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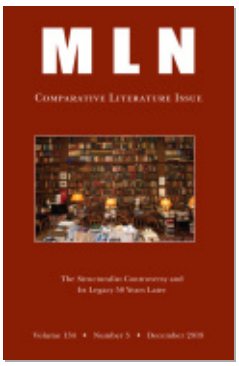

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Introduction

Jacques Derrida's "Structure, Sign, and Play in the Discourse of the Human Sciences" offered a radical rethinking of structuralism and of structure itself. According to Derrida:

> Structure—or rather the structurality of structure—although it has always been at work, has always been neutralized or reduced, by a process of giving it a center or of referring to a point of presence, a fixed origin. The function of this center is not only to orient, balance, and organize the structure—one cannot in fact conceive of an unorganized structure—but above all to make sure that the organizing principle of the structure would limit what we might call the *play* of the structure. By orienting and organizing the coherence of the system, the center of the structure permits the play of its elements inside the total form. And even today the notion of a structure lacking any center represents the unthinkable [*l'impensable*] itself. (Derrida, *Writing and Difference* 278–79)

Both the French "*impensable*" and the English "unthinkable" may refer to something only previously unthinkable, also as something terrifying or monstrous, invoked in Derrida in closing (Derrida *Writing and Difference* 293). It is also possible, however, to give it, as I shall do here (even if Derrida does not), its direct sense of something that is beyond thought altogether, rather than only being something as yet

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unthought and possibly to be thought one day. Derrida locates two interpretations of the play of structure. The first interpretation, as exemplified by that of Claude Lévi-Strauss, is defined by experiencing this absence nostalgically, as a loss. The second is a "Nietzschean *affirmation* . . . of the play of the world and of the innocence of becoming, the affirmation of the world of signs without fault, without truth, and without origin, which is offered to an active interpretation . . . and [which] *determined the noncenter otherwise than as loss of center*" (*Writing and Difference* 292). Rather than adopting the second, more radical interpretation, Derrida, while acknowledging the (irreducible) *difference between* them, argues for the necessity of considering the *différance* of these two interpretations—their common ground and efficacy.

I shall be primarily concerned here with this problematic in the discourse of mathematics and the natural sciences or that concerning them, as in the history or philosophy of science. The subject, not considered in Derrida's essay, was brought up by Jean Hyppolite in their exchange following Derrida's presentation at the "Structuralist Controversy" conference at Johns Hopkins in 1966. Hyppolite's comments show a sophisticated understanding of mathematics and science. This is not surprising given Hyppolite's background and his directorship of Ecolé Normale Supérieure and his presidency of Collége de France, which brought him in close contact with leading mathematicians and scientists, including those working in relativity, such as Elié Cartan and André Lichnerowitz, and genetics, such as Jacques Monod and François Jacob. I shall argue that twentieth-century mathematics and natural science not only brought into center stage the concept of structure but also, with quantum mechanics, confronted the play of a structure in Derrida's sense. While the concept of structure in twentieth-century mathematics and science and its influence on structuralism in the human sciences have been addressed, the role of quantum mechanics in bringing into *play* the play of structure has not been. Considering the latter is one of the main contributions of this essay.

The circumstances of the exchange merit a brief commentary in view of the attention and mistreatments it had received during the Science Wars in the late 1990s.[1] Replete as they were with misconceptions, absurdities, and abuses when it came to poststructuralist ("French") thought, the Science Wars had legitimate arguments mostly found, however, in those debates that concerned the history, philosophy, and sociology of science. These debates, conducted in such peer-reviewed

[1]See, for example, Plotnisky *The Knowable and the Unknowable* 157–166.

journals as *Nature* and *Science*, also involved scientists that held much more responsible views than the likes of Alan Sokal and Jean Bricmont, or Paul Gross and Norman Levitt, who had the most notoriety at the time. Here, by contrast, I explore the relationships between poststructuralist theory and the natural sciences, following Hyppolite's view: "I think we have a great deal to learn as we study the sciences of man; we have much to learn from the natural sciences. They are like an image of the problems which we, in turn, put to ourselves" (Macksey and Donato 266).

The Einsteinian Constant and the Structure of Relativity

Hyppolite first asked: "When I take, for example, the structure of certain algebraic [sets] [*ensembles*], where is the center? Is the center the knowledge of general rules which, after a fashion, allows us to understand the interplay of the elements? Or is the center certain elements which enjoy a particular privilege with[in] the [set]?" (Macksey and Donato 265–266). The second concept is the mathematical concept of the center of an algebraic structure. At stake in Derrida is clearly the first concept, given his definition and the impossibility of conceiving of a structure without a center. This only applies to the first sense of the center, because there are algebraic structures without a center in the second sense. Then Hyppolite asked the question that became so prominent in and even triggered the Science Wars:

> With Einstein, for example, we see the end of a kind of privilege of empiric[al] evidence. And in this connection we see a constant appear, a constant which is a combination of space-time [space and time?], which does not belong to any of the experimenters who live in experience, but which, in a way, dominates the whole construct; and this notion of the constant—is it the center? (Macksey and Donato 266)

As discussed below, according to Hyppolite, the natural sciences, genetics in particular, move beyond such a "constant" and, as a result, perhaps toward the play of a structure. Hyppolite's first sentence, "With Einstein, for example, we see the end of a kind of privilege of empiric evidence," is important, and was, regrettably, underappreciated by the present author in his previous commentaries on the exchange.[2] The point it subtle. First, empirical (experimental) evidence does not disappear: there could be no physics without it. But in relativity, it is no longer privileged in the way it was in classical physics, where

[2]See, for example, Plotnitsky, *The Knowable and the Unknowable* 157–166.

the mathematics used strictly represented what was observed. For the moment, I restrict myself, as did Hyppolite, to the so-called *special relativity*, which disregards gravity, treated by Einstein's *general relativity*, which, as will be seen, brings additional complexities into this situation. The mathematics of relativity is governed by a mathematical construct, the four-dimensional concept of spacetime, introduced by Hermann Minkowski, as the center of the mathematical structure of relativity. Spacetime as such cannot be empirically observed and, it may be argued, does not physically exist. It may, in my view, be plausibly surmised that the "constant" invoked by Hyppolite refers to this *mathematical concept*, rather than any numerical entity, with which the term "constant" is commonly associated in physics. While this use of the term may be unconventional, it is not out of place, and has been read by Derrida along these lines, although what Derrida called "the Einsteinian constant" (the phrase not used by Hyppolite) was interpreted by him as the *play* of the physical structure of relativity, rather than, as by Hyppolite, as the *center* of its mathematical structure.

Spacetime is a single four-dimensional mathematical entity, which disallows one to treat space and time, as mathematical entities, as distinct within it, because they can change their roles there. By contrast, empirically, space is always observed as space and time as time. The concept of spacetime, however, allows one to mathematically connect the theory to all experimental situations and all numerical experimental data of relativity, including all empirical constants, most especially c, the speed of light in a vacuum, which remains constant regardless of the motion of the source and is the constant most associated with relativity. Mathematically, then, the *structure* of special relativity is *centered* by the concept of spacetime, as a single *constant* mathematical entity, in which space and time coordinates cannot be unconditionally distinguished. By contrast, physically, any empirically observed space and time are variable, defined by, respectively, the rods and clocks in a local reference frame, and are always distinct from each other. Thus, relativity, through spacetime, which *centers* its mathematical structure, reflects the variability of the structure in the physical domain considered: there is no Newtonian absolute reference frame, which would govern the manifold of events, defined by local measuring instruments. Is this variability still centered? Yes, as Hyppolite appears to imply! Derrida, by contrast, appears to associate the constant in question with the (play of the) structure of the physical domain of relativity:

> The Einsteinian constant is not a constant, it is not a center. It is the very concept of variability—it is, finally, the concept of [play]. In other words, it is not the concept of some*thing*—of a center starting from which an observer could master the field—but the very concept of play which, after all, I was trying to elaborate.
>
> Hyppolite: It is a constant *in* the play?
>
> Derrida: It is *the* constant *of* the play.
>
> Hyppolite: It is the rule of the play.
>
> Derrida: It is a rule of the play which does not govern the play; it is the rule of the play which does not dominate the play. (Macksey and Donato 267)

Derrida's answer is too quickly improvised. Beyond disregarding the difference between the mathematical structure of relativity and the structure of the physical domain governed by it, Derrida must have been aware that the variability of a structure may still be controlled by a center. The fact that the Einsteinian constant is not the "concept of a center starting from which an observer could master the field," and thus involves a variability within the experimental field of relativity (defined by "observers" in different reference frames), does not automatically imply that this variability is decentered, or that the mathematical structure of the theory is decentered. In fact, the variability, in effect *relativity*, of reference frames, which precludes an absolute reference frame (such as that defined by Newton's absolute space and absolute time) that would control all local reference frames, *is* controlled by the centered mathematical structure of the theory, with the center defined by the mathematical concepts of spacetime. Hence, this physical variability is centered as well, as a form idealization. (All modern physics, from Galileo on, only provides idealized models of physical reality.) Derrida, however, appears to suggest, without explaining why this is so, that the Einsteinian constant, by which he, too, means a concept rather than anything numerical, connotes the decentering play of the physical structure of relativity.

It is possible that Derrida had something else in mind, for example Einstein's general relativity, his non-Newtonian theory of gravity. In this case, we do not have a single mathematical spacetime but a geometrical structure that is constant only locally, while it is variable globally, because space is curved by gravity. One might see this geometrical structure, in Deleuze and Guattari's terms, as a "machine," "Einstein's abstract machine," generating and connecting varying spacetime structures (Deleuze and Guattari 511). It is difficult to know whether Derrida had in mind something like such a machine of general relativity, rather than a structure. Still, it *would not* automati-

cally follow that physical structures governed by general relativity are decentered. Indeed, apart from exotic solutions, such as black holes, physical structures considered by general relativity are centered and governed by centered mathematical structures or machines. Only in quantum mechanics does one confront the decentered structures of physical phenomena, to which, however, quantum mechanics still relates, probabilistically, by means of centered mathematical structures.

Structuralism, Play, and Interpretation of Interpretation

As Derrida argues, it would be an error to assume that structuralism is defined merely by the assumption of the center limiting the play of structure. There is this kind of structuralism, which may be called (with caution) the Bourbaki structuralism, following the approach to the foundations of mathematics by the Bourbaki group. By contrast, as Derrida argues, Lévi-Strauss's structuralism is defined by a sense of the absence of the center of a structure, but an absence experienced as a nostalgic and even guilty sense of loss. Derrida locates subtle tensions in Lévi-Strauss's argumentation, first, between play and history, and second, between play and presence. I shall limit myself to that between play and presence. This tension is also more fundamental because it grounds that between play and history, given that history is defined as a form of presence, Derrida argues, in Lévi-Strauss and elsewhere. All forms of presence share their determination in what Derrida calls the metaphysics of presence or ontotheology, which is essentially an assumption of a containable set of principles governing the field considered and transformations within it, an assumption also grounding that of the center of structure. As Derrida argues:

> Play is a disruption of presence . . . Play is always a play of absence and presence, but if it is to be thought radically, play must be conceived of before the alternative of presence and absence. Being must be conceived as presence or absence on the basis of the possibility of play and not the other way around. If Lévi-Strauss, better than anyone else, has brought to light the play of repetition and the repetition of play, one no less perceives in his work a sort of ethic of presence, an ethic of nostalgia for origins, an ethic of archaic and natural innocence, of a purity of presence and self-presence of speech—an ethic, nostalgia and even remorse, which he often presents as the motivation of the ethnological project when he moves toward the archaic societies which are exemplary societies in his eyes. . . . Turned towards the lost or impossible presence of the absent origin, this structuralist thematic of broken immediacy is therefore the saddened,

> *negative*, nostalgic, guilty, Rousseauistic side of thinking play. (*Writing and Difference* 292)

There is, however, the other side of thinking of play:

> [This other side] would be the Nietzschean *affirmation*, that is, the joyous affirmation of the play of the world and of the innocence of becoming, the affirmation of the world of signs without fault, without truth, and without origin, which is offered to an active interpretation. *This affirmation then determined the noncenter otherwise than as loss of center.* And it plays without security. For there is a *sure* play, that which is limited to the *substitution* of *given* and *existing*, *present*, pieces. In absolute chance, affirmation also surrenders itself to *genetic* indetermination, in the *seminal* adventure of the trace. (*Writing and Difference* 292)

It would perhaps be more accurate to say that chance is irreducible within this play, in accordance with Derrida's concept of play, announcing, "the [interplay] of chance and necessity in calculations without end" (*Margins of Philosophy* 7). "One could call *play*," Derrida says elsewhere, "the absence of the transcendental signified as limitlessness of play, that is to say as the destruction of ontotheology and the metaphysics of presence. . . . This *play* . . . in not a play *in the world*, as it has always been defined, for the purposes of *containing* it, by the philosophical tradition and . . . the theoreticians of play . . . It is *the play of the world* that must be first thought before attempting to understand all the forms of play in the world" (*Of Grammatology* 51). Derrida concludes:

> There are thus two interpretations of interpretation, of structure, of sign, of play. The one seeks to decipher, dreams of deciphering a truth or an origin which escapes play and the order of the sign, and which lives the necessity of interpretation as an exile. The other, which is no longer turned toward the origin, affirms play and tries to pass beyond man and humanism, the name of man being the name of being who, throughout the history of metaphysics and of ontotheology . . . has dreamed of full presence, the measuring foundation, the origin and the end of play. The second interpretation of interpretation, to which Nietzsche points the way, does not seek in ethnography, as Lévi-Strauss does, the "inspiration of a new humanism."
>
> There are more than enough indications today to suggest we might perceive that these two interpretations of interpretation—which are absolutely irreconcilable even if we live them simultaneously and reconcile them in an obscure economy—together share the field which we call, in such a problematic fashion—the social science. (*Writing and Difference* 292–93)

The first interpretation, Lévi-Strauss teaches us (against his own grain), is thus only a dream. But then so is the second one. "For my part," Derrida says, "although these two interpretations must acknowledge and accentuate their difference and define their irreducibility, I do not believe that today there is any question of *choosing*—in the first place because here we are in a region (let us say, provisionally, a region of historicity) where the category of choice seems particularly trivial; and in the second, because we must try to conceive of the common ground, and the *différance* of this irreducible difference" (*Writing and Difference* 293). At stake is the common efficacity of each interpretation and their varying relationships, which are irreducibly plural, subject to what Derrida calls *dissemination*, correlative to *différance*.

How are we, then, to think this *différance*, which is to say, to think the unnamable or even the unthinkable or, if this unthinkable is rigorously beyond thought, unthinkable even as unthinkable? Derrida settles for the unnamable:

> Here there is a kind of question, let us still call it historical, whose *conception*, *formation*, *gestation*, and *labor* we are only catching a glimpse of today. I employ these words, I admit, with a glance toward the operations of childbearing—but also with a glance toward those who, in a society from which I do not exclude myself, turn their eyes away when faced by the yet unnamable which is proclaiming itself and which can do so, as is necessary whenever a birth is in the offing, only under the species of the nonspecies, in the formless, mute, infant, and terrifying form of monstrosity. (*Writing and Difference* 293)

A year later, in "*Différance*," the "as yet unnamable" becomes that for which there can be no name, not even the name Being, not even the name *différance*, "which is not a pure nominal unity, and unceasingly dislocates itself in a chain of differing and deferring substitutions" (*Margins of Philosophy* 26). Perhaps, however, at stake is not only the unnamable but also the unthinkable, invoked, as noted, by Derrida in referring to "a structure lacking any center" as representing "the unthinkable itself." One could give this unthinkable a "name" insofar as no conception could be associated to it, and if the unthinkable is a name, it implies that what it names is unthinkable even as unthinkable. But is it a name, then? Derrida speaks of *différance* as "neither a word nor a concept" (*Margins of Philosophy* 3). Is Derrida's unnamable also unthinkable? It may or may not be, but as his thought and the thought of modern science tell us, the thought of this unthinkable, the thought of that which is beyond thought, is possible.

Structural Nonrealism and Improbable Happenings

A preference for the form that the metaphysics of presence defined by realism (the possibility of representing physical objects and behavior) and causality (defined by the fact that the state of an object at a given moment in time determines its states at all moments in time), found in classical physics and relativity, still represents a majority view among scientists and philosophers of science. This preference is sometimes accompanied by a sense of loss in confronting quantum physics, which makes realism and causality difficult to assume. Given, however, that this preference is commonly accompanied by the belief that a return to realism and causality is possible in all fundamental physics, it is difficult to speak of a nostalgia of the type Derrida finds in Lévi-Strauss, in which case this type of recovery is no longer deemed possible. This view is exemplified by Einstein's discontent with quantum mechanics, according to which chance and probability are irreducible, and God or nature, contrary to Einstein's famed contention, may play dice, or a more complex game, because, rather than being random, quantum phenomena exhibit an interplay of randomness and order. Probability, I might note, is not the same as randomness or chance, as it brings a degree of order into our dealing with randomness.

One can present this complexity in terms of structure (Plotnitsky, "Structure without Law"). To do so, however, one needs to extend the usual meaning of this term, as a strictly organized collection of elements and the relationships among them, by allowing such collections to be sometimes organized and sometimes random, with elements represented as effects of the interactions between quantum objects and measuring instruments. These effects are manifested, as *phenomena*, in these instruments, in juxtaposition, on Kantian lines, to quantum *objects*, which are never observed and are beyond representation or even conception. These effects are, however, only organized in the sense of being statistically correlated in a way not found in classical physics or relativity. Moreover, they are so correlated only in certain specified experimental circumstances and are random in certain other specified experimental circumstances. Finally, even quantum correlations still involve randomness, because they only pertain to certain collectivities of effects, while each individual effect involved corresponds to an independent random event. Indeed, arguably the greatest of many mysteries of quantum phenomena is that, under certain circumstances, individually random events conspire to produce statistically ordered collective multiplicities. It follows that each observable structure of quantum phenomena is lacking a center, because

there is no available or even conceivable law that governs how these structures come about. There is no ontological order behind this combination of order and chance. Such an order would make chance and the recourse to probability merely a practical, epistemological matter arising due to the mechanical complexity of the systems considered, as in classical statistical physics or chaos theory. In quantum physics even predictions concerning the behavior of the simplest individual objects, elementary particles, are, when possible at all, probabilistic.

On the other hand, the *mathematical* structure of quantum theory is centered, just as is that of classical physics or relativity, although that of quantum mechanics is more complex. Its center is an infinite-dimensional object, known as Hilbert space. However, unlike classical physics or relativity—where, as explained, both structures, that of the theory and that of the physical domain it considers, are centered—the *centered* mathematical structure of quantum mechanics relates, by means of probabilistic predictions, to the *decentered* structures of quantum phenomena. Furthermore, through these decentered structures, the mathematical structure of quantum mechanics relates to something in nature, quantum objects beginning with elementary particles, that is beyond representation or even thought, and thus cannot be assigned any structure. One might speak in this case of structural nonrealism or, depending on emphasis, nonrealist structuralism (Plotnitsky "Structure without Law"). There is a further twist. The (centered) structure of the formalism is not sufficient for making predictions concerning the (decentered) structures of quantum phenomena. These predictions require additional rules, such as the Born rule, that are not derived from the formalism and its centered structure, but instead reflect the play of the structure of quantum phenomena and the inconceivable nature of quantum objects.

On the other hand, how quantum theory emerged or how our thought (with the help of nature) constructs quantum phenomena may require understanding, by means of the human sciences, that, "in the region of historicity," defined by the *différance* between "two interpretations of interpretation, of structure, of sign, of play." Is it possible to have a scientific model for this emergence? Hyppolite appears to suggest such a possibility via genetics and information theory, also linking this view the (decentered?) interplay of "genesis and structure," in his famous title terms (Hyppolite, *Genesis*). What he says, however, has affinities with quantum mechanics, given the role of chance and "improbably happening[s]" in this genesis:

> But natural science has gone much further. It no longer searches for the constant. It considers that there are events, sometimes improbable, which bring about for a while a structure and an invariability. It is that everything happens as though certain mutations, which don't come from any author or any hand, and which are, like the poor reading of a manuscript, realized as a defect of structure, simply exists as mutations? . . . It is a question of a structure which in the nature of a genotype produced by chance from an improbable happening, of a meeting which involved a series of chemical molecules and which organized them in a certain way, creating a genotype which will be realized, and whose origin is lost in a mutation? Is that what you [Derrida] are tending toward? . . . And you know that the language we are speaking today, *a propos* of language, is spoken about genotypes, and about information theory. (Macksey and Donato 266)

Hyppolite refers to the then-recent work bringing together genetics and information theory, specifically the work of Jacques Monod, François Jacob, and André Lwoff, who were awarded a Nobel Prize in 1965, when Jacob was also appointed a professor at Collége de France, where Hyppolite was the president. It would be difficult to argue that any *theory* in these fields was then, or has been since, defined by a decentered play of its structure. It is conceivable that a theory of cellular information processing in embryonic development or in the neural workings of the brain will be analogous to quantum mechanics insofar as the *phenomena* considered would exhibit such a play. As in quantum mechanics, however, this handling is likely to be done by means of mathematically centered structures. On the other hand, the *functioning* of these structures may depend on assumptions and concepts exterior to them, such as Born's rule in quantum mechanics or "the convention of simultaneity" in relativity, which I shall discuss in closing.

Conclusion: Conventionality and *penser à côté*, with Poincaré

Even if one restricts oneself to the experimental-mathematical structure of relativity and leaves aside psychological and social forces that shaped it, the situation defining it is complex. First, the structure of the theory and its center depend on experimental determination of space and time by means of rods and clocks. Space and time are *local effects of* rods and clocks rather than, as in Newton's scheme, something (ultimately absolute space and time) *measured by* rods and clocks. This fundamental reversal, however, depends on the definition, or as Hans Reichenbach was first to argue, *convention*, of simultaneity. Even prior to the discovery of relativity, questions had been raised, specifically by

Henri Poincaré (an important figure in the history of special relativity), as to whether simultaneity was absolute: that is, whether there is a unique event at location A that is simultaneous with a given event at location B. In introducing relativity in 1905, Einstein asserted that it was necessary to make this assumption in order to be able to compare the times of occurrence of events in spatially separated locations. This assumption defines what is known as "standard synchrony." As Reichenbach and others argued, however, the choice of standard synchrony may be a convention, rather than an empirical fact.[3] While this claim has been debated, the possibility that it may be valid is sufficient for my purposes, especially given that it has not been definitely refuted.

A broader question here is that of a possibly irreducible role of *conventions* in determining the structure of a scientific theory. This role was brought into sharp focus by Poincaré in considering whether the geometry of physical space is Euclidean or non-Euclidean. Poincaré argued that deciding on one or the other was a convention. This question has never been settled either. But even as a possibility, this case, too, suggests that conventionality may be irreducible in defining the structure of a scientific theory from outside it. Poincaré does appear in the 1966 conference, in the paper by Charles Morazé and the discussion that follows it, in responding to a question asked, again, by Hyppolite:

> The path of invention goes toward the "overture" of the field of problems and not toward the solutions. And it is an extraordinary opening which is, in retrospect, understandable, which is as profound in the mathematical domains as in the domain of the invention of literary structures; because the novel of Marcel Proust is entirely different from the novel of Balzac, and the 'new novel' is something else again. There are, therefore, openings in history which are openings of a domain or of a problem, . . . the invention of a problem. (Macksey and Donato 35)

In response, Morazé cited Poincaré: "That's what Poincaré, I think, said: 'The important thing, if you want to find the correct idea is to begin by thinking off-center [*penser à côté*]'" (Macksey and Donato 35). I would not be surprised if Poincaré, much of whose work was on planetary motion, was thinking of Kepler, thinking literally off-center in his discovery that the planets' orbits were elliptical, off-center, rather than circular. I would like to give this statement a more Derridean meaning: "thinking off-center [*penser à côté*]" also means to enter the play of structure from which a new structure would emerge, which is

[3]See, for example, Janis, "Conventionality of Simultaneity."

also Derrida's understanding of "the margins of philosophy" (Derrida, *Margins of Philosophy*). This emergence always entails a new convention or set of conventions, which requires unconventional thinking, *penser à côté*. Thus, the Copernican system was a new convention created by such thinking.

No theory is fully determined by conventions. Kepler's theory is not a convention, and it was proven to be more crucial than whether the Sun or the Earth is the center of the Solar system. In retrospect, especially in view of Einstein's general relativity, this decision is a matter of convention, although a heliocentric view simplifies calculations. Regardless of which convention one adopts, Kepler's theory or, more generally, Newton's theory of gravity will have to be maintained. Nor is Einstein's relativity reducible to conventions. But neither can any theory avoid conventions; and conventions or theories themselves are never determined by empirical facts (if such a thing as an empirical fact, existing apart from a theory, is possible) or by science alone. They are determined by the *historicity* of science, which exceeds science or any containable demarcation. This is a good thing because this excess helps us to think off-center, *penser à côté*.

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