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Bruno Latour – Special Issue

The Paradigm of Complexity in Edgar Morin and the Latourian Epistemology: An Attempt to Approach

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Abstract:

This study compares the philosophies and epistemological proposals of philosophers and sociologists Edgar Morin and Bruno Latour. To this end, we present Morin's thought - specifically his critique of what he calls the old paradigm of simplification and his proposal of a new paradigm of complexity or complex thought. We then attempt to demonstrate, by comparison, how Latourian epistemology fits within this epistemological proposal or new paradigm as an example of a metatheory that is capable of successfully dealing with the challenges presented by Morin's complex thought. This study seeks to contribute to the field of knowledge theory in social sciences and studies in Science, Technology, and Society through a more descriptive, comprehensive, and careful methodological and epistemological proposal concerning the various constitutive factors of any research object in the field of knowledge and technologies.

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Introduction

This study proposes to compare the philosophy and epistemological-methodological proposal of the philosophers and sociologists Edgar Morin and Bruno Latour. Edgar Morin is considered one of the greatest references in education worldwide and an important thinker in the epistemology of social sciences, having contributed significantly to proposals for education and methodology in humanities and social sciences research. Bruno Latour was one of the founders of what would become a true paradigm in social sciences, science and technology research because of his contributions to the Actor-Network Theory (ANT). We

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believe that this attempt to theoretically approach these two authors, focusing on their epistemological proposals, greatly contributes to research methodology in social sciences and education, as well as to develop and understand both authors' theoretical proposals.

This study is structured in four parts: First, a presentation of Edgar Morin's proposal and his critique of the old paradigm—simplifying par excellence—that prevailed from the mid-17th century to the late-19th century (and still imposes itself in many parts as strong resistance to modern sciences). Next, a brief outline of the challenges presented by the first analyzed author (Edgar Morin) in the form of principles that should guide the new paradigm he proposed – capable of confronting the complexity of the world revealed by the quantum and relativistic revolution in physics from the beginning of the 20th century, which is also taken as an example for this complex thought model. After that, a presentation of Bruno Latour's epistemology and methodological proposal while seeking to compare his ideas and demonstrate how the Latourian philosophy fits into the paradigm of complexity and can overcome the challenges proposed by Edgar Morin. Finally, a brief conclusion of this essay, pointing out the convergences between these authors and the advantages of using an epistemological and methodological proposal that addresses the complexity of knowledge described by Morin, as we believe is the case with Latourian theory.

The Crisis of the Old Paradigm According to Edgar Morin

Edgar Morin, a pseudonym for Edgar Nahoum, is a French sociologist, anthropologist, and philosopher born in 1921, who also holds degrees in history, geography, and law. In addition to participating in World War II as a member of the French Resistance, Morin is an important current reference in sociology, politics, pedagogy, and the epistemology of science, the last of which is the focus of this study.

The following works by Edgar Morin were used in this comparative study: *Science with Consciousness* (2005), originally published in 1982, *Introduction to Complex Thought* (2005b) from 1990, and *Well-Made Head* (2003) from 1999. These works were chosen because it is in them that this author developed most of his theory and epistemological proposition, which he calls Complex Thought or Paradigm of Complexity in the cited works. The works will not be analyzed chronologically, nor is it our intention to analyze them in detail, but their ideas and concepts will be cited and grouped to facilitate our comparison.

To understand Morin's proposal of a Complex Thought, we need to follow the criticism he makes of what he calls the old paradigm, or paradigm of simplification (or even simplifying thought). Only then can we understand the challenges that this author considers as obstacles to a truly transdisciplinary and open science and how he intends to overcome them through his propositions.

In summary, we can say that the paradigm of simplification corresponds to determinism, typical of physics and the sciences in general from the 18th century until the beginning of the 20th century (Morin, 2005b, 34). This type of reasoning, with origins in 17th-century Cartesian rationalism and empiricism, assumed a perfect, or quasi-perfect, correspondence between what was rationalized (i.e., the knowledge generated from logic and mathematical calculation) and reality. To achieve this ambitious goal, general laws were proposed, which attributed a single cause to a particular effect, and, therefore, should perfectly describe the movement and functioning of the studied objects (such as celestial bodies, refraction of light, pendulum movement, etc.). Newtonian physics is considered the main exponent of this type of thought, and it is on this basis that chemistry, biology, geology, and even sociology in its early stages (called "social physics" by Auguste Comte) were developed at that time. The main objective of this old science—still very present in our thinking—was to accurately determine and predict the behavior of the studied objects, whether they were astronomical, optical, gaseous, or demographic (Morin 2005, 157).

However, this type of thought prevailed not only in the exact sciences. Morin suggests that industrialization, urbanization, bureaucratization, technologization, as well as economism, were designed based on a rationalizing ideology, which includes work and human beings, who were seen as simple objects from which maximum efficiency should be extracted, like machines (Morin 2005, 162).

According to Morin, the problem with this type of thought is that, despite having been very successful in predicting certain phenomena, especially those of physical and chemical nature, so necessary for the technological and industrial development of the 18th century, they are simplifiers par excellence, eliminating from reality everything that cannot be reduced to a perfectly predictable law or equation. The paradigm of simplification, corresponding to this type of rationalizing thought, would operate from two factors: disjunction, that is, the fragmentation of a complex phenomenon into as many parts as necessary for its study, and reduction, which unifies, aiming to simplify, things that are diverse, usually in the form of a law or deterministic equation (Morin 2005, 160). All these aspects generated (and still do) a totalizing view of the world from partial data that focus only on one or a few aspects of reality, simplifying for the sake of maximum efficiency.

However, it was in physics itself that this movement was overcome. It was after the discovery of quantum phenomena (discrete packets of energy), by Max Planck, and the dual nature of light, which behaves as both a wave and a particle at the same time,³ initially developed by Niels Bohr, that physics finally took the first step toward complex thought. From that point on, it was no longer possible to insist on pure rationalist and deterministic methods, as it was impossible to precisely and simultaneously predict the position and speed of a photon or electron, or to describe the quantized behavior of light in terms of classical physics (Morin 2005, 213).

As Thomas Kuhn (2005), a philosopher of science, astutely points out in his seminal work, the crises in the sciences caused by the inadequacy of the old paradigm in explaining anomalies, and unforeseen phenomena are overcome not through the accumulation of knowledge, but rather through “revolutions”, where a new paradigm capable of explaining both the old and new problems replaces the previous one. This was the case with quantum physics, which had to embrace the phenomenon’s complexity and the incapacity of the old paradigm to explain it, opening a dialogue with uncertainty and incompleteness (Morin 2005, 230). According to Morin:

Bohr, in my opinion, marked an event of paramount epistemological importance when, not out of exhaustion, but out of awareness of the limits of logic, he ended the grand tournament between the corpuscular and wave conceptions of the particle, declaring that one must accept the contradiction between the two notions which became complementary, as rationally, the experiments led to this contradiction. (...) Since then, a dialogue with contradiction has been opened. We have been led to establish a complementary and contradictory relationship between the fundamental notions necessary to conceive of the universe. (Morin 2005, 186-187)

We can also cite the invaluable contribution of Albert Einstein’s theory of relativity, which rendered the old categories of absolute space and time from classical physics completely outdated, making the observer (and their velocity relative to the object) a crucial factor in understanding the fabric of space-time as unified dimensions, necessary for

³ This is demonstrated by the famous double-slit experiment, first performed by Thomas Young in 1802 and confirmed over the last two hundred years by physicists, despite their inconclusiveness regarding its interpretation, the subject of a heated debate to this day, with several competing interpretations. There is a wealth of material available on the different interpretations of this phenomenon and ensuing discussions; here we suggest (Al-Khalili 2003).

predicting the trajectory of light and objects moving at speeds close to that of light, such as electrons and cosmic rays. As Morin points out, the new physics challenged the determinism of classical physics; however, it still allowed for the visualization of patterns, regularities, and even more reliable predictions than the previous paradigm, “and which, in essence, it was not the ruin of determination or determinism, but a flexible way of seeing the relations between determinism and its opposite” (Morin 2005, 71).

There is another important aspect of the old paradigm emphasized by Morin that we must not overlook in this analysis: the fact that the classical view not only separates the cognizing subject from the cognizable object but considers the subject as noise, a disturbance in the data to be avoided at all costs in favor of “objectivity” as if it were possible to exclude the subject from this relationship and collect only “impartial data”. At the same time, the subject itself, detached from the objectivity of the world, becomes a specter of its vague perceptions based on deceptive senses and thought categories (Morin 2005b, 40). However, the modern philosophy of science, especially following the emergence of anthropology and sociology of science, considers that subject and object are inseparable, products of each other, and that it is impossible to think about the world from “objective and impartial categories” since knowledge is always the product of the combination of data and impressions with some mental model or scientific theory that categorizes things and perceives phenomena in an inevitably conventional way to some extent. At the same time that the world or the environment only exists from our consciousness and its perceptions, the subject is also a product of the environment and brain physics, where physical-chemical laws prevail (Morin 2005b, 45; 88); therefore, it is pointless to try to exclude one or the other.

All this effort to eliminate this supposed noise—and thereby the cognizing subject, seen by the old paradigm as an obstacle to be overcome—is due to the aversion to uncertainties in this deterministic way of thinking about the world and its parts. Uncertainty is the main enemy of reason in the old paradigm (Morin 2005, 2005b). However, as quantum physics has demonstrated, uncertainty is inevitable when it comes to infinitely small and fast objects, which constitute everything in the world (since quantum mechanics dominates the universe of particles and sub-particles that make up the atoms of things and our cells). Therefore, for Morin, uncertainty is not our enemy. As in quantum mechanics, it is an ally for a more complex, richer, and, therefore, more comprehensive world vision.

Here we have come to the core of Morin’s epistemological theory (2003; 2005; 2005b). By accepting uncertainties, we are able to perceive the complexity of the world and its parts, including ourselves and our collective organization, which we like to call society.

The Challenges and Principles for the Complex Thought of the New Paradigm

Resuming Morin’s (2005; 2005b) conclusions about the emergence of a new paradigm, we have come to believe that the uncertainties arising from this new way of thinking are not a problem in themselves. On the contrary, by accepting that we cannot be certain about many complex phenomena (from the movement of electrons to the movement of economic agents), we are finally able to perceive that we are dealing, most of the time, with complex phenomena, open systems, which are in constant interaction with the environment. With this, our analyses and perceptions can become richer and more comprehensive (Morin, 2005; 2005b; 2003), just as Niels Bohr perceived in quantum mechanics and is cited by Morin:

At first, this situation could seem very regrettable, but, in general, throughout the history of science, when new discoveries revealed the limits of ideals whose universal value had never been challenged, we were rewarded: our view expanded, and we

became capable of uniting phenomena that previously seemed contradictory. (Bohr, *Light and Life*, 1932 as cited in Morin 2005b, p. 44)

Nevertheless, for Morin (2005), despite the possibilities opened by the new paradigm of complexity – proposed as an open system instead of a self-contained one (like the mathematical models of classical physics and classical economics), this change is imposed on us not as a miraculous solution, but as a challenge. Proposing a more comprehensive analysis of any subject, pointing out its relationships with the environment and other systems, and not excluding the subject-object relationship, is, as the name suggests, much more complex. We need to consider many other factors and be more careful with the conclusions so as not to run the risk of closing the analysis within itself with some form of reductionism. To overcome these challenges, Morin (2005) proposes that we face the obstacles we have created when thinking of the world in the last centuries as a closed system. To this end, he proposes a series of principles and challenges that guide the paradigm of complexity and which we will briefly examine below.

The first principle to be examined refers to a central idea in Morin's thought, which permeates his entire work: the dialogic principle, which refers to the complementarity between two apparently contradictory logics, but which are, in fact, codependent, such as life and death, reproduction and evolution, individual and collective thinking, and, especially, the dialogue between order and disorder (Morin 2005b, 73). For Morin, we need to recognize that it is possible for order to arise from chaos or disorder, that is, organized phenomena can emerge from what is apparently chaotic, like a planetary system can arise from a cloud of gases resulting from the explosion of a supernova, or from a social system that is organized based on multiple contradictory collective interests (Morin 2005, 179). The idea here is that chance is necessary for an organization as a result of a non-deterministic process. In his words:

the complexity of the order/disorder/organization relationship arises, therefore, when it is empirically noted that disordered phenomena are necessary under certain conditions, in specific cases, to produce organized phenomena, which contribute to the growth of order. (Morin 2005b, 63)

The next principle concerns the simultaneity of unity and multiplicity in organizations, understood by Morin as what constitutes a system (physical, biological, or social) from different elements, called the systemic principle (Morin 2003, 93; Morin 2005, 180). He also claims that, while a system is smaller than the sum of its parts (since it often inhibits individual potentialities, whether of an individual through social constraints, or of a chemical compound because of molecular stability), it is also greater than the sum of its parts, as new properties and potentials emerge from this organization, such as molecular properties that are not present in isolated atoms or social institutions such as morality or State apparatuses that only arise as a result of collective organization.

This leads to another principle highly valued by Morin: the holographic principle, which suggests that the whole is contained within the part and the part within the whole (like DNA is present in all of our cells, or general culture, such as language, is present in the individuals who compose it) (Morin 2003, 94; 2005, 180; 2005b, 74).

As a consequence of the holographic principle, another principle must be considered, that of a recursive organization (Morin 2003, 95; 2005, 182; 2005b, 74). This means that the effect acts upon the cause, feeding back and interfering with the cause – like a thermostat affects the temperature of an oven, despite being a result of the heat caused by the oven. Similarly, we are both products and producers of the social system – and this aspect of the complexity of open thinking constitutes the sixth avenue. In Morin's words:

A society is produced through interactions between individuals, and these interactions produce an organizing whole that retroacts on the individuals to co-produce them as human individuals, which they would not be without instruction, language, and culture. Therefore, the social process is a continuous productive circle in which, somehow, the products are necessary for the production of what produces them. (Morin 2005, 182)

These principles lead us to a challenge, which Morin (2005, 183) calls the “crisis of closed disciplines”, such as dependence and autonomy, subject and object, living being and environment, where clearly demarcated concepts are insufficient to explain the complexity of the world. Morin asserts that it is necessary to perceive, in agreement with the dialogic principle, that apparent contradiction sometimes indicates not an error but complementarity. In his words: “In the universe of simple things, ‘the door must be open or closed’, but in the complex universe, an autonomous system must be open and closed at the same time. One must be dependent in order to be autonomous” (Morin 2005, 184).

Finally, to complete the paradigm of complexity, it is necessary, according to the author (Morin 2005, 185; 2005b, 96), to reintegrate the observer into the observation, that is, to stop interpreting them as noise or an obstacle to research and assume the complementarity between subject and object as emerging parts of the same phenomenon. As we will see later with the second analyzed author (Bruno Latour), subject and object are products of the same process, and it is not much different here. Impartiality is nothing more than an abstraction of a science that has developed based on an idealized system considered closed. However, if we want to practice science—natural or social—accepting the challenge of complexity, we must also admit that the subject is part of the world, is a product of the environment (physical and social) while being a creator of that environment (physically and ideally), according to the dialogic and recursive principle.

As previously emphasized, these aspects of complex thought, or paths that lead us to the paradigm of complexity, are above all challenges. The old paradigm, which Morin (2005b) calls the paradigm of simplification, has cemented our thought, limiting it to well-defined disciplines and sub-areas (closed concepts) where each part of this thought (economics, biology, sociology, physics – more specifically each specific sub-area, such as financial economics, microbiology, particle physics, etc.) should be simplified until it becomes completely predictable and determinable, like a hermetically closed system where nothing enters and nothing leaves, and therefore is self-sufficient to explain itself. Obviously, and as the history of the sciences and the social studies of science and technology (SSST) clearly demonstrate, this model has never fully come to fruition. Throughout the entire history of the development of scientific theories, there have always been (many) outliers, anomalies, and inconsistencies, always demanding new explanations for these “exceptions”, new theories, and the addition of more and more parts to these closed systems so that they could stand, like Ptolemaic epicycles.

Still, the old paradigm insists on disciplinary segregation in many fields to this day, ignoring the relations between spaces and knowledge, or at most trying to connect these closed systems to each other like pieces in a large computer, where there is only one communication channel (input/output) between each of these parts, theoretically completely controllable and predictable (although, in practice, being much more complicated and subject to errors). Thus, for example, economics has nothing to do with biology, even though it is possible to estimate losses in the volume of fish caught annually because of the reduction of their population due to declines in breeding rates, the problem is “solved” economically perhaps with new taxes and incentives, perhaps with the exploitation of other ecosystems, markets, and suppliers, but never assuming that the decline in the breeding rate of this fish population is associated with economic policy. Environmental, social, and economic problems are becoming increasingly global and systemic, but simplifying thought insists on this model separated from the world, where

economics is resolved with economics and environmental and social problems remain unsolved. Growth or reduction rates (rise in global average temperature, decrease in fish population, impoverishment of populations, etc.), measured very successfully by social and natural disciplines, are enough to feed economic predictions – through this single non-dialogic and non-recursive communication channel, thus not needing to “merge”. The course is set for disaster, as long as it is mathematically predictable, there is no cause for concern in terms of the epistemology of scientific knowledge and model of social action.

Therefore, it is increasingly urgent to embrace the open systems of the paradigm of complexity, to recognize how much ecology interferes with the economy and vice versa, or how much technological policy and economic policy have in common. By proposing complex thought, which sees the relationships between objects, subjects, and knowledge, in which the effect acts on the cause and the whole is present in the part, Morin wants to draw our attention to the challenge of overcoming closed and simplifying thought, but also to the opportunities that open up when we embrace complex thought, with enough courage to see the relationships between problems, regardless of their disciplinary identity, in an effectively transdisciplinary stance. The disciplines should indeed be respected, but not the reductionism. As Morin puts it, it is not only a political and social problem but also an epistemological one, “the problem is not so much to open the boundaries between disciplines, but to transform what generates these boundaries: the organizing principles of knowledge” (Morin 2003, 24-25 - our emphasis).

At this point in the study, we must ask ourselves: is there any theoretical proposal, any epistemology of knowledge that respects these principles and duties? That sees the relationships between the parts and the systemic character of action and knowledge? That truly leads us to a complex thought, a new paradigm in terms of the construction of scientific knowledge and action? Our answer to this question is yes, and here we enter the second part of the study, where we present Bruno Latour’s approach to Morin’s proposal, which enables us to recognize Latour as a legitimate representative of the paradigm of complexity.

Bruno Latour’s Epistemology as an Example of Complex Thought in the New Paradigm

The second author in this essay, who serves here as a comparison and suggestion of epistemology and methodology that aligns with Morin’s complex thought, is Bruno Latour (1947-2022) – a philosopher, anthropologist, and sociologist who studied, among other things, scientific and technological endeavors as of the late 1970s. Latour is considered one of the foremost exponents of French pragmatic sociology and has examined various topics throughout his career, especially science and technology, the environment, democracy, and epistemology. Known for famous works, which deviate from conventional sociological and epistemological thought, such as *We Have Never Been Modern* (1994) and, more recently, *An Inquiry into Modes of Existence* (2019), Latour emphasizes notions and principles inspired by many branches of knowledge theory, from Tardian sociology (Tarde 2003), through the process philosophy of Alfred Whitehead, and more contemporary authors such as Michel Serres, Gilles Deleuze, and Félix Guattari, among many others (Harman 2009).

The aim of this section is to present Bruno Latour’s thinking—often equated with the Actor-Network Theory (ANT), as he is its most prominent exponent—and point out the similarities between Latour’s epistemology and Morin’s proposal for a paradigm of complexity or complex thought. Latour’s theory (we will call it that in this study because we understand that it transcends the ANT in its more recent writings, such as *An Inquiry into Modes of Existence*, 2012) was developed in 1979 with the publication of *Laboratory Life* and includes dozens of books and publications. Because of its complexity and breadth, in this study, we will only address its main concepts, especially those that converge with Morin’s

proposal, in an attempt to demonstrate that Latour's theory fits into the paradigm of complexity through concepts and methods that surpass the old paradigm or paradigm of simplification and moves toward complex thought.

One of the first points that Latour seeks to redefine is the notion of subject and object in the conception and making of modern science. In agreement with Morin (2005; 2005b), Latour (1994) opposes modern epistemology, which understands object and subject as two opposite and completely separate spheres, where the supposed partiality and interests of the subjects are simply an obstacle to the correct understanding of the analyzed object. For Latour, object and subject (or nature and society) are not starting points but rather the result of a long process that he calls translation or mediation.

Before we delve into the theoretical comparison we intend to conduct, it is important to briefly address the concept of translation, also called mediation, which is probably the central concept of the ANT and Latourian epistemology as a whole. It is worth emphasizing here, to avoid confusion, that Latour uses these terms in a completely interchangeable manner, preferring one or the other depending on the work or situation. However, if we delve into the reading of his collective work, we will realize that these terms have very close and complementary meanings, especially from the use that this author (and other ANT authors, such as Michel Callon and John Law) makes of them. This means that, in general, the actions, or rather, the performances of any actant (human or non-human), in the understanding of the ANT, always occur at the same time: *translations*, since they imply modifications and interpretations of reality; *mobilization*, considering that they involve movement of actants around some point or objective; *mediations*, once it is always necessary to use or create new connections—or associations—between actants to carry out an action. In Latour's words: "I used translation to mean displacement, drift, invention, mediation, the creation of a link that did not exist before and that to some degree modifies the original two" (Latour 2001, 206), "In place of a rigid opposition between context and content, chains of translation refer to the work through which actors modify, displace, and translate their various and contradictory interests." (Latour 2001, 356).

Having made this brief clarification, we can continue with the subject-object issue. For the author of *We Have Never Been Modern*, nature and society are inseparable, one does not exist without the other, and it is impossible to say where one ends and the other begins. Just as we are social beings, we are also animals (and, therefore, beings of nature). Even language, which often defines us as human beings and provides us with the raw material for our thinking, is a product of both social conventions and our innate brain and phonatory apparatus. Similarly, what we call society is the result of both legal and political conventions and an instinctive impulse present in our DNA, since the human being is a social animal and our ancestors already lived in herds long before the emergence of modern homo sapiens. On the other hand, what we call nature surpasses us while it is our creation, impossible to be conceived without the aid of language, culture, and, more recently, through scientific understanding. And it is this point that Latour uses to demonstrate the reach of his ideas:

The transcendent nature remains, after all, mobilizable, humanizable, and socializable. Laboratories, collections, calculation and profit centers, research institutes, and development offices daily mix this nature with the multiple destinies of social groups. Conversely, although we have built the society in full, it lasts, it surpasses us, it dominates us, it has its laws, it is as transcendent as nature. This is because the laboratories, collections, calculation and profit centers, research institutes, and development offices daily trace the limits of social groups' freedom and transform human relations into durable things that no one created. The critical power of moderns resides in this double language: they can mobilize nature within social relations, while keeping it infinitely distant from men; they are free to construct and deconstruct their society, while making their laws inevitable, necessary, and absolute. (Latour 1994, 42)

According to Bruno Latour (1994), the separation that moderns make between subject and object, or their collective equivalents – society and nature, is completely artificial, produced by us at the end of a lengthy process of mediation (which blends the two things) and purification (which separates into two poles things that are inherently similar), but that we categorize as “social” or “natural” depending on the final result (closer to what we consider one or the other). For instance, an environmental policy like the preservation of natural reserves. Although this involves plants, animals, and natural resources, sometimes upon which our survival depends, we believe that these laws and policies fall into the “society” pole because they seem more conventional than natural to the modern mind. However, their hybrid nature is apparent. It is nature’s policy while being a natural imposition when considering our dependence on these resources and the consequences of their devastation. At the same time, a certain species of tree within this reserve is placed in the “nature” pole, as it involves categories, concepts, and definitions from the natural sciences, such as biology and botany. However, these categories are constructed by the members of these sciences, through dynamics that are far more human than conventional epistemology and modern thinking can admit, involving categories of thought, concepts, points of view, interests, and controversies that demonstrate that nothing in that universe is fixed or absolute (Latour 2001). The history of science itself and the controversies that Latour explores throughout his career⁴ demonstrate the conventional and political nature inherent to scientific activity. In other words, the taxonomic categories of natural sciences are also hybrids, the result of a process that has human and non-human elements and transformations.

We can observe in this account that, as proposed by Edgar Morin (2005; 2005b), subject and object are not antagonistic, quite the contrary, they are complementary, one only exists from the other. And Bruno Latour takes this argument to its ultimate consequences when he states that subject and object are not starting points, but finishing lines, results of a process (mediation) that involves the two parties all the time, so that only through a high level of abstraction can we separate what pertains to one or the other:

If we are trying to unfold the Middle Kingdom itself, we are forced to reverse the general form of explanations. The point of cleavage and encounter becomes the starting point. Explanations no longer depart from pure forms [nature pole and subject/society pole] toward the phenomena, but rather from the center toward the extremes. The latter are no longer the fulcrum of reality, but rather provisional and partial results. (Latour 1994, 77)

It is worth noting that this is not the same as saying that everything is conventional. As the author himself strives to debunk (Latour 2001, 134-167; Latour 2012, 355-371), the so-called “social constructivism”, which attributes all reality to the subject and society – as if it were merely a convention, without (or with very little) support in the facts (or better said, in the resistance of non-humans), is just another type of reductionism. It inverts the logic of positivism toward the prism of conventional sociology, where everything is “social construction”.

Latour’s epistemology is very careful in this respect and strives to demonstrate in many of its examples and case studies that, while the reality of facts is flexible and supports many

⁴ There are many case studies and controversies explored by the author throughout his career, and it would be difficult to list them all. Here, we indicate some of the more famous ones if the reader is interested: microbiology and Pasteur’s yeast (Latour 1988); the isolation of TRF (H) in an endocrinology laboratory (Latour 1997); the development of nuclear research during World War II (Latour 2001); various cases (Latour 2000).

definitions (which are never definitive and are always at most “stabilized”), this same reality – which Latour (2019) more recently called “Mode of Existence” or Beings of Reproduction, imposes resistance and does not behave simply as scientists and engineers wish. All the time there is a type of struggle and mobilization of other actants to “domesticate” nature, making it behave more or less as engineers want or fit into explanatory scientific models and theories. In Latour’s words:

(...) reality, as the Latin word *res* indicates, is what resists. But resists to what? To the trial of strength. If, in a given situation, no dissenter is able to modify the form of a new object, then yes, it is reality, at least as long as the trials of strength are not modified. In the examples presented, there were many resources mobilized in the last two chapters by the dissenters to support their claims that, let us face it, resistance is futile: the assertion must be true. At the moment when the contestation stops, at the moment when I write the word “true”, a new and formidable ally appears in the winner’s field; an invisible ally until then, but now behaves as if it had been there all the time: Nature (Latour 2000, 155 - author’s emphasis).

Indeed, it is this process of mobilization, modification and redefinition (also called mediation) of human and non-human actants (which always act together) that Latourian epistemology seeks to explore symmetrically, making visible the movements of both sides in a struggle around temporary stabilizations that we call scientific facts or successful innovations. No definition of natural phenomena occurs outside of patterns and models manufactured by scientists through a long chain of references (Latour 2001, 86). At the same time, non-human actors insist on not fitting perfectly into these patterns, acting unpredictably or revealing themselves to be more complex than we imagined, always provoking new discoveries and changes in scientific and technological understanding.

This unattainable complexity is an important part of the approach between the two authors. For Morin (2005, 177), complex thought must not only deal with, but also embrace uncertainty and incompleteness as part of scientific knowledge, both in the exact sciences and in the humanities (or even in transdisciplinary studies, which are the author’s ideal). Accepting uncertainty allows complex thought to explore innovative and often revelatory paths. For instance, in quantum mechanics, embracing the inability to calculate the position and momentum of electrons with precision at the same time (Heisenberg’s Uncertainty Principle) led to the realization that it was possible to discern interference patterns and wave functions. These provide a highly precise estimation of the region where an electron could be found (an orbital), even if it’s impossible to pinpoint the exact location of the electron within that region at any given moment. It is from this sense of incompleteness that Bohr’s principle of complementarity (the dual nature of light) is born, previously mentioned in this study, and which serves as an example and analogy for the other sciences in Morin’s proposal.

Similarly, in Latour’s epistemology (Latour 1988), reality is never thoroughly and definitively known. It can only be perceived through gradients of resistance – trials of strength, that is, through interactions between actants that produce noticeable changes or differences. In this way, it is as if we are groping reality in the dark, sensing the real only through its resistance, much like the edges and textures of an object that react to the touch of our fingers – akin to how quantum physics does not fully comprehend the wave-particle duality of light, but fumbles this phenomenon from the resulting patterns of experiments involving slits and particles (and their interactions). Here we can see that uncertainty and incompleteness are at the heart of Latour’s theory from the outset. It is this principle of uncertainty that allows the author to explore controversies and view reality only as temporary stabilizations, which exclude any form of reductionism and determinism.

We will gain a better understanding of how Latour's theory deals with uncertainty and complexity as we delve into how this theory (or meta-theory) responds to the challenge of complexity proposed by Morin (2005) based on the principles driving this challenge, as previously presented in this study.

We will start with the dialogical principle, which states that apparently antagonistic ideas and concepts, such as order and disorder, individual and collective, etc., should be explored to find their probable complementarity in most of the complex phenomena studied by scientists, as most of the time, according to Morin (2003; 2005; 2005b), one depends on the other. In this sense, no other concept in Latourian theory is more representative than the notion of human and non-human actors, or the heterogeneity of the mediation process. As we have already discussed in this section, according to Latour, nature and society are finish lines, not starting points. The process, which necessarily involves both, always includes what we call human actors, i.e., individuals, groups, institutions, businesses, governments, etc., and non-human actors, such as machines, equipment, technological assemblies, algorithms, materials, etc. For this author, it is more important to realize that one cannot exist without the other, does not act without the other, and that for human actors have strength and their associations be durable, they necessarily need to be associated with non-human actants (Latour 2000; 2012). In the Latourian epistemology, there is no division between "social universe" and "material universe". The symmetry advocated by the author is not a proposal for "equality" between two irreconcilable worlds, but rather the complete absence of asymmetry:

We cannot speak of an empirical case when the existence of two coherent and homogeneous aggregates, for example, technology "and" society, make any sense. The ANT is not—I repeat: is not—the creation of an absurd "symmetry between humans and non-humans". Achieving symmetry, for us, means not imposing a priori a spurious asymmetry between intentional human action and a material world of causal relationships. There are divisions we should not cross, overcome, dialectically reduce. They need, indeed, to be ignored and left to their own resources, like a once formidable castle now in ruins. (Latour 2012, 111-112 - author's emphasis)

Particularly regarding the complementary notion of order and disorder – so valued in the epistemology proposed by Morin (2005; 2005b), we can say that the main concept of Latourian theory – that of translation or translation, is inspired, according to Law (2007, 5), by the philosophy of Michel Serres, in which translation is treated as the overly human attitude of seeing some order in the sea of disorder that is the world. This ordering, in turn, is always fragile and temporary. As Latour (2000, 338; 2001, 107) demonstrates, scientists, engineers, and even politicians must make a great effort, mobilizing many heterogeneous parts and materials, to keep associations operating as expected in scientific theories, technological innovations, or government programs. Order, therefore, can both emerge from disorder and be devoured by it, amounting to nothing more than a temporary arrangement with more or less strength and stability. Interpretive flexibility (included in the concepts of translation or mediation) and impermanence of associations are principles highlighted and explored throughout all of Latour's work, through dozens of case studies.

By assuming that nothing is definitively known and at most can be considered a temporary stabilization resulting from resistance, Latour also contemplates chaos and the unknown as parts or actants that are not perceived or mobilized. The author will call this unknown universe "plasma", that is:

(...) that which has not yet been formatted, measured, socialized, inserted into metrological chains, covered, inspected, mobilized, subjectivized. How big is it? Take a

map of London and imagine that the social world visited so far only covers the space of the subway. The plasma would be the rest of London (...). (Latour 2012, 347)

This non-mobilized and unformatted part of the world we inhabit (both physically and subjectively) can be perceived as chaotic, as simple ignorance – or better said, not inserted into our metrological chains. This is a fundamental piece in Latourian theory, which not only prevents social and “realist” reductions, but also explains changes in the scientific and social universe.

From this, we can affirm that the dialogical principle proposed by Morin is completely satisfied by the various sets of “symmetries” proposed by Latour, since his intention is always to demonstrate that the two logics (society/nature; subject/object; human/non-human; reality/construction), are not only complementary, but in fact have never been distinct - except as a product of high abstraction at the end of a process that is necessarily heterogeneous.

The next challenge proposed by Morin (2005) refers to the systemic principle and its consequence, the holographic principle, which says that in phenomena involving organizations (understood as that which constitutes a system involving different parts), not only is the part present in the whole, but the whole is also present in the part. Latour does not use these terms, but in his philosophy, the whole, the macro, the “global”, or better said, the network of associations, is always present, even when we address an actant or action localized in time and space.

According to Latour (2012), although the concepts of local and global are most often seen as antagonistic, these terms are actually complementary, since one cannot exist and operate without the other. For this author, what we call local can only function globally (from a network), at the same time that global can only operate locally. If we consider every actor as an actor-network, we rapidly understand why every local is global: as we trace the connections that allow an actor to act, we soon perceive the global network that is linked to them. Direct interactions must be seen as the endpoint of a myriad of people, a large number of actions pointing in that direction. In his words:

An actor-network is always tracked whenever, in the course of a study, the decision is made to replace actors of any size with connected sites and locations, rather than inserting them into the micro and the macro. Both parts are essential, hence the hyphen. The first part (the actor) reveals the scant space where all the magnificent ingredients of the world begin to be incubated; the second (the network) explains by what vehicles, traits, trails, and types of information the world is put inside these places and then, once transformed there, expelled from within its narrow walls. This is why the “network” with a hyphen is not just a stealthy presence of Context, but as that which connects the actors. (Latour 2012, 260)

Furthermore, in Latourian theory, the number of actual interactions is always much larger than what is visualized by the analyst. Even the actors considered mediators in the ANT never act alone, they are always connected to a network that surpasses them and goes far beyond what it is possible to map. As Latour points out: “The “actor”, in the hyphenated expression ‘actor-network’, is not the source of an action but the moving target of a vast array of entities swarming toward it” (Latour 2012, 75), and also: “By definition, action is displaced. Action is borrowed, distributed, suggested, influenced, dominated, betrayed, translated. If it is said that an actor is an actor-network, it is primarily to clarify that it represents the main source of uncertainty about the origin of action” (Latour 2012, 76 - author’s emphasis). Therefore, the portrait produced by the analyst is always partial, in the figurative and literal sense, once it is impossible to trace all associations and mediations. The account will always be inconclusive, always open to improvements, and never deterministic.

Thus, we can say that in the ANT and, consequently, in Latourian thought, the whole is always present in the part. It is always signified, mobilized, directed, influenced, represented (and so on) through other actors-networks (again, human and non-human). Therefore, there is no isolated or autonomous particle or actant, the “global” network is always acting together.

The next challenge proposed by Morin (2005) refers to the recursive principle, which says that the effects (of nature or society) act on the cause to reproduce themselves, which ends up generating differences during the process. This principle certainly fits in with the perspective of the ANT, as, according to Latour (2000; 2012), there is no pre-defined social structure that orders us and defines our behavior, like defined pieces in a game with ready-made rules. On the contrary, this “structure” is constantly questioned, challenged, disassembled, and reassembled by the actors-networks through their translation movements, with various and often conflicting objectives and interests. This does not mean that what we call society is always chaotic and unpredictable. The primary goal of most actors-networks is to produce stabilizations, compulsory passage points, black boxes that will remain unquestioned and functioning properly for a long time in a certain range in space (or network).

However, here it is necessary to make two important caveats. First, according to Latour (2012, 288), these stabilizations are only possible because of the non-human actors we are capable of mobilizing. They are the ones that allow action at a distance from a long chain of actants that enable, for example, a bank transfer, which in turn allows banks and account holders to trust their hard-earned money (a fundamental actor here) in a deposit that operates in an extremely complex and mysterious way for the minds of most people. The trust in all these factors (and many others)—which indicates stability, where ATMs and financial apps function as black boxes,⁵ which we do not need to understand how it works, but only how to operate, and banks act as a compulsory passage point for most transactions—is what allows account holders not to form desperate lines to withdraw all their money from the account as well as some financial stability to an increasingly globalized and branched system.

In the second place, as Latour has stressed throughout his work, these stabilizations are only temporary. Rarely does a black box—such as a well-established scientific theory or a widespread technological artifact—last a long time without undergoing modifications, questioning, defects, adaptations and, finally, its complete replacement by something more efficient and effective. Even in the example previously provided, we cannot forget the successive and constant financial crises we have faced with increasing frequency. What is a company or a bank whose shares are high today may well go bankrupt tomorrow, sometimes leading to a crisis in the entire financial system in much of the world, as we saw in 2008. New unicorns (startups worth more than a billion dollars) emerge every month, just as old companies that monopolized markets for decades go bankrupt every year. Nothing is fixed in this “structure”. In Latour’s epistemology and cosmology, nothing is, everything is in a state of becoming. To understand how a temporary stabilization in the form of a star (actors associated in a network, not crossed by any “social force” or extra dimension) occurs, the

⁵ Latour (2000) borrows this concept from cybernetics to represent well-established scientific facts or widely disseminated technological artifacts. Although these incorporate a myriad of heterogeneous associations within them, which enable their scope and functionality, they are treated as sealed devices. Only what goes in and what comes out matters, meaning what this black box allows to be done without the user needing to understand it deeply or how it was constituted. Latour also uses this concept to represent *ready science* when controversies have been resolved and the fact or artifact is stabilized. In contrast, according to the author, the analyst of science and technology should “open” this box, demonstrating how the view of *science in action* produces a perspective much more detailed and realistic than an analysis of finished science can do.

ANT analyst should follow and pay close attention to the transformations and mobilizations that form all the time around these stabilizations in the form of disputes and alliances to destabilize or expand them.

Thus, we can say that Latour's philosophy fits into Morin's recursive principle (2005; 2005b), as there are no absolute and immutable causes. The effects of a network are constantly acting on their own causes (or the translations that shaped them) aiming at their expansion or replacement, which necessarily produces changes over time (in fact, all the time to some degree) in a recursive manner. In this process, non-human actors are essential, since most changes occur in the form of technological innovations (even in scientific research, which most of the time can only advance when it can count on new and better instruments). The fragility of order (social and natural) is, therefore, a fundamental point both in the paradigm proposed by Morin and in Latour's philosophy.

Regarding the crisis of closed concepts and their overcoming (Morin, 2005, 183), pointed out in the previous section, we can say that Latour's theory satisfies this point because the notion of symmetry previously addressed, in which there is no clear and definitive division between subject and object, society and nature, human and non-human, or network and environment (as the notion of plasma allows us to visualize). All these notions are united in Latour's philosophy through the synesthesia expressed by the concept of mediation, which unites different things in a single movement. The separation of these concepts, as we have already explored, is the result, the finish line of a process that operates from the heterogeneity inherent in the construction of black boxes (such as scientific theories and technologies). It is, therefore, an artificial construction of the moderns (Latour 1994) who like to separate things into binary pairs (ready science), but who in practice (science in action) operate from hybridization. Therefore, Latourian epistemology operates precisely from the deconstruction of closed concepts, in which the aim of the analyst is to demonstrate how these concepts are artificial constructs and that sociology only stands to gain by avoiding them.

Finally, Morin (2005, 185; 2005b, 96) states that it is necessary to bring the observer back to the observation. After going through all the principles and challenges, it is unacceptable to continue considering the observing subject as an obstacle or noise to be avoided. The researcher is an integral part of the research, without whom it would be impossible. Continuing with our comparison, we can say that Latour has never shied away from this challenge, and at no point in his work he tried to remove the observer to make the analysis "impartial". Quite the contrary, according to this author, the observer or analyst is an integral part of the network and the movements they map.

According to Latour (2000; 2001; 2012), the analyst should consider the situation or black box they seek to describe from the perspectives of as many actors-networks as they can trace, symmetrically, without assigning more or less importance to one or another based on preconceived notions such as the social status of the interviewee. It is through the controversies that can be perceived from the different accounts and narratives of the observed actors that the analyst is able to discover and map issues, problems, alternatives, and non-human actants that were previously hidden to laypeople or those not involved in the project at hand (in the case of technologies or government programs, for example). And the observer or analyst of the ANT is part of this process. At the end of their research, the researcher must produce a report or account of the case. This account should be as descriptive, accurate, faithful, and objective as possible (which is only achievable through the symmetrical consideration of viewpoints and human and non-human actors). The more detailed the composition of this map of actors and the description of the behavior and actions of the actors in question, the stronger this account will be. Therefore, according to Latour (2012, 179), it is always a risky account, as in the end, if it is good enough, it will become part of the very network in question and act as a mediator that can modify the course of action.

This differs from the discourse that scientific analysis should be completely impartial and “disinterested”, as well as from the discourse that claims it is impossible and that all we can produce are “narratives” which are entirely dependent on the actors’ perspectives. According to Latour (2012, 366), the sociology of associations is not a “construction” like fiction. By acknowledging that the analyst is also an actor-network, we can realize that it is possible to produce a detailed and well-grounded account with a plurality of viewpoints, which can be considered objective without excluding the subjectivity inherent to all actors-networks (including the analyst). The same applies to the activities of natural sciences such as physics, biology, etc. By producing a well-articulated chain of references and a detailed description of the data and how they were obtained and processed, the natural scientist (as well as the social scientist) ensures the circulation of information within well-defined channels, corresponding to the notions of circulating references or immutable mobiles (Latour 2001). By analyzing these movements and translations through the lens of the sociology of associations, we can perceive a richness far greater than the reductionist essentialism of the old paradigm claimed to be realistic.

Final Remarks

Throughout this study, we have sought to demonstrate how Latour’s methodology and epistemology align with Morin’s epistemological proposal for a broader scientific practice and understanding. They both embody a new paradigm that embraces the complexity of the world and rejects reductionist determinisms and closed concepts of the old paradigm, which has not yet been completely overcome in most scientific areas and methods. By doing so, we hope to have indicated not only how Latourian epistemology is a solid example of complex thought, but also how much we stand to gain by utilizing the principles shared by these authors.

At this point, we would like to emphasize the importance that Morin attributes to quantum mechanics and relativity to overcome the old paradigm and inspire complex thought. These fields of physics broke with long-established and unquestionable principles, such as the notion of absolute time and space, which allowed for reductionist and deterministic operations in the sciences as a whole. By exploring the wave-particle duality and the inherent uncertainties of this mechanics, physicists were able to perceive that contradictions sometimes indicated complementarity and that certain measurements were impossible (at least simultaneously). It has become increasingly clear to physicists that it was impossible to know everything at the micro scale, such as the position and momentum of an electron (Heisenberg’s uncertainty principle), and that one had to settle for patterns and wave functions that only indicated probabilities, albeit with great precision.

Similarly, the sciences in general, including the social sciences, have gradually moved away from deterministic claims and have been driven toward identifying trends, patterns, and probabilities. As a result of this approach, according to Morin and also to us, we have not lost reach and precision; on the contrary, we have been able to perceive more relationships, more interactions, open systems instead of closed ones, complementarities instead of contradictions, and previously overlooked recursivity. In essence, complexity has replaced simplification.

Latour does not use the same analogies in his work, especially regarding quantum mechanics. However, throughout our comparison, we have been able to perceive how Latourian epistemology is resistant to any type of reductionism or determinism, whether of naturalistic or social nature, and converges with Morin’s proposal of complexity in epistemology. In this sense, it would not be incorrect to say that Latour’s philosophy operates somewhat like quantum mechanics, where non-humans, like sub-particles, do not behave exactly as we desire, and cannot be precisely measured and visualized. As Latour

points out, our knowledge about reality is solely based on the resistance and trails of strength offered by the actants. Therefore, they are like experiments that only grope at quantum phenomena through the wave functions resulting from them. No one knows exactly how massive particles, such as electrons, are able to behave as both waves and particles simultaneously. The only thing physicists have at their disposal are the resistance and trails of strength offered by these sub-particles through experiments involving multiple slits. There is always the possibility of new potentials and resistance being perceived, revealing some new aspect of reality that will only be understood in some way when it is incorporated into a collectively stabilized explanatory model.

As sciences advance in their endeavors, it is inevitable that new conceptions and resistance emerge, leading to destabilizations and opening previously sealed black boxes. We have nothing to lose in this process, except for some accommodations. But for that, we need to embrace the complex thought of this new paradigm, immune to simplifications and unquestionable facts.

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