthmic Ontology](#)
- [Modern Rhuthmic Physics and Space-Time Theory](#)

[Previous chapter](#)

The very same year, 1977, Edgar Morin published *La Méthode. La nature de la nature - Method: Towards a Study of Humankind: The Nature of Nature* (trans. J.-L. Roland Bélanger, 1992). This essay was the first installment of a long series designed to establish a new scientific paradigm: "the paradigm of complexity." The latter stood as a challenge to the fragmentary and reductionist spirit dominating the scientific enterprise and advocated a dynamic and productive interpenetration of disciplines based on the concepts of "permanent reorganization," "information" and "loop." In order to be able to perceive the universe in its true "nature," i.e. as a "complex expanding whole," or as "one single physico-bio-psycho-socio-cultural system," physics, biology and social science should overcome their separation and work tightly together. Six volumes were published between 1977 and 2004 [1].

In volume 1, Morin approached the paradigm of complexity mainly under its physical aspect, while volume 2, 3 and 4 were respectively dedicated to discussions of the contributions of life science (1980), anthropology of knowledge (1984), and theory of beliefs and ideas (1991). However, he explained later that he had first written a draft in four parts that had been eventually developed into four volumes, and that all four subjects had actually already been introduced in the first one (see Preface in 2008, pp. 13-14). Since the volumes 5 and 6, dedicated to the relation between species, individual, and society, and to ethics, were added retrospectively in 2001 and 2004, we are therefore legitimate in limiting ourselves here to the first volume, even if further studies, extended to the following installments, would certainly be welcome.

Rhythmologically speaking, *Method* presented a paradoxical contribution. On the one hand, contrary to Lefebvre's, Barthes', and Serres' essays, it never referred directly to the concept of rhythm. Although Morin knew of a large number of disciplines and even, as we will see, was personally acquainted with some of the proponents of rhythmology and rhythmanalysis in his days, rhythm never became part of his vocabulary. But, on the other hand, not only Morin shared, as we will see, many ethical and political ideas with most members of the rhythmic constellation of the 1970s, but a significant part of the concepts he was manipulating was clearly related with the most recent science whose *rhuthmic* roots Serres' study had so powerfully illuminated. As we will see by following step by step his argumentation, somehow, his contribution replicated what Serres had done for the ancient materialist thought: it presented a complete *rhuthmic* worldview rooted in the latest scientific knowledge.

Concerning biographical data, we may limit ourselves to a few facts. As soon as 1940, Morin had become a member of the French Resistance and, the next year, had joined the Communist Party. However, like Henri Lefebvre, Morin had been quite critical concerning the post-war evolution of his party and was finally expelled in 1951. It is therefore no accident that in 1968, he succeeded Lefebvre at the University of Nanterre and passionately followed the student revolts for the daily *Le Monde*.

We do not know of any close collaboration with Michel Foucault, of whom he seems to have read only *The Order of Things* (see index, 2008, p. 2452), which did not fit, as we shall see, in his own dialectic or better yet, hermeneutical perspective. Likewise, whereas *Discipline and Punish* painted a disciplinary world in which individuals had almost no autonomy, Morin preferred to concentrate on their creativity and imagination, on everything that could derail the regulated course of events.

In a significant contrast, from the beginning of the 1960s, he had worked with Roland Barthes within the "Center for the Study of Mass Communication" established in 1960 at the École Pratique des Hautes Études by the sociologist Georges Friedmann, his mentor at the CNRS. In 1973, this center evolved into the "Center for Transdisciplinary Studies. Sociology, Anthropology, Semiology" and was codirected by Barthes and himself until 1977.

Finally, Morin was close to Michel Serres with whom he shared not only sympathetic views on the 1968 revolt, but also a renovated materialist perspective based on the latest progress of physical, life and computational science in the 20th century. At least in the first volume, he cited extensively Serres's reflections on the history of science (see index, 2008, p. 2461).

Concerning now Morin's theoretical position, as we will see, the whole project of founding a "complex thought" was motivated by the deep ontological turn of science that had occurred around the middle of the 20th century. Like Serres' reconstruction of the ancient physical "fluid paradigm," Morin's opposition to the simplification of classical science and his project of "en-cyclo-peding" knowledge were heavily influenced by the remarkable return of the Ancient idea that everything from physical nature up to human societies and cultures, through living beings, was entirely supported and propelled by a *fundamental and general creative dynamism*.

We may therefore quite legitimately associate Morin's alternative worldview and epistemology with the previous rhythmic contributions we have studied hitherto. If the term "rhythm" was not part of his vocabulary, the subject "rhythm" itself was in fact at the center of his concerns provided, naturally, it was taken in its pre-Socratic sense as "way of flowing." Of course, the relationship with Serres's thought will appear more obvious than with those of Lefebvre, Foucault or Barthes. But we will see that some hidden links, even with the latter, quickly emerge as soon as we consider them from a rhythmological perspective. And that, while Morin's essay receives surprising new colors from its confrontation with the latter, reversely, it certainly sheds some light on them and their specific limitations.

Modern *Rhuthmic* Ontology

We can have some hints of Morin's proximity to his contemporaries' interest in rhythm by first looking at some of his intellectual sources of inspiration.

In an instructive survey on the multiple origins of the complexity paradigm, Michel Alhadeff-Jones has luminously emphasized its Bachelardian lineage (2008). Gaston Bachelard (1884-1962), as we have already noticed in chapter 1, was involved at the beginning of the 1930s in a debate with Henri Bergson (1859-1941) on the nature of *duration*, which opened the way to his founding of *rhythmanalysis*. But, in the very same years, he was also the first philosopher who legitimized the role of *complexity* as an ideal for contemporary science and this is in my opinion no accident. In his famous book *Le Nouvel Esprit scientifique* (1934) - *The New Scientific Spirit* (1985), he formulated for the first time a "non-Cartesian" approach to science. While, he noticed, Cartesian epistemology reduces any complex phenomenon to the analysis of its components, understood as simple, absolute and objective, non-Cartesian epistemology favors a dialectical approach that apprehends phenomena as tissues of relations.

There is no simple idea, because, in order to be understood, a simple idea [...] must be inserted in a complex system of thoughts and experiences. (Bachelard, *The New Scientific Spirit*, 1934/ed. 1978, p. 152 - quoted by Alhadeff-Jones, 2008, p. 68)

As Alhadeff-Jones put it, "Bachelard's recognition of complexity appeared therefore at the root of a new type of scientific explanation" (2008). But we should add that just as duration was not, as Bergson claimed, a linear and unified line similar to a melody, but composed of an intertwined bundle of instants and therefore liable for a rhythm analysis scientific thought flow was not, as Cartesian philosophers had it, a linear intellectual process progressing from one simple fact to the next, but was composed of an intertwined and dynamic bundle of ideas. Bachelard did not mention rhythm analysis in this instance but we must keep this proximity in mind when reading Morin. "Rhythm of duration" or "complexity of scientific thought" were actually two sides of the same concern. Although the former belonged to the philosophy of time and the latter to the philosophy of knowledge, each shed light on the other under a common concern for the organization of the flow of experience. Rhythm appeared as a complex organization of time, and complexity as a rhythmic organization of thought.

A second hint of Morin's proximity to the "rhythmic" concerns of his contemporaries can be found in the opening chapter of *Method*. Borrowing heavily from a famous article on "Science and Complexity" published in 1948 by Warren Weaver (1894-1978), who elaborated further, on his own, some of the epistemological ideas already introduced by Bachelard (Alhadeff-Jones, 2008), Morin started his inquiry with a long section dedicated to the "invasion of disorders" into the classical physical worldview that happened from the mid-19th century and the paradigm change it finally triggered (pp. 29-38).

Imbued with the inherited ancient principles of order, balance, and measure, classical modern physics was based on a mechanistic and determinist perspective. The world was compared to a clock, run by immutable laws, and excluding any disorder.

Order, Master-Word of classical science, reigned from the Atom to the Milky Way. [...] From Kepler to Newton and Laplace, it is established that the innumerable nations of stars obey an inexorable mechanism. [...] This clockwork Universe marks time and crosses time unalterably. Its texture, everywhere the same, is an uncreated substance (matter) and an indestructible entity (energy). The laws of physics, except for the strange exception of the second law of thermodynamics, know no dispersion, wear, and degradation. The self-sufficient Universe maintains itself perpetually. The sovereign order of the Laws of Nature is absolute and immutable. Disorder is excluded, from the beginning, forever. (*Method*, vol. 1, 1977, trans. J.-L. Roland Bélangier, 1992, pp. 29-30)

However, due to the introduction by Rudolf Clausius of the second principle of thermodynamics and the concept of "entropy," or irreversible loss of energy, and the discovery of the relation of this loss to the increase in the internal molecular disorder by Ludwig Boltzmann (1850-1880), due as well to the introduction of disorder and probability into micro-physics by Max Planck (1900-1910), and finally due to the recognition of a genetic unregulated expansion of the cosmos by Edwin Hubble and others (1920-1970), the Platonic, Aristotelian, Thomistic, Galilean, Cartesian, Newtonian world, based on stability, order, hierarchy, general determinism, and laws became obsolete or, at least, was to be re-founded on principles utterly foreign to it.

After its collapse during the first half of the 20th century, this world was replaced, from the 1950s, by a new world based on becoming, disorder, multiplicity, chance encounter that clearly emulated that of the ancient materialists.

As Serres, Morin first noticed that this new perspective presupposed a critique of straight determinism. Just as declination appeared in Lucretius in the laminar flow of atoms "*incerto tempore, incertisque locis*," the universe was now conceived as "*constituting its order and its organization in turbulence, instability, deviance, improbability, energy dissipation*" (p. 38 - Morin's italics).

But he also noticed that, although the probability to produce lasting beings was infinitesimal Serres referred for his part, one remembers, to phenomena "statistically of extreme rarity" the universe had witnessed and still did the relentless "constitution," "organization," "emergence" of new beings. In other words, in this new perspective, organization, order, and laws did still exist but only as emergent and impermanent phenomena. Instead of being *the* overarching physical norms, order and determinism became the impermanent results of both a generalized disorder and an infinity of random processes of organization.

Contrary to what had been concluded as early as Clausius from the second principle, the new development of thermodynamics initiated by Ilya Prigogine (1917-2003) showed that the universe was not merely doomed to an unavoidable thermic death and a maximal entropy (p. 32). There was actually not exclusion but "complementarity between disordered phenomena and organizing phenomena" (p. 37).

A similar revolution had occurred during the same period, Morin remarked, in life science thanks to John von Neumann (1903-1957), Heinz von Foerster (1911-2002) and Henri Atlan (1931-), who conceived of the living respectively as "function[ing] with disorder," as "constructed with disorder," or merely as resulting from "chance as organizer" (p. 38).

Even cosmo-physics had adopted this perspective. The *big bang* theory supposed that "a concentrated state of infinite density would have been at the source of the Universe, which would have been born in and by an explosive happening" (p. 39). But nothing intelligible according to our common space-time physical standards could be concluded from it because it presupposed that there was properly no time and no space "before" the big bang, i.e. no "before." It was therefore "useless to look for spatio-temporal or logomorphic figuration concerning the state or the being which precedes our universe" (p. 40). The question of the origin had to be tackled with purely theoretical tools.

Opportunely, mathematician and topologist René Thom (1923-2002) had recently proposed a mathematical representation of the notion of "catastrophe" (1972), which Morin defined as "change/rupture of the form in condition of irreducible singularity" (p. 40), and which gave us the necessary means to address the problem.

The fundamentally complex and rich idea that Thom brings is to tie all morphogenesis or creation of form to a rupture of form or catastrophe. *It allows us, therefore, to read disintegration and genesis in the same processes.* (*Method*, vol. 1, 1977, trans. J.-L. Roland Bélanger, 1992, p. 40)

And that mathematical revolution concerned not only the "absolute beginning" of the Universe but also "the whole metamorphic process of transformations which disintegrate and create."

Different from the *big bang* which is a concentrated moment in time and which becomes a cause separated from the processes which triggered it and which it has triggered, the idea of catastrophe, while welcoming the idea of an explosive happening, is identified with the whole metamorphic process of transformations which disintegrate and create. Now, this process *is still going on today.* (*Method*, vol. 1, 1977, trans. J.-L. Roland Bélanger, 1992, p. 41)

To explain this genuine generative power of the being, much further in the book, Morin hypothesized that it existed, associated with "the causal determinism which governed classical science" and with the newer "probabilitary

causality of a statistical character" (p. 305), an "endo-causality" resulting from the retroaction of the effect on its cause. This causality did not any longer connect, on a general basis called natural law, one cause with one particular effect, but introduced a "causal autonomy" that could strongly transform the expected result.

Just the idea of retroaction affects, and much more profoundly than it seems at first sight, the simple, external, anterior, imperial, classical idea of causality. Retroaction returns to the loop, that is to say to the organizational autonomy of the machine-being. Organizational autonomy determines a causal autonomy, namely *creates an endo-causality*, not reducible to the "normal" play of causes/effects. (*Method*, vol. 1, 1977, trans. J.-L. Roland B elanger, 1992, p. 257)

This particular causality was responsible for the emergence of totally new beings possessing new "selves" or identity principles.

Endo-causality implies production-of-self. In the same movement in which the self is born from the loop, there is born an internal causality which generates itself by itself, that is to say a causality-of-self producing original effects. The self is, therefore, the central figure in this internal causality which generates and regenerates itself by itself. (*Method*, vol. 1, 1977, trans. J.-L. Roland B elanger, 1992, p. 259)

The being was thus deeply temporalized, that is, not only inserted in a linear duration but considered as "active" and "organizing" by itself. "Everything [was] interactions, transactions, retroactions, organization."

In nature, activity is a total organizational phenomenon. Everything is active in an active system, and all the more so since it must support and maintain stationary states. Activism is generalized: flux, disequilibrium, instability, turnover, reorganization, regeneration, disorder, antagonisms, disorganizations, looping, variations, fluctuations. Everything is interactions, transactions, retroactions, organization. (*Method*, vol. 1, 1977, trans. J.-L. Roland B elanger, 1992, p. 231)

As we can see, there was no fundamental difference with the Ancient atomist ontology as reconstructed by Serres: there was no fixed beings interacting according to fixed laws; rather, the *physis* was a flowing chaos, yet relentlessly generating and destroying, by chance encounters and retroactions, greater or smaller pockets of impermanent order. Thus, even if Morin never referred to the concept of *rhuthmos*, his ontological reflection clearly prolonged the Ancient *rhuthmic* paradigm into a remarkable extension based on the latest discovery of modern science and mathematics.

Order, disorder, organizing potentiality must be thought of together, both in their well-known antagonistic character and in their unknown complementary character. These terms shuttle from one to the other and form a sort of moving loop. In order to conceive this, we need more than a theoretical revolution. A revolution of principle and of method are called for. (*Method*, vol. 1, 1977, trans. J.-L. Roland B elanger, 1992, p. 41)

As a matter of fact, in the general conclusion of the book, Morin explicitly compared his view with that of the pre-Socratic thinkers. What will be described, in a following section, as the fundamental "event-ness" and "generativity" of the universe did only but resume the Ancient dynamic conception of the *physis*.

We have henceforth an immanent principle of organization, properly physical. Thereby *physis* recovers the generic plenitude which the pre-Socratics had attributed to it. It is this reanimated and regenerated *physis* that can be *generalized*, that is to say reintroduced into everything living, everything human. (*Method*, vol. 1, 1977, trans. J.-L. Roland Bélanger, 1992, p. 377)

Modern *Rhuthmic* Physics and Space-Time Theory

The same theoretical proximity can be observed in Morin's presentation of the latest progress of physics and Space-Time theory in the following sections in which he summarized the scenario of cosmogenesis as it had been reconstructed since Georges Lemaître's (1894-1966) and Edwin Hubble's (1889-1953) studies in the 1920s and 1930s.

Morin painstakingly described the first cloud of photons that rised up and dilated after the *big bang*, the extreme heat, the "original fire," the decrease of temperature because of expansion, the materializing of the first particles (electrons, neutrinos, neutrons, protons), the "chance encounters" by which protons and neutrons, "bouncing in all directions," "aggregated" to constitute nuclei of deuterium, helium and hydrogen, the "turbulences" that provoked inequalities at the heart of the fast expanding cloud, the first "atomic compounds," the reinforcement of these first atomic nuclei by gravitational attraction of particles that reinforced in turn their fast-rising gravitational attraction, the "dissociation of the cloud" into proto-galaxies and of those proto-galaxies into proto-stars, the ignition of local thermonuclear chain reactions triggered by the multiplication of collisions between particles due to the increase in density, the balance reached, sometimes, between explosion and gravitational rush to the heart of the newborn stars, the general decrease and local dramatic increase of temperature due to the ignition of these thermonuclear machines, finally the constitution of planets circulating around the stars (pp. 44-46).

Not only most of Democritus' and Lucretius' atomist concepts were here already mobilized, but at the very root of these processes, Morin found, consistently with his "creative ontology," the "capital" role played by what he called successively "inequality," "deviation, even minute," "minimal inequality," "minute variations," which clearly constituted modern versions of Lucretius' foundational concept of "clinamen."

The universe is born in extreme heat, and this heat includes these forms of disorder: agitation, turbulence, inequality of process, chance character of interactions, dispersion. The idea of inequality is capital. The general recooling is not homogeneous: it includes its zones of unequal character and its local moments of reheating. [...] Inequality of development has as starting point the thermic character of the initial catastrophe. Beginning there, and no matter how minimal, there is inequality in the very emission of the cloud. Now, and this is what undermines in its very foundations the previous deterministic vision of the world, which was a vision of ice and not of fire: any deviation, even minute, which is constituted in the emitting source tends to grow and be amplified in an extraordinary way in the course of the process of diffusion. The minute variations which are produced in the very first conditions of dispersion are going to lead subsequently to extreme and extraordinary varieties. (*Method*, vol. 1, 1977, trans. J.-L. Roland Bélanger, 1992, pp. 44-45)

In the same Lucretian vein, Morin emphasized, in the second part of the book, the genesic power of "the whirling form" which was "the primordial Form of being, existence, productive organization."

We now understand why the whirling form has signaled to us everywhere, in the galactic skies, the circulating air and water, the flaming fire. It is the form in and by which turbulence is transformed into loop. It carries in itself the quasi-indistinct presence of chaos and genesis, all the while remaining the [primordial Form] [*la Forme première*] of being, existence, productive organization. (*Method*, vol. 1, 1977, trans. J.-L. Roland Bélanger, 1992, p. 224, my mod.)

The emergence of order and organization out of disorder and chaos was then allowed by the "agglutination" of atoms according to a modern analogon of the "congruence of figures, magnitudes, positions and orders" as Simplicius put it (see above, chap. 4), which consisted in various types of "interactions," strong interactions bonding protons and neutrons, gravitational interactions accelerating the concentration of galaxies and condensation of stars, or electro-magnetic interactions binding electrons to nuclei and atoms into molecules (p. 48).

As a matter of fact, a few pages below, Morin paid homage to Heraclitus by clearly mixing, and therefore somehow equating, ancient and modern views on the "original fire."

The cosmos was formed in a genesic fire: everything which was formed is a metamorphosis of fire. It was in the fiery Cloud that particles appeared, that nuclei were bonded. It was in the fury of fire that stars lit up and atoms were forged. The idea and the image of Heraclitian fire belching, rumbling, destructive, creative is surely that of the original chaos whence logos arises. (*Method*, vol. 1, 1977, trans. J.-L. Roland Bélanger, 1992, p. 54 - same idea p. 82)

Naturally, Morin used also concepts that had been elaborated only recently as the reinforcement or deterioration of a phenomenon through "retroaction," "loop" and "positive [or negative] feedback."

At this point we can already have the concept of positive retroaction intervene (positive feedback), which means accentuation/amplification/acceleration of a deviance itself. The constitution of the star is an increase of density which is increased by itself until the lighting, which triggers a counter-process. (*Method*, vol. 1, 1977, trans. J.-L. Roland Bélanger, 1992, p. 44)

Morin coined in the second edition of volume 1 (1980) the word "Chaosmos" to render this tight interrelation of chaos and cosmos (pp. 26, 53). His conclusion was again both a dismissal of classical physics and a clear homage to ancient Atomists. The current cosmic "order" and the apparently "universal and eternal laws" of physics were actually born from chaos, events, and singularities.

I will have the opportunity to illustrate this indefensible paradox in the old vision of the world: it is the singular and event-full character [Fr. *évènementialité*] of the cosmos which is at the source of its universal laws! (*Method*, vol. 1, 1977, trans. J.-L. Roland Bélanger, 1992, p. 46)

What is more, chaos, events and singularities were still currently happening. "Genesis [had] not stopped." The universe was still "disintegrating and self-organizing in the same movement."

Now, we must give in to new evidence. Genesis has not stopped. We are still in the expanding cloud. We are still in a universe where galaxies and suns are being formed. We are still in a universe which is disintegrating and self-organizing in the same movement. We are still in the beginning of a universe which has been dying since its birth. It is this permanent and working presence of chaos which we must make people see. (*Method*, vol. 1, 1977, trans. J.-L. Roland B elanger, 1992, p. 55)

In this "Chaosmos," space and time were not universal and homogeneous. Space, as it appeared through the latest physics, had no unique "structure." It was expanding, "polycentric" like a "drifting set of archipelagoes" and, therefore, could not be represented as a unique sidereal room.

The universe inherited from classical science was centered. The new universe is acentric, polycentric. [...] What constituted the armature and architecture of the universe becomes [a set of archipelagoes] adrift in a dispersion without structure. (*Method*, vol. 1, 1977, trans. J.-L. Roland B elanger, 1992, p. 58, my mod.)

Similarly, time was not anymore determined and measured by the eternal functioning of the cosmos. It had become external to the universe which was therefore "dereified" Morin said also "historicized" by comparison with human societies.

The old universe was a perfectly regulated watch. The new universe is an uncertain cloud. The old universe controlled and distilled time. The new universe is carried away by time: galaxies are products, moments in a contradictory becoming. [...] The new universe is dereified. This means not only that now everything is in process or transformation. It also means that the universe is simultaneously, perpetually in childbirth, in genesis, in decomposition. (*Method*, vol. 1, 1977, trans. J.-L. Roland B elanger, 1992, p. 58)

Due to "the great meta-Copernican, meta-Newtonian revolution, which had been making its way subterraneanly from Carnot and Boltzmann to Planck, Bohr, Einstein, and Hubble," there was neither "a center" of space nor "a non-equivocal axis of time."

There is no longer a center of the world, be it the earth, the sun, the galaxy, a group of galaxies. There is no longer a non-equivocal axis of time, but a double, antagonistic process stemming from the same and only process. The universe is, therefore, simultaneously polycentric, acentric, decentered, disseminated, diasporating... (*Method*, vol. 1, 1977, trans. J.-L. Roland B elanger, 1992, p. 80)

The "universal order" was therefore not any longer universal. It was not "stretching out boundlessly in time and space" but had been born "in time" and "sandwiched in space." However, if it was not any more "an absolute," it had

become "capable of development."

Universal order, stretching out boundlessly in time and space, has henceforth been born in time, sandwiched in space between micro-physical chaos and diaspora. It is no longer general, but provincial. It is no longer unalterable, but degradable. Nevertheless, if it loses as an absolute, it gains as a process [Fr. *devenir*]. It is capable of development. (*Method*, vol. 1, 1977, trans. J.-L. Roland Bélanger, 1992, p. 73)

Like Serres, Morin thus opposed two physical paradigms supported by two ontological options that had fought against each other ever since the Antiquity. Classical modern physics, he asserted, had based itself on classical Greek thought, ie. on Plato and Aristotle, but the latter had forgotten Heraclitus and wrongly opposed *Hubris* (irrational excess, madness) and *Dike* (law, moderation, and equilibrium) (p. 57). Contrary to Serres, though, Morin did not insist on the ancient opposite view, common until the 1st century BC, which based science on a fluid perspective but compared the world not with fire but with water. Surprisingly, he quoted Lucretius only twice in the whole book (pp. 29, 385).

Anyway, the physical nature of the world was not that described by classical physics; it was not "perpetual order, moderation, equilibrium." On the contrary, it was composed of "irreversible movements, order mixed with disorder, expenditure, waste, imbalance."

We must change worlds [nous devons changer de monde]. The universe inherited from Kepler, Galileo, Copernicus, Newton, Laplace was a cold, chilling universe of celestial spheres, perpetual order, of moderation, equilibrium. We must swap it for the warm universe of a flaming cloud, balls of fire, irreversible movements, of order mixed with disorder, of expenditure, waste, imbalance. (*Method*, vol. 1, 1977, trans. J.-L. Roland Bélanger, 1992, p. 58)

[Next chapter](#)

[1] The whole work has been republished in French in 2008 with a new preface.