Relativism-Relativity

Relativism-Relativity:
An Interdisciplinary Perspective
on a Modern Concept

By

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CONTENTS

LIST OF FIGURES

AUTHOR'S ARGUMENT

Setting out to write on "the many faces of relativism," Maria Baghramian admits that the subject can be carved up in different ways, its ascription depending "on a great variety of doctrines and positions" (Baghramian: 1), several of which have already entered into the history of ideas. At the same time, writers on the topic are reproached for a lack of consistency concerning their criteria for the classification of the objects and domains of relativism.

It is doubtful whether consensus about classificatory definitions will ever be reached, even when less slippery notions than "relativism" are being debated. Maybe a common divisor or an algorithm for the definition of the concept in its intensional meaning should take priority over its extension, as the list of "objects" and "contexts" will always be an open set. In Baghramian's classification below (Baghramian: 6) for instance, we could add religious relativism to the cognitive/ moral/ aesthetic taxonomy (δ is actually doubling up α) of objects of relativism, considering that even Saint Paul approved of the altar whose inscription read "To an unknown god" (Acts 17:23), which may be paraphrased as "To God Whoever He may be"….

> α cognitive norms: truth, rationality, logic, epistemic standards (cognitive relativism, epistemic relativism)
> β moral values (moral relativism)
> γ aesthetic values (aesthetic relativism)
> δ knowledge claims, worldviews, ontologies, systems of belief (cognitive, conceptual, and epistemic relativism)

We have opted, therefore, for an "essay," i.e. an informal approach, which traces the birth and modulations of a defining concept in the passage from medieval to modern history. Since the sixteenth century it has meant different things to different thinkers, its symptoms being complaints including cognitive uncertainty (Michel de Montaigne), epistemological fallibility (William Whewell), and ungrounded morality (Friedrich Nietzsche), amongst others. This, however, has been only one side of the coin, the other showing pluralism as the liberating premise for the mind's supervening to genuine knowledge, epistemic structures, and ethical attitudes. It is especially through relationism, Karl Mannheim's

word for a special case in the declension of relativism, that modern epistemology has turned up more fruitful results in its search for representational regimes of being and meaning.

The concept of relativity is today automatically associated with Einstein's physics, but is born of the confrontation between Cartesians and Helmontians on the early modern battlefield of the philosophy of science. It was one of the favourite issues of essayistic speculation in the later nineteenth century when it came to be perceived as a more appropriate epistemic position than Kantian transcendentalism in a post-Nietzschean world, which had experienced the transvaluation of all values. Walter Horatio Pater saw in relativity the very spirit of modernity.

In its twentieth-century hypostasis, radicalized by existentialism and aggravated by the agnosticism of the Copenhagen School of Quantum Physics, relativism was both lauded, especially by vanguard artists and subversive social groups, and exposed as an amoral and dangerous attitude.

Our essay is a revisionary and historicist approach to the issue, which cuts across the disciplinary borders of science, philosophy, ethics and art. Earlier versions of current theories in the New Physics, such as relative time and space, the two (implicate and explicate) orders, the superposition of states, fractal geometry, or space-time, are traced back to the work of Kepler, Leibniz or D'Alembert. Such ground-breaking ideas, first launched in the tentative form of the essay, which acquired a quasi-canonical status in the French Encyclopaedia, referenced other disciplinary fields (psychology, ethics, social science), and entered into fertile negotiations with discursive and formal innovations in literature.

Present-day holistic approaches to the order of artefacts as semiotic manifold, inter-disciplinary and cross-cultural studies are rooted in the cultural anthropology of the Victorian Age, whose relativistic statements and attitudes invite second thoughts on its reputation for heavy handed moralising and strong inclination toward classifications and taxonomies. Thomas Young's double-slit experiment of 1801, which had demonstrated the wave nature of light in opposition to Newton's corpuscular theory, had also pressed home the idea that all knowledge is partial and provisional, Cambridge philosopher William Whewell urging scholars to seek confirmation of their theories in the history of science and across disciplinary borders. The "consilience of inductions from classes of facts altogether different" (Whewell: 230) did not suggest a way to group things together according to natural relationships but a new vista leading to **polyvalent logic.** Thomas Henry Huxley would follow it and make an even more explicit statement in this sense: "The rationale of contradictory

opinions may with equal confidence be sought in history". (Huxley: 230). Even the apostle of the end-of-the-century aestheticism, Walter Horatio Pater, who could no longer abide by laws, logic, and archetypes in the biological and perceptual flux of differentiation, sought an anchor for the phantasmatic house of life in the "unity of the spirit" achieved through communication across disciplinary spheres which "breathe a common air" and "catch light and heat from each other's thoughts". (Pater: 11).

In a way, Hegel was right thinking that no further progress was possible in the philosophy of spirit after his phenomenology, which looks now like a monument to the tradition of transcendental idealism. All great generalizations about the absolute in relation to the real and the ideal, the issue of system and structure in philosophy understood as science were gradually replaced with an anxious awareness of the constructed nature of man's world and, implicitly, of its historicity. The germ of deconstruction planted by Hegel the moment he allowed the Absolute Spirit to descend to language as "its main element and habitation" (Hegel: 439) took roots and bloomed forth when language lost its Cratylic transparency in relation to its referent turning upon itself as a historical, conventional, arbitrary and indeterminate medium.

Pluralism and relativism affect all theoretical concerns, statistics replacing analytic self-evidence, logical consistency and rules for the operation of the intellect or even empirical evidence. Philosophy ceases to be "the project of the self-understanding of reason on its own terms, within its own structure as given by language" (Hendrix: 13). The philosophy of science turns to the semantic energies of all forms of social expression, negotiating meanings with all the discourses in the public sphere. As reason no longer controls perception, which, in light of empiricist psychology, is relative to the perceiver, it seeks confirmation from as wide a circle of social subjects as possible. The relativist thinker works with multiple and mutually-exclusive points of view (Leibniz: logical **and** existential definitions of identity), makes room for the previously excluded third, and gives up on fixed identities. "More is different" says Noble-Award winner Philip Anderson: interaction with the environment will change a system's Eigenstates (characteristic features), so that everything may be said to exist only in a field of forces and in perpetual transition to something else. The reversibility of implicate and explicate order unfixes the relationship between parts and whole in structural metaphysics. The real and the ideal are collapsed in superpositions of states, and the disappearance of the symbolic distance between Platonic *archē* and phenomena renders an aesthetics of representation impossible. As in Borges's parable "On **Exactitude** in **Science**", the map that reproduces the

territory point for point is rotting away its superfluity. On the other hand, are there rules for correct setting in perspective or representation? Deleuze and Guattari finished off the demolishion of a myth originating in Plato that the intellect can reduce things to *paradeigma*, establishing an unfailing parallelism between the choric and the thetic, or work out "a logic of tracing and reproduction" (Deleuze and Guattari: 12). Differential calculus, the recognition of the difference that will never completely vanish between the landscape of facts and theoretic constructs of figures, marked the beginning of the disenchantment of the mind from its humanistic dream of taking the universe into posession. The prevailing studies in non-linearity suggest that contemporary physicists share the philosophers' opinion that "mimicry is a very bad concept, since it relies on binary logic to describe phenomena of an entirely different nature."(Deleuze & Guattari: 11). The map does not reproduce but adds up to the territory. The new relationism allows of connection despite heterogeneity: "any point of a rhizome can be connected to anything other, and must be. This is very different from the tree or root, which plots a point, fixes an order." (Deleuze &Guattari:7). Patterns keep forming in the absence of constraints from pre-existing structures. Essentialism yields to contextualism, being in itself to being for or with an otherness:

> We will never ask what a book means, as signified or signifier; we will not look for anything to understand in it. We will ask what it functions with, in connection with what other things it does or does not transmit intensities, in which other multiplicities its own are inserted and metamorphosed, and with what bodies without organs it makes its own converge. A book exists only through the outside and on the outside." (Deleuze & Guattari: 4).

> Relations work changes in the related elements: a "capture of code, surplus value of code, an increase in valence, a veritable becoming, a becoming-wasp of the orchid and a becoming-orchid of the wasp." (Deleuze & Guattari: 10)

It is this integrated picture of the world of experience that we carry with us in our progress through life. Cognitive psychologists have identified four types of relations establishing among elements as they are recorded in memory: word-concept (word dog refers to the concept "dog"), concept-concept (dog-animal), concept-percept (word-image), word-word (collocating words, words forming semantic fields: dog-tail-bone-cat…) (Griffiths: 213). Experiments have proved that subjects remember best elements associated with contexts and words related through topic. Where lists of semantic features prove difficult to memorise, topic models activate the richest patterns of node activities,

because the objects of our experience are inserted within latent mental structures which are activated by any element of the set.

The last type of relations, word-word, is the structural principle of semiotic aesthetics: a troping of the topological, an open-ended, lateral and rhizomatic linkage of signifieds sliding under signifiers. Man's world, that Heideggerian worlding of the physical universe, is a web of related meanings, an integrated model of culture in which no element exists in isolation from the rest. Integrated teaching, interdisciplinary teaching by topics, is the present institutionalization of that incipient semiotic understanding of being which Leibniz figured out as a holistic order of interlocked monads.

Relativist thought is a constant in modernity which otherwise meant accelerated change, uprooting of distinctions and opening of the floodgates to the liberating manifestation of differences, concomitantly with the proliferation of codes built through them in an increasingly complex civilization.

From *onta,* the reflector's gaze turned to *relata*. Whewell coined the word "palaetiology" for his art of correspondences: the past retrieved from present evidence, examination of artefacts "from nation to nation and from age to age", and collection of evidence from the treatment in common of sciences so that they "may reflect light upon each other." (Whewell: I/ 640). With Leibniz in the previous century, the mind had turned away from the stupendous machine of the universe towards the successive orders of its own making, articulated around "principles, maxims, and rules of procedure" (Ibid.). These protocols governing the articulation of discourses, which Michel Foucault would call "episteme" or regime of knowledge and discourse, are acknowledged as multiple and provisional, yet fatally normative, since at no time can the human mind jump over its own shadow, disciplinary validity in between scientific revolutions being assessed in relation to them.

Nowadays relativism has ceased to be merely a range of attitudes, from the positively assessed liberalism to the negatively assessed suspended judgement: "Everything is allowed", to quote Ivan Karamazov. In the hypostasis of relationism, it is the model we use to describe the emergent universe, globalization, or the workings of the mind, the way we read and write about books, the way we teach…

The essay looks at the concepts of relativity or relativism as they have fed into simulation models of being or of world building, books at either end of this time span, in East or West Europe, being read, not as fruit of personal genius or an individual's empirical psychology, but as knots in international networks of cultural semiosis and institutional exchanges.

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CHAPTER I

THE TIME AND SPACE OF MODERNITY

I.1. Newton and absolute time and space

Heisenberg's "uncertainty principle" may be considered the Copernican Turn in physics that marked the shift away from the classical world through the erasure of the dividing line between the subjective and objective aspects of the world. The physical description of phenomena in space and time was declared impossible, any measurement being relative to the observer's apparatus: "it is not possible to decide, other than arbitrarily, what objects are to be considered as part of the observed system and what as part of the observer's apparatus" (Heisenberg 1956: 1054). Even the time-honoured debate around absolute or relative time, showcased in the museum of the "classical world," centred on the physical concepts of space, time and motion. In the attempt to put his finger on the pivotal point of the quantum turn, Heisenberg was sharing the stereotyped representation of modernity as a well-proportioned and harmonious edifice, built on the firm ground of physical laws and determinism. At a closer look, however, the edifice reveals its tensed structure, polarized between Newton's absolutism and Leibniz's relativism.

Newton's first law of motion states that: "Every body will remain at rest or in a uniform state of motion unless acted upon by a force," which constrained him to define speed as the distance travelled per unit of time. But which time? The time pointed at by some clock, or absolute time? Did the first law of dynamics establish a certain idea of time? Unlike his contemporaries, Descartes and Leibniz among others—who considered time to be the order of successive events—Newton opted, in his laws, for absolute time, i.e. that which is mathematical and independent from whatever there is or happens in the universe. The space in which bodies move is also an absolute one, a passive container, distinct from the things within it. It goes without saying that, in such space, motion too is absolute.

In the Scholium opening of *Principia mathematica*, Newton defines the concepts of time, space, position and motion, which he uses in his treatise. The definition of the first two concepts is controversial and remains to be resolved.

> I. Absolute, true, and mathematical time, of itself, and from its own nature, flows equably without relation to anything external, and by another name is called duration: relative, apparent, and common time, is some sensible and external (whether accurate or unequable) measure of duration by the means of motion, which is commonly used instead of true time; such as an hour, a day, a month, a year.
>
> II. Absolute space, in its own nature, without relation to anything external, remains always similar and immovable. Relative space is some movable dimension or measure of the absolute spaces; which our senses determine by its position to bodies; and which is commonly taken for immovable space; such is the dimension of a subterraneous, aerial, or celestial space, determined by its position in respect of the earth. Absolute space and relative space are the same in figure and magnitude; but they do not remain always numerically the same. For if the earth, for instance, moves, a space of our air, which relatively and in respect of the earth remains always the same, will at one time be one part of the absolute space into which the air passes; at another time it will be another part of the same, and so, absolutely understood, it will be continually changed. (Newton: 6-12)

It is interesting to note that, although Newton decided to investigate real phenomena—those which can be observed experimentally—he chose to work with absolute quantities, which cannot be measured, since they have "no relation to anything external." Absolute space is conceived of as independent of bodies, and would therefore also exist in their absence.

In opposition to Newton's absolute time, Julian Barbour discusses "the end of time," as there is no connection between successive states of the universe which might very well be represented as a collection of pictures. Barbour sees classic space-time as a block of crystal (Barbour: 1), through which time flows like a river. Newton's assumptions about absolute space and time have proven to be merely formal. It is only relative positions and motions that can be measured experimentally, since they alone are a physical reality.

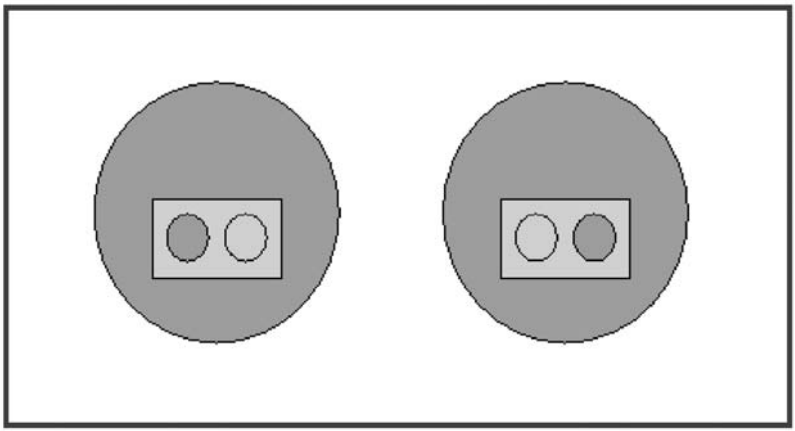
In classical mechanics, spatial and temporal relationships among objects (events) are expressed by an inertial reference system of coordinates to which a clock has been attached. Newton's first law, the principle of inertia, applies to this system. In mechanics, the speed of

interaction transmissions is taken to be arbitrary, so that all the clocks in the universe can be synchronized, i.e. it is possible to build a universal clock. As a result, the length of a certain event is the same no matter what reference frame is used. Simultaneity is absolute, i.e. two simultaneous events in a particular frame of reference remain the same in any other. Finally, events in Newtonian time space can be ordered in time.

Mathematical equations, in an ideal space-time, do not vary with the sense of time. Were we to change t with -t (reversible time), they would remain unchanged. Looking in either direction from the present moment, we can determine both past and future events.

I.2. Leibniz and relative time and space

The rival theory to that of absolute space and time was a form of relationism supported by Newton's contemporary, philosopher and mathematician Gottfried Wilhelm Leibniz. From Leibniz's perspective, space and time were just orders of coexisting or successive events (Fig. 1).



If space is real separately from substances, then two substances can be indiscernables and be in different locations – this entails a paradox. But, if space is a 'projection' of internal properties of substance, then two apparently indiscernible substances are really different by virtue of those properties which are perceived as spatial relations.

Fig. 1

Moreover, they are illusions rather than substances, depending on the existence of things in the world. Leibniz illustrates his concepts intuitively through an analogy with the members of a family in the fifth paper of his correspondence with Clarke (Leibniz 1716: 36-37):

> The mind can give itself a picture of genealogical 'lines', whose 'size' would consist purely in the number of generations, with each person having his place on one of the lines. Add to this the fiction of soul-migration, so that a single human soul could turn up a second time further down the line; if that were to happen, someone who was a father or a grandfather might become a son or a grandson, and so on. Yet those genealogical places, lines, and spaces, though they would express real truths, would only be ideal things. And here's another example to show how the mind is prompted by accidents that are in subjects to invent for itself something that is outside the subjects.

The family metaphor is classified as a "fiction" in this passage, rather than "generality," as Robin le Poidevin describes it in his *Travels in Four Dimensions* (38), by analogy with other abstract notions, such as "Papacy" or "Presidency of the United States": "not because there is some concrete item which persists through changes of holders of the office, but because different people at different times come to stand in the same relations to other people or institutions."

The distinction here—which took Bertrand Russell some time to resolve—is that between a class of objects and its elements. The notion designating the class, for instance, "family" or "felines," was eventually placed by Russell on a higher level of a hierarchical classificatory scheme than its members (tiger, panther, lion, etc). The distinction is logical, not ontological.

On the contrary, for Leibniz, space and time resemble here the innate ideas which are prompted by the accidents of Plato's reality of "shadows" (the objects of empirical experience). Immanuel Kant, who would define space and time as "representations," had his work cut out by Leibniz. While Kant separated the object of knowledge (epistemology) from the object of anthropology (representation, not according to reason, but "in a pragmatic or physiological sense," i.e. according to the individual's arbitrary associations), Leibniz separated the principle of essence (logical distinctions, observing the principle of non-contradiction) from the principle of existence. It is the latter that makes the whole of existence into a whole or a net of interconnected monads. As any predicate is said to be included in the subject, the infinity of virtual predicates stretches any individual entity to include the whole of existence. The source of predication about the entities existing in the world is observation (that

which is discernible), as well as ideal representations for which there is no factual correlative; one such example is the fiction of incarnation, which unfixes types (class of objects) from origin, triggering the endless sliding of signifiers: from father to son, etc. Space and time are of the nature of perception:

> I don't agree that everything finite is movable. According to the hypothesis of my adversaries [Clarke and Newton], a part of space is something finite yet not movable. Anything movable must be capable of coming to be in a new state that is discernible from the one it began in; otherwise, the 'change of place' is merely a fiction. For the moving of a finite thing to make any change that can be observed, the thing must be a part of some other finite thing. (Leibniz 1716, 33)

There is no pre-existing container for the material universe, and no empty and fixed position. Being positioned is equivalent to being situated in relation to other bodies, including that of displacing or being displaced. It is the whole configuration that creates possibilities for placement within the observer's perceptual field, which is not, however, relative to the individual observer.

Place is not where God is but where God acts, Leibniz says in his fourth paper; by this he means that space is relational, but the network of relations is law-like and akin to an information structure. Its intelligible nature is suggested by the "geometry of situations" phrase coined by Leibniz to describe it. It is according to certain laws that the geometry of a given situation changes, which boils down to an inferential statement about the dependence of time on space (Leibniz 1716, 20):

> 41. Clarke contends that space doesn't depend on the situation of bodies. I reply that it's true that space doesn't depend on this or that particular spatial lay-out of bodies, but it is the order that makes it possible for bodies to be situated, and by which they have a lay-out among themselves when they exist together, just as
>
> **what Leibniz wrote***: le temps est cet ordre par rapport à leur position successive.*
>
> **what that means:** time is that order with respect to their successive position.
>
> **what he may have been getting at:** time is the order that makes it possible for events to have a chronology among themselves when they occur at different times.

I.3. Relativity in the twentieth century

The end of the nineteenth century saw the rise of a new disciplinary field in physics: electromagnetism. Into it fed the contributions of physicians from the previous century and earlier; Maxwell, whom a number of equations were named after, synthesized their work. The question was now whether Maxwell's equations remain the same (invariant) for different frames of reference. In mechanics, the problem had already been solved; the equations of Newtonian mechanics remained invariant under a group of equations called "Galilean transformations." They were used when a mechanic event was studied in another frame of reference. On the contrary, Maxwell's equations were not Galilei invariant.

At that moment, the situation in physics was as follows:

- Absolute space and absolute time continued to be the basic concepts of mechanics.
- The distance between two points and the duration of a phenomenon were also considered to be absolute.
- The geometry of the time was Euclidean.

The hypothetical and elastic medium, called ether, was supposed to fill the planetary void, which supported the propagation of electromagnetic waves.

- The highest speed of interaction with transmission had been identified as the speed of light in the void.
- The speed of light had been proved to be independent of the inertial system. In addition, Henri Poincaré found out that Maxwell's equations were invariant under Hendrik Lorentz's transformations.

The world, however, was still known in its old frame, since neither the discovery of the electromagnetic field, nor that of Riemannian spaces had significantly destabilized it. It was Albert Einstein who, in 1905, introduced a new theory in physics known as the special theory of relativity. Entities lost their autonomy and their identity, depending now on a system of space-time coordinates which positioned them in a four-dimensional universe with time marked off as an imaginary number, while measurements became dependent on the reference system. Existence itself, the Kantian "Ding an sich," was a thing of the past. Absolute values were gone, making room for the differences resulting from relative evaluations.

The universal clock, which had promised to measure the time on Jupiter as accurately as on Earth, had been replaced with a clock which showed time according to its position in various locations on Earth. At the base of a mountain, the time of the space distorted by the gravitational

field differed from that pointed out by a mountain climber's clock at the top.

It was a matter of decades before mankind was forced to radically revise the familiar representations of its portion of the universe as if it had moved to another system of reference. And yet, people were being told that the "novelty" was nothing other than classical physics. By whom? By the young representatives of the Copenhagen School who were claiming to have achieved the true Copernican revolution in physics.

Quantum mechanics was not just relativistic but purely agnostic. The results of experiments were not only relative to the observer but also inaccurate when several parameters were concomitantly measured. This strange theory is known as the "Uncertainty Principle," as it must indeed have been perceived at that time, for until then the scientific world had admitted its limitations without principles. According to Werner Heisenberg, it was impossible to measure concomitantly a particle's position and its momentum. Another difficulty was that of predicting the collapse of the wave function (the pointer state to which the multitude of a system's possible states would collapse).

The post-war era has been entirely dominated by the New Physics. The space-time of our galaxy has ceased to be the only universe. Not only was the ether proved to be a fiction but also the mystery of the correlations of quantum systems from a distance, without contiguity, has not yet been solved. The multiverse theory is spinning its versions of parallel or interfering pasts and futures with humans crossing them as copies.

"Inquietudes" is the appropriate subtitle of a chapter in "La cosmologie comme « manière de faire un monde ». Physique, relativisme et Irealisme," contributed by Aurélien Barrau to *Forme et Origine de l'Univers*, a book he edited together with D. Parrochia in 2010. Here is a passage from his radical criticism of the relativistic attitude taken to the verge of ethical and conceptual chaos:

> Quels rapports cette cosmo-mytho-logie, qui n'est qu'un condensa – ou un précipité – des ramifications multiples de la physique contemporaine, entretient-elle encore avec la vérité ? Non pas avec les vérités détournées et retournées, la fidélité à l'événement de Badiou ou le rapport à l'infini de Hirt par exemple, mais avec la vérité en tant que telle. Se pourrait-il qu'elle invite, avec une acuité sans précédent, à renoncer au concept même de vérité globalisante et totalisante? Contribuerait-elle à porter un coup de grâce à la vision « correspondantiste » qui, depuis Socrates et malgré les objections insistantes de ces derniers siècles (de Vico à Dewey en passant par Hegel, Marx, James ou Tarski), constitue toujours l'acception orthodoxe et rassurante du « vrai » L'époque ne se prête guère à ces

positions supposées dangereuses et presque unanimement décriées. A en juger par la violence avec laquelle toute velléité au relativisme (au sens le plus large, qui couvre le constructivisme, le perspectivisme, etc.) est balayée – non seulement dans le champ épistémique mais aussi dans les champs éthique et esthétique –, il faut à l'évidence conclure que quelque chose de grave se passe ici. Moins une colère qu'une angoisse: le relativisme fait peur à la manière de ce à quoi on ne souhaite pas faire face. Pas d'affrontement, juste un mépris. Un revers de la main, un haussement d'épaule, une sage distance à instaurer entre ceux qui savent et le magma confus et subversif des « relativistes ».

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CHAPTER II

IDENTITY BETWEEN ESSENTIALISM AND CONSTRUCTIVISM

II.1. Physics and identity

There are no two identical things, Leibniz says, grounding his belief in the consistency and wisdom of the Creator:

> Nature does not contain any pair of real things that are indiscernible from one other; because if it did, God and nature would be acting without reason in treating one differently from the other; so God doesn't ever produce two pieces of matter that are perfectly equal and alike. (Leibniz 1716, 31)

In the classical world, there are indeed differences among objects of the same kind, such as, for instance, a set of chairs. We say that these objects, which differ from one another, are "discernible."

By contrast, the objects of quantum mechanics (elementary particles) are considered identical if they belong to the same type, such as electrons, neutrons, etc. Being identical, they cannot be distinguished among themselves. We say, with a term borrowed from Leibniz, that they are indiscernible. The problem of identity in quantum mechanics is a complex one, since the behaviours of quantum particles differ from those observed in the classical world, and these can no longer be ignored, as Werner Heisenberg remarks:

> Many of the abstractions that are characteristic of modern theoretical physics are to be found discussed in the philosophy of the past centuries. At that time, these abstractions could be disregarded as mere mental exercises by those scientists whose only concern was with reality, but today we are compelled by the refinements of experimental art to consider them seriously. (Heisenberg: 65)

This is an excerpt from a lecture given by Heisenberg at Chicago University shortly after the beginning of experimentation in quantum

mechanics, in which he explored the concepts of identity, individuality, and discernibility.

Absolute identity is a relationship established between a thing and itself. X is the same as Y (are the same), if and only if whatever is predicated upon X is also true about Y. The Principle of the Identity of Indiscernibles goes back to Leibniz (Leibniz 1716):

> 31. Our reasonings are grounded upon two great principles, that of contradiction, in virtue of which we judge false that which involves a contradiction, and true that which is opposed or contradictory to the false; (Theod. 44, 169.)
>
> 32. And that of sufficient reason, in virtue of which we hold that there can be no fact real or existing, no statement true, unless there be a sufficient reason, why it should be so and not otherwise, although these reasons usually cannot be known by us (Theod. 44, 196).
>
> 33. There are also two kinds of truths, those of reasoning, and those of fact. Truths of reasoning are necessary and their opposite is impossible: truths of fact are contingent and their opposite is possible. When a truth is necessary, its reason can be found by analysis, resolving it into more simple ideas and truths, until we come to those which are primary (Theod. 170, 174, 189, 280-282, 367. Abrege, Object. 3).

When we say that particle A and particle B are identical, what we mean is that there is just one particle with two different names. An object can have one or more features, but each of them is a part of its identity. The identity of an object (entity) is only one and there is no such thing as an entity without identity. Closer to the present day, W. V. Quine maintains both the ontologically grounded and the relative definitions of identity:

> We cannot know what something is without knowing how it is marked off from other things. Identity is thus a piece with ontology. (Quine: 55)

The individuality of an object, on the other hand, is defined by a number of characteristic properties. To put it differently, we can attach a set of properties to any object, through which it acquires individuality. The individualities of two objects are defined by the differences that exist between the two sets of properties. Even two seemingly identical things, such as two coins which have the same value, size and weight differ from each other at least on account of their distinct positions in space (it goes without saying that objects are considered impenetrable). It follows that the two individualized objects are discernible. Macroscopic things, therefore, are individualized and discernible.

Could we say the same thing about a number of electrons? Quantum literature will answer invariably that, since electrons (elementary particles in general), as quantum objects, cannot be identified, they behave as identical particles when they partake of an assemblage. (Castellani & Mittelstaedt 1587-1594).

The particles' lack of identity and, hence, their indiscernibility, was ascertained almost simultaneously with the birth of quantum mechanics. Erwin Schrödinger, one of its founders, went so far as to say that the elementary particles that lie at the basis of the physical world are indiscernible.

> Even if you observe a similar particle a very short time later at a spot very near to the first, and even if you have every reason to assume a causal *connection* between the first and the second observation, there is no true, unambiguous meaning in the assertion that it is the same particle you have observed in the two cases. The circumstances may be such that they render it highly convenient and desirable to express oneself so, but it is only an abbreviation of speech; for there are other cases where the 'sameness' becomes entirely meaningless; and there is no sharp boundary, no clear-cut distinction between (the two types of circumstances), there is a gradual transition over intermediate cases … I beg to emphasize this and I beg to believe it: It is not a question of our being able to ascertain the identity in some instances and not being able to do so in others. It is beyond doubt that the question of 'sameness', of identity, really and truly has no meaning. (Schrödinger 1951, 17, 18).

The emergence of quantum mechanics has raised new problems around the concepts of identity, individuality and indiscernibility. In fact, the question was whether Leibniz's principle of the identity of indiscernibles applies to the quantum world as well.

In order to find out in what way quantum particles behave, let us imagine two particles and analyze the possibilities of locating them in two boxes (or in two states). First of all, it must be said that elementary particles are indistinguishable no matter how they are considered, i.e. classic or quantal, in the sense that they possess the same intrinsic properties, such as electric charge, mass rest, etc. In classical physics, the particles can form four configurations (Fig. 2): (1), (2) and (3).

Configuration (3) will split into two variants: one particle to the left, and the other to the right, and then they change places. This distribution actually conforms to the well-known Bose-Einstein statistics.

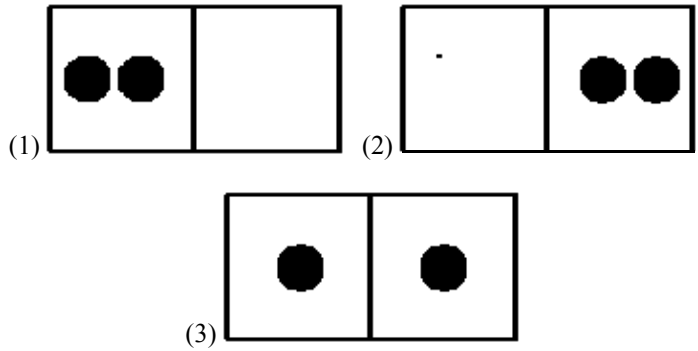

Fig. 2

According to quantum formalism, an ensemble of quantum particles has the property that the permutation of two particles leaves it unchanged. In other words, if at some moment the state of the ensemble is F, and, in this state, we exchange particles 5 and 14 among themselves, we get a state G which does not differ from F, in the sense that no measurement will identify some difference between F and G. We say that the system is permutation- invariant. Invariance under permutation is a property of quantum particles.

Things occur differently in classical physics. Any permutation will yield a different ensemble, so that, although particles are indistinguishable, they can be considered individualistic by virtue of some properties beyond the intrinsic ones. The fact that the permutation of quantum particles does not bring about changes in the state of the system leads us to the conclusion that these particles have no individuality and are non-individuals. H. Weyl found an intuitive and expressive way of describing this property:

> … the possibility that one of the identical twins Mike and Ike is in the quantum state E1 and the other in the quantum state E2 does not include two differentiable cases which are permuted on permuting Mike and Ike; it is impossible for either of these individuals to retain his identity so that one of them will always be able to say 'I'm Mike' and the other 'I'm Ike.' Even in principle one cannot demand an alibi of an electron! (Weyl: 241)

Bosons have the property that, in an ensemble, many of them may be in the same state. Bose-Einstein statistics does not prohibit that. That explains why two particles can occupy the same box (state), as shown in the Figure 3.

The fermions of an ensemble, however, are only distributed one per box. Fermi-Dirac statistics does not allow of two fermions in the same state. That is why their configuration is (3).

Apart from intrinsic properties (rest mass, charge etc.), classic and quantum particles are also possessed of state-dependent properties. Which properties are taken into account for the assessment of their indiscernibility?

The principle of the identity of indiscernibles takes three forms: (Krause & Coelho: 2).

a) The weakest form, P (1), which states that it is impossible for two individuals to share all properties and relations.
b) The stronger form, P (2) leaves out spatiotemporal properties.
c) The strongest form, P (3), only takes into account only monadic, non-relational properties.

One can notice that P (1) is not violated by classical particles, as classical statistical mechanics assumes such particles to be impenetrable, in the sense that their spatiotemporal trajectories do not overlap completely. We may conclude that they can be individualized by these properties.

Within the confines of classical physics, P (2) and P (3) get pretty mixed up. It is known that the particles of the same kind are regarded as indiscernible, i.e. they possesses all their intrinsic properties in common, and these are non-spatiotemporal. It is possible, therefore, for two individuals to share all their properties.

In quantum mechanics, things are different. If we believe that quantum particles are characterized by both intrinsic properties, and state-dependent properties, then even the weakest form of the principle, P (1), is violated. It cannot be used therefore to guarantee the individuality of a quantum particle falling back on state-dependent properties, as in the classic case.

John Stachel suggests an interesting analysis of the electrons present in a stable structure, such as the atom. Each electron is here characterized by a set of four quantum numbers, which is as much to say as that these particles will acquire some measure of individuality derived from their position inside a structure (atom). Identity, as *haecceity*, is not to be separated from its *quiddity*. Stachel defines as follows his notion of "structural realism," i.e. of a universe which is thoroughly structured:

> Before turning to some of the problems raised by the role of individuality in various physical structures, it seems proper to say what I

> mean by "structural realism." As discussed in Stachel 2002b, this term has been given various interpretations. For short (and with no claim of historical accuracy), I group these interpretations under three headings: Pythagorean, Platonic and Aristotelian. For the Pythagorean, mathematical structures are the only reality. For the Platonist, structures impose themselves on inherently (formless) matter. For the Aristotelian, matter is inherently structured.
>
> I would describe myself as a "genetic Aristotelian." That is, I take processes rather than things as fundamental. But these processes have a material basis. At any stage of its development, matter is inherently structured in many complex ways. This is the synchronic aspect of structure. But there is also a diachronic aspect. Any given structures are the result of preceding processes of structuration: they have a history of their formation, a limited duration, and their dissolution results in the formation of other structures. (Stachel: 207-208)

John Stachel's concept of identity is, therefore, no longer context-invariant. We have come to a relativistic position in the argument which makes every entity part of a "stupendous whole," whose birth is in the indistinguishable units—field quanta—of the quantum fields.

II. 2. Relative identity

Absolute identity means everything or nothing. One can speak of the identity of two objects only when the sets of their properties overlap; in fact, when the two objects are one and the same. There are, however, situations where one needs to describe objects which are partly identical, partially distinct, or relatively identical.

On the other hand, some philosophers criticize the notion of "absolute identity," because an elegant logical definition cannot be provided for it. Identity, therefore, is only relative, defined as follows: it is possible for two objects, A and B, to have the same P property, but not to share the G property as well. In the example, "X is the same chair as Y, but X is not the same material as Y," the two objects X and Y are the same in relation to a particular property (chair) but not with respect to the material they are made of as well. Such distinctions necessitate the operation of a sortal concept for the identification of an equivalence class.

Being more resilient, the notion of relative identity can offer simple solutions where absolute identity fails. It becomes apparent that, in the framework of this type of identity, one can only make relative statements. **An object ceases to be a single, precise and absolute identity**, defined on the basis of context-invariant properties. Instead of being tautologies of the selves, objects allow the observer to associate them on the basis of a

limited number of common contextual features. An intelligible pattern replaces thus an atomistic, starburst picture.

We may even conceive of an object's identity as a set of relative identities belonging to a vector space, such as the Hilbert space used in quantum mechanics. In other words, the identity of the object is the totality of possible states generated by its relative identities. The disclosure of some particular identity in an object when set in relation to a context may be regarded as a process of de-coherence, when, of all possible states, only one pointer state will be realized at that moment.

To have a representation of the realization of relative identity states in a given space, we can imagine our three-dimensional space filled with identical cubes stacked next to one other in the three directions. Each cube contains a possible state of an object's identity. Together, these independently existing states define, through superposition, the identity of the object.

II. 3. Suspended identity: the self multiplied as me-copies across the multiverse

The Garden of Forking Paths by Jorge Luis Borges may be seen as the proleptic scenario of an endlessly forking universe, hatched in the mental laboratory of an artistic genius, but achieving the status of scientific hypothesis after the war:

> All these, however, are just metaphorical examples meant to color the grayness of technical explanations. A notable exception is "The Garden of the Forking Paths," where Borges proposes, unknowingly (there is no way he could have known), a solution to a still unsolved problem in quantum mechanics. "The Garden . . ." published in 1941, anticipates literally Hugh Everett III's doctoral thesis, published in 1957 under the title "Relative State Formulation of Quantum Mechanics" [Everett: 454] and that Bryce DeWitt later popularized as the Many Worlds Interpretation of Quantum Mechanics. (Rojo: 70)

At the close of the twentieth century, Everett's theory was boosted by mathematician Max Tegmark, according to whom any mathematical structure can create a universe.

The Fabric of Reality (the title of a book published by David Deutsch in 1997) is even more complex than that, with the author describing a multiverse which, unlike Everett's, forks both in space and towards

innumerable futures. The alternatives at some decision point will grow, as if out of a severed sapling, into corresponding (consistent) pasts and futures.

Borges did indeed think of his fictional space as an unusual one, as his own invention in the "republic of letters," whose originality consisted in its forking out in time instead of space. There is, therefore, the possibility of the past or the future to be altered according to the protagonist's choices of alternatives.

A Chinese astrologist, Ts'ui Pên, gives up his official position as governor in order to write a book and build a very uncommon labyrinth.

Ts'ui Pên's book is a superposition of states, being itself and also the world which is written into being: a temporal labyrinth forking to infinity. Its chaotic nature comes from the amount of uncertainty in a universe which is a mix of determinism and randomness. People are free to choose, but, irrespective of their choice, both alternatives are realized in parallel words. Modal logic, which demands that one world exist to the exclusion of all others, does not apply here. In Borges' story, as in Everett's relative-states theory, one does not opt for one possibility but for all at once. Each alternative will extend into its own future and past.

English Sinologist Stephen Albert explains to Yu Tsun the maze structure designed by his ancestor, Ts'ui Pên, which he has managed to decipher:

> In all fictions, each time a man meets diverse alternatives, he chooses one and eliminates the others; in the work of the virtually inextricable Ts'ui Pên, the character chooses—simultaneously—all of them. He creates, thereby, 'several futures', several times, which themselves proliferate and fork. (Borges: 125)

A character wills a multiverse for the first time in literature: "I leave to several futures (not to all) my garden of forking paths." The limitation on the number of futures (several but not all), would suggest some laws of supervenience, and some constraints on the probability calculus which apparently concerns collocation:

> That fabric of times that approach one another, fork, are snipped off, or are simply unknown for centuries, contains all possibilities. In most of those times we do not exist; in some, you exist but I do not; in others I do and you do not; in others still, we both do. In this one, which the favouring hand of chance has dealt me, you have come to my home; in another, when you come through my garden, you find me dead; in another, I say these same words, but I am an error, a ghost. (Borges: 127)