Reflections on the book about time

« Le facteur temps ne sonne jamais deux fois, Etienne Klein, Flammarion, 2009 »

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References for versions in English and in French:

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By the same author:

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- Jean-Daniel Dessimoz, « Cognition and Cognitics – Definitions and Metrics for Cognitive Sciences, in Humans, and for Thinking Machines, 2nd edition, augmented, with considerations of life, through the prism "real – imaginary – values – collective", and some bubbles of wisdom for our time », Roboptics Editions llc, Cheseaux-Noreaz, Switzerland, 345 pp, March 2020. Electronic version: ISBN 978-2-9700629-4-3, Printed version: ISBN 978-2-9700629-3-6 , https://www.roboptics.ch/editions-english/ .

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Reflections on the book about time

« Le facteur temps ne sonne jamais deux fois* »,
by Etienne Klein, Champs Sciences, Flammarion, Paris, France, 2009.

Reflections on the book about time

*"The time factor never rings twice" (in French, the word "facteur" has not only the meaning of "factor" but also that of "postman")

Abbreviations

For convenience, we will use the following abbreviations:

EK: Etienne Klein.

FT : EK's book. Le facteur temps ne sonne jamais deux fois (Etienne Klein, Éditions Flammarion)

AIR : www.cognition.roboptics.ch . « Cognition and Cognitics - Cognition, natural and machine-based » website, incl. references to CC2.

CC2 : Jean-Daniel Dessimoz, « Cognition and Cognitics – Definitions and Metrics for Cognitive Sciences, in Humans, and for Thinking Machines, 2nd edition, augmented, with considerations of life, through the prism "real – imaginary – values – collective", and some bubbles of wisdom for our time », Roboptics Editions llc, Cheseaux-Noreaz, Switzerland, 345 pp, March 2020. Electronic version: ISBN 978-2-9700629-4-3, Printed version: ISBN 978-2-9700629-3-6 , https://www.roboptics.ch/editions-english/ .

MCS : MCS (Model for Cognitive Sciences) Cognition Theory (re. notably Appendix A, AIR, or CC2)

Preambule

N1: A few lines about the book.

The book FT[1] by Etienne Klein (EK) is interesting because of the synthesis he proposes of multiple opinions of scientists, philosophers or artists, all related to time. In addition to the choice of sources, and the related bibliographical references, he adopts a unifying point of view without really wanting to take sides, it seems.

N2: References to my own view of time

I propose to comment on the elements of EK's book in several ways. Sometimes I express my disagreement; other times I agree, whether it has already inspired me in the past, or on the contrary that I discover it in the book and that it confirms or reinforces my convictions; and finally, sometimes my comments aim at enriching the reflection on contextual points.
And as a preliminary, I think it is useful to express my own opinion on time, and in a more fundamental way, on any modeling (definition, conceptualization). Here are three ways to access it: a web site (AIR), a book (CC2), or the few paragraphs in appendix A.

N3: Organization of the document

In the main section, I propose to organize the reflections that EK's book inspires in the order of pagination of his FT book. Nevertheless, I do so after having read this book in its entirety, and my reflections follow a logic that should now be optimal for a future reading of these reflections. There is also elsewhere an appendix B which gives an account of the "raw" notes taken during the first reading, as well as multiple extracts from the book, taken temporarily to facilitate the work. Appendix C concludes this book with a detailed table of contents.

Reflections

The reflections follow each other in an order similar to the themes treated by the book. They are numbered, and the title includes in brackets the pagination and sometimes the chapter number of the corresponding theme in the FT book.

R1 (P7-19) – Nature of time

Etienne Klein presents time essentially as an element of the *real*, in his opinion and in the opinion of many other thinkers he quotes. It is already his first words: "Strange thing, really, that time..."; the thing, in Latin, is res (-rei), that is to say the very root of the word "real"; it is also "a particular substance" as Etienne Klein formulates it on p. 32. Other opinions are also reported which, although in the minority, seem to me preferable, as for example at the end of page 19: "... to deprive [time] of any intrinsic reality", or from Wittgenstein on p.33: "... time is not a material...", from Leibniz on p.35 ...neither space nor time have any real existence outside the objects they allow to be connected..."; or again from Lucretius on p. 39: "...time does not exist by itself... from the movement of things and their peaceful rest".
As for me, I find it useful to consider that time is only an idea, in the strict sense of permanence, and in the broad sense of duality "permanence and change" (the latter specifically characterized by speed, that is to say the opposite of time in the strict sense); time

[1] Le facteur temps ne sonne jamais deux fois*, champs sciences, no 942, Flammarion, 2009, 270 pp. ; *"The time factor never rings twice" (in French, the word "facteur" has not only the meaning of "factor" but also that of "postman")

is only a concept pertaining to the *imaginary* (cf., in brief, *A10. Time, a.k.a. permanence and change, and in more developed form, the site AIR or the book CC2*).
In this *imaginary* world, it is an understatement to say that any law is arbitrary, since nothing exists... And even if, like scientists, we propose to model the *real*, we will only be able to do so in an infinitesimal way, with a very real infrastructure to support this imaginary world, and thus an infrastructure necessarily limited by physical laws (cf. capacities of the brain, of computers, etc.). Therefore :

- it is necessary to focus on one goal at a time, and to bring to the specific model corresponding to it only the necessary minimum of relevant elements, notably coming from the real;
- and it must also be admitted that, for different goals, and even for identical goals, it is quite possible that different models can, at the same time, prove to be respectively valid.

(re., in short, *A7. The imaginary is notably the world of symbols, words, images and theories; even when it aims at representing the real*; and in more developed form, the *AIR* site or the *CC2* book).

R2 (P21-22) – About analogies and the flow of a river

In his book FT, Etienne Klein presents a river metaphor to explain the flow of time. Time would be the water of the river, and the riverbed a mysterious "off-time"?
In general, I agree with EK's approach in his FT book, which consists both in relying on analogies and in calling for caution in their interpretation (in short, this point would be similar to *A8 - The Challenge of Definition*, and, in a more developed form, would also be found in the *CC2* book).
Nevertheless, in my opinion, the definition of time does not require an analogy here, but rather the direct observation of the real.
In particular, the real includes bridges over rivers. And everyone can understand the notion of "time passing" by the evidence of "water flowing under these bridges". In my opinion, it is the static character of the bridge that can establish the notion of permanence, in complementarity to the flow of water which is a matter of change. Thus, time in the strict sense describes permanence, and since permanence is evaluated by changes, time in the broad sense corresponds to the duality of permanence and change (in short, see *A10. Time, a.k.a. permanence and change* and in more developed form, the *AIR* site or the *CC2* book).

R3 (P22) – Not moving, sitting in one's boat, and yet knowing that one is mobile

Etienne Klein continues his river metaphor by changing the perspective, taking the observer, who was initially static on the bank, into a boat now gliding on the river. This subject gives rise to two very different reflections for me. The first is fundamental, and erases part of the difference that we generally imagine between subject and object; and the second is linked to an aspect of time concerning the relationship between two entities.
The observer of the boat, the subject in our case, like any cognitive agent observes the real and discovers regularities in it. It is a question of consciousness and acquisition of knowledge. A priori, the real is here the object that we observe. But progressively, the observer discovers also in this object, in his environment, elements that he ends up identifying as constituting himself, as for example his shadow, his hands or his own nose! In this sense, the subject is just an object like any other. (cf. A11. Comparison by marked masses, AIR or CC2). To return to the boat, the observer, even when the boat is carrying him, has fundamentally the same understanding of the real, and thus of the motionless banks and the passing of time, as when he is standing on the bank, or leaning over a bridge. With the collective development of

knowledge of the real world, and according to practical needs, attention has thus been fixed on a reference point situated on an increasingly large scale: on the boat, on the banks or on the bridge, on an Earth (flat or round), on the Sun, or even on a more global scale.
Time is thus first of all the duality permanence-change which seems to characterize the real, as illustrated in particular in the Greek mythology respectively by the deities Aeon and Chronos. In this respect, Greek mythology has also given us Kairos, a third deity in some way linked to time! If Kairos is in the boat, the observer, who is now placed on the bridge over the river, must be attentive to grab Kairos by the hair as he passes. Basically, this expresses not only the idea that the coincidence of multiple changes (here, the passage of the boat, and the action of the observer) is not self-evident, but more importantly that this coincidence must take place in the present, where all the real is! In fact, the real is by nature in the instant, in the present... and therefore the real does not pass but nevertheless it can change and thus the possibility of a coincidence, of the materialization of a threat or an opportunity often remains fleeting.

R4 (P26) – EK's nuances between "arrow" and "course" of time

In his book FT, Etienne Klein articulates his vision of time in two very distinct main parts, which he designates respectively by his terms "course" of time and "arrow" of time.
This distinction was at first difficult for me to understand, and it was only after having read more than half of the book that I felt the need to reread the first pages in order to understand the meaning according to EK .
It seems to me useful for a good understanding of these two notions proposed by EK, the course and the arrow, to distinguish between the real and the imaginary, as well as to see time as a duality of permanence and change, as I summarize it for example in Appendix A.
In short, experience shows us on the one hand that the real changes (for example, the water flows), hence the notion of "course" in EK, and on the other hand that this change in the real is oriented (the water flows downwards), hence the notion of "arrow" in EK. This is evidence, or in other words it is axiomatic.
The possible confusion comes from the passage to the imaginary. Firstly, whereas the real, simply, "is", the notion of time belongs to the imaginary. And secondly, the "laws" that are apparently unavoidable in the real, do not apply by themselves in the imaginary.
Thus the imaginary allows us to create the notion of time, as well as to fantasize pseudo-real, scenarios of the past and the future; the imaginary also offers the possibility to the observer to move freely, without much delay, towards arbitrarily distant dates, as for example at "distances" amounting to billions of years, towards the past, for the date of the big bang; or towards the future, for the deadline of the extinction of the Sun.
In our present society, the imaginary has taken on such importance that it becomes necessary to recall that the real remains infinitely different from the image that one gives of it. In particular, the real, even if it changes, is entirely in the moment, whereas in the imaginary that occupies us, such as EK presents it to us, the real could in principle be represented at an arbitrary date, and even more, as a sequence along a "time line", like a film that one would unroll or rewind. The real can thus give the impression of having a course. And this brings us to the second point, the direction of evolution that this course would have. It is necessary to remember that, contrary to the imaginary where freedom is total, where if laws are to be respected, they are the only laws that one gives oneself, in an arbitrary way, revisable at will, the real is constrained by a certain irreversibility; the real changes only in one direction, according to an "arrow", let's say from the past to the future, to correspond well to our experience: this is how things appear to us; or again, in a language typical of experienced physicists, "everything happens as if the real followed such a law"; this implies in their models an increase of entropy and corresponds to the second principle of thermodynamics.

R5 (P26) – The direction of time flow

In its context, Etienne Klein's question on page 26 "What makes time flow?" is absurd (cf. *R1- Nature of time*).
Nevertheless, the more general question of the "direction of time" deserves to be addressed.
If we remain in the imaginary world, it is of only secondary interest. In itself, the imaginary world does not exist, and in that world any law is arbitrary. The law that we adopt for our discussion, as for any scientist, is to define as faithfully as possible what the observation of real teaches us, to the point of being able to predict its evolution.
The first interest must therefore be in the real, which exists, which underlies the imaginary, and which is the object of our scientific approach. Let us replace the question "What makes time pass?" by "What makes the real change?" The meaning of time will thus simply reflect the generally accepted postulate that entropy can only increase as long as it has not reached its maximum, that is, as long as a certain order remains.
The second principle of thermodynamics summarizes the experience that we all have of the real, when transformations occur; we observe innumerable irreversible processes, and these go spontaneously and inexorably in the direction of an increase in entropy; for example, as EK says as well in substance, the contact between a hot body and a cold body necessarily leads to an equilibrium where the temperature of the two bodies becomes equal.
Strictly speaking, time characterizes permanence, and thus implicitly equilibrium, a certain immobility, and thus the notion of "direction" of time is not applicable here. In a broader way, time also refers to the phenomenon of change, and then the second principle of thermodynamics, which effectively imposes an irreversible sequence order, in the changes that occur, implicitly defines a direction that the concept of time must respect when it aims to correspond to the changes of the real.

R6 (P26-27) – Disagreement about moving in space-time

Etienne Klein considers that the passage of time would result from our movement in space-time.
It does not make sense to say that an element of the real can move in a model, by nature imaginary.
Generally speaking, the real is; the real is everything. It is notably us, who circulate...
On the other hand space-time is a model, which belongs to the imaginary. And the imaginary is not (at most, it is the cognitive agent who imagines, it is him who has a certain reality)! One can draw an apple, but eating the drawing of this apple does not nourish.
In the particular case, the correspondence between the real and the imaginary, as far as space is concerned, is quite immediate; we can draw a system of axes in the corner of a room and from then on we can move at least a few meters with the evidence of a perfect coherence between movements in the real and movements in the imaginary.
Mathematically, that is to say in a model of the imaginary, one can define a space of dimension 4 instead of 3 without great difficulty, and move there with the same ease.

But in the real, the dimension of time is not. If one can take a step in the real in terms of a change of position, on the other hand, a step in terms of a change of time is a nonsense, because the real by nature is in the instant, in the present; time, with a past and a future, is a purely imaginary concept.

R7 (P29-32) – About causality

Causality is a logical link between the origin of a change (the cause) and what this change produces (the effect).
Thus, the notion of causality overlaps with that of time by their common reference to change, hence similar difficulties arise, depending on whether we observe these notions in the context of the real or the imaginary world.
The definition given by Google for the word cause[2] is for me luminous: "That which produces something; reason or origin of something". Several aspects are fundamental:

- Without causality, one could not produce. It is a matter of evidence.
- The cause as a reason is a matter of the imaginary.
- The cause as origin appears here to concern the real.

EK reports Kant's views on p.29, concerning successions, which he distinguishes between objective and subjective. Different from subjective succession, which belongs to the imaginary, the important thing here is *objective* succession, which relates to the real. Like time, the objective succession is oriented according to the arrow of time in EK's jargon, or in a general way, in the direction imposed according to the laws of thermodynamics; this succession is typically irreversible and is similar to causality.
What is not said enough, is that on the other hand in the imaginary world no law prevails. In particular, not only is time there reversible, but one can also jump without constraint from one moment to another. Thus, Aristotle and Thomas Aquinas[3] include the final causes, belonging to the imaginary, among the conceivable causes to produce an effect; ditto for Google and reason, or for Karl Jaspers and the motives[4], in his comprehensive psychology.
In life, it is the *values*, the goals, the intentionality, the visions, the reference to a future ideal that cause the modeling and the action. This is almost explicit in the very word "produce", since etymology shows us the root "ducere" as directing, with the prefix "pro" referring to the future. To produce is thus to advance, to provoke change, to mobilize the cause to obtain the effect.
In fact, it is the detour of the causal link via the imaginary world, of which the livings are capable, which finally brings to the real, the effects of freedom and, in a word, existence.

R8 (P33-65) – Block universe and presentism ? Time is a matter of the imaginary.

In general, chapters 3 and 4 call for the same remarks as developed in *R1-Nature of time*.
In particular, the assertion of EK et al. in P63: "all events ... past, present and future have the same reality ..." does not seem to me to be correct. In my opinion, one should not confuse real and imaginary. The real simply "is", as already said by Parmenides (or Hermann Weil, quoted by EK on p.61: "the objective world simply *is*..."). On the other hand, past and future are only imaginary.
Also on p.63, the presentation concerning presentism seems to me a bit messy (adding notions of disappearances and appearances, and of renewal which are far from the limpid assertions of Parmenides "what is, is" and of Weil "the real simply is"), but on the substance I can relate to it, in the sense of my statement in the preceding paragraph. When one observes the real, one can very generally model both permanent and changing elements in it (re. *A10. Time, aka permanence and change*).

[2] Google definition for the word « cause », last accessed April 13, 2022.
[3] THOMAS D'AQUIN, Somme Théologique, I_a, II_{ae}, Prologue et Qu.1.
[4] Jeanne Hersch, *Karl Jaspers*, Paris, L'Âge d'homme, 2002 (1re éd. 1978), 165 p. (ISBN 2-8251-1727-7)

R9 – Additional inspired remarks about the real and the present: the instant and the characterization, in the instant, of change.

The presentism discussed by EK in chapter 5 inspires me to think again about the challenge of reconciling the instantaneous character of the real, and the perception that one can nevertheless draw from it concerning a possible change. Let's see this in two points, the first concerning the present, and the second concerning change.

R9a – About the present.

In philosophy, the essential, vertiginous and mysterious, is said in three words: "the real is". Nevertheless, in communication errors are frequent, and the remedies to correct them rely on redundancy, a kind of repetition. Let's try redundancy, let's say the same thing in five words: "everything is in the instant".
(Parmenides also chose redundancy: to the essential "what is, is", he added "what is not, is not").
A deceptively favorable formulation would be to say that "the real is in the present". While this is understandable, two pitfalls threaten. The first is that it would invite the classical model of time into our case, with its notions of past and future, stifling the present to a duration tending towards the null. The second pitfall is the connotation of the word "present"; if the instant and the present both share the notion of being in their etymology, bringing the desired redundancy, they differ in their prefix: the instant keeps us in the center, while the present places us, less happily, "in front", as an observer, as an accessory, peripheral element.

R9b – How to perceive the change in the instant?

Change implies two different states; but if everything is in the instant, how can we perceive change, how can two states coexist?
I will retain two propositions on this subject.
The first one is my favorite, coherent with the previous point (*R9a - About the present*): everything is in the instant, and some elements can appear to us immediately (evidence) as changing or on the contrary rather permanent.
The second proposal adds the imaginary and the cognitive to the observation of the real: comparison with traces (e.g. footsteps in the snow), or dynamic effects perceptible in the instant (e.g. the shape of bent reeds, indicating the wind speed; or the wet thumb which perceives the direction of air movements by a very local drop in temperature). Humans (among other agents endowed with cognition) create their own traces (memory), and already at a very young age, children practice the game of hide-and-seek, for example.

R10 (P67) – A beautiful quotation from Valéry answers a question which would be absurd if we were to stick to science alone

In his chapter 6, Etienne Klein wonders about the first instant of time.
In scientific terms, we are interested in the real. From then on, we have to change our point of view: we should not want to start from an origin, possibly billions of years and more away, in the past, that is to say in the imaginary, but we should start from the real and therefore from the instant.
Thus, passing to the imaginary, there is a certain symmetry between a future that we can sketch, up to an indeterminate date in the future, and the past that we can consider in the same way, sketching it also haphazardly up to immemorial previous times. From this point of view, the origin of time is too far towards the past, just as the end of time is too far towards the future, for us to be able to imagine what these extremes could mean.

This answer is quite compatible with Paul Valéry's elegant and more holistic formulation (cf. FT, p.67, taken up below in *R10a - First approach to Valéry's quotation, seen from an "artistic, poetic and literary" angle*). For Valéry does not stop at the usual goal of science, which is to model the real in a predictive way, a hopeless enterprise in this case of origins; he also winks at the more humanistic goals of edification of the masses, which are themselves quite relevant and relatively accessible, if one admits that civilization is preferable to barbarism.
Many times, in my life, I have come across quotes or reflections related to Paul Valéry. Each time, it made a strong and good impression on me, mainly in philosophical terms, although Paul Valéry's activities mainly touched many other areas of society, all different from philosophy.
It so happens that I had initially analyzed the three lines. I had then developed them in order to put them in correspondence with the "colors" that I propose to understand life, then I pushed the cursor further towards a very recognized contemporary philosophical jargon.
I then learn that in his Cahiers Valéry writes: "I read philosophers badly and with boredom, who are too long and whose language is unsympathetic to me "[5].
Here again, I follow him, and for the reader's judgment, three variants follow below.

R10a – First approach to Valéry's quotation, seen from an "artistic, poetic and literary" angle.

The quote on page 67 is in three short lines. Thank you to Etienne Klein because they are relevant. They are also typical of Valéry's genius:
"Any origin, any dawn of things is of the
same substance as the songs and the
tales that surround the cradles."
At first glance, the text is very pleasant.
All the terms are simple, relate to everyday life, and, considered in isolation, are immediately understandable. The tone is very positive, especially by the chosen terms "dawn, songs, tales, cradles".
A deeper analysis for the perceptive reader reveals that Valéry denounces all discourses, religious, scientific, philosophical, or political, which claim to explain where the world comes from as devoid of any truth (a fine challenge for this chapter 6!).
Nevertheless, Valéry does not go to war against these postulates and is satisfied with a wink, conceding then that it is quite necessary to surround the youth and to transmit to him not only food, to begin with bottles of milk, but also a culture, bottled in stories; in this sense, he is ready to rally thus him also to these superficial, "naive" views of the world.
In conclusion, the text is even more pleasant; admirable of concision and appropriateness.

R10b – Interpretation of Valéry's quotation, with link to the four pillars real-imaginary-values-and-collective

While science is primarily concerned with nature (the *real*) and the representations we can make of it (the *imaginary*), life is part of a broader framework, where we can distinguish two other categories of major importance, *values* and the *collective* (in short, re. *A1. Much more than science, life, and in a more developed way*, *AIR* or *CC2*).
Let us see how Valéry's quotation appears to us, when viewed through such a 4 "colors" prism (Table 1).

[5] Paul Valéry, *Cahiers*, t.1, p. 197; via Wikipedia, accessed 18.02.2022

« Toute origine, toute aurore ... » "*Any origin, any dawn...*"	The text begins with a reference to the past, so it takes us first into the *imaginary*; it is about concepts, elements of thought;
« ... des choses... » "*... of things...* "	nevertheless, the author is interested in the *real*, which is all to him, and all in the present;
« ... est de la même substance que... » "*... is of the same substance as...*"	at this stage of the reading, we already know that the substance in question is the *imaginary*, given the nature of the subject; but the suspense remains as to a later, possibly more restrictive characterization of the *imaginary* brought into play;
« ... que les chansons et que les contes ... » "*... the songs and tales...*"	focus 1; more precisely, these are narratives mobilizing the *imaginary* to describe the world (the *real*) and to express goals, an ideal to aim for (*values*), in a social context (the *collective*) ;
« ...qui environnent les berceaux. » "*...that surround the cradles.*"	(focus 2); more precisely still, these are stories that represent the *real* and the *values* in a highly simplified way, that model them so that they can be understood by all the members of the group, of the *collective*, and even by the very young children.

Table 1. Living well together requires a prior education, the adhesion to a common culture where the explanations, always schematic, benefit from the infinite freedom of which the imagination is in principle capable.

R10c – Valéry is a philosopher

Valéry is a philosopher, without, however, resorting to a proper philosophical jargon; this is obviously a great quality.

As for me, as we have seen, it seems useful to me on a cognitive level to distinguish 4 pillars to build a good theory of the world and of life, the real (the domain of the true), the imaginary (the domain of the beautiful), the values (the domain of the good), and the collective (the domain of living together).

But one can naturally go further, towards a more specialized philosophical jargon. The link is attempted here, for example, with Merleau-Ponty[6] (also quoted by EK in FT) for the formulation of my 4 colors in a rather contemporary philosophical jargon (re. Table 2), and then it is applied to the interpretation of Valéry's quote.

« 4 Pillars, 4 colors»	*Corresponding concepts in Merleau-Ponty*
Real (cf. blue, true)	Phenomenology, starting from things
Imaginary (cf. green, correct, beautiful)	Idealism, noesis
Values (cf. red, good)	Intentionality, noeme
Collective (cf. silver-gray, together)	Intersubjectivity, culture, language, art, anthropology, sociology

Table 2 In philosophy, some very specific concepts need their own word.

"Any origin, any dawn...", here it is a question of the past, "...of things...", in relation to the real, all in the moment, "...is of the same substance...", which belongs to the imaginary, noetic-nometic, "...as songs and tales...", cultural, artistic narratives, mobilizing the

[6] Maurice Merleau-Ponty, *Phénoménologie de la perception*, Paris, Gallimard, coll. « Tel », 2005, 537 p. (ISBN 2-07-029337-8).

imagination to describe the world and to express values, goals, corresponding to an intentionality, " ...that surround the cradles", these narratives belong to a phenomenology with broad strokes, expressionist, representing the real, modeling it, in a strongly simplified way to be understood by a group, a collective, even by the very small children, in a perspective of intersubjectivity and social anthropology.

R11 (P72) – Even refocused on the present, the question of being remains mysterious and dizzying

After having examined the problem of the origin of time, Etienne Klein quotes Leibnitz: "Why is there something rather than nothing?"
This question is already implicitly contained in the most fundamental assertions since Parmenides, as indicated in my remark *R9a - About the present* (In philosophy, the essential, vertiginous and mysterious, is entirely said in three words: "the real is") and calls in my opinion for Leibnitz the same answer: mystery and vertigo.

R12 (P77) – Kant and the nature of time

Etienne Klein quotes Emmanuel Kant: "Time is only a subjective condition of our (human) condition and it is nothing in itself outside the subject".
I can understand Kant's point of view, especially in the first of his two sentences, but I still have some reservations about the second.
Yes, time is only an idea, notably imagined by our brain, and as such time is not (or said a bit redundantly, is not real); because time marks out past and future, which are all only imaginary.

But the second sentence, "... [time] is nothing in itself outside the subject" should not be taken with too much importance, because time, in its widest sense, refers well to the permanent and changing characters of the real. And this real, it is everything; in the present.

R13 (P83-94) – Where does our presence in the present moment come from?

In Chapter 8, "Where does our presence in the present moment come from?" Etienne Klein discusses several opinions of great interest and elicits several reflections from me, mostly related to quotes from sources outside the FT book itself.
These reflections follow, relating in turn to Samuel Beckett, Mc Taggart, St. Augustine, Carnap, and Einstein, with finally, a particular emphasis on the subject of "the Now".

R13a (P83) – About Samuel Beckett: not replacement, but continuity.

Samuel Beckett	*Comments*
Flux cause, Que toute chose, Tout en Toute chose, Donc celle-là, Même celle-là, Tout en étant N'est pas. Parlons-en. *Flux causes,* *That all things,* *All in* *All things,* *So this one,* *Even this one,* *While being* *Is not.* *Let's talk about it.*	Beckett seems to me to be foaming a false problem Yes, the real is changing, it seems inexorably evolving towards a distant and perfect equilibrium, which will no longer concern us, and where it will be cold (0 degrees Kelvin), physicists tell us. But this does not have to be seen as what is is not! Let's consider a simple case. If we bend a pipe, it is not useful in general to ignore the continuity of this change and to imagine, in a way analogous to the successive images of a film, a sequence of innumerable discrete events which would replace a less bent pipe by a new one which is a little more bent; besides, as the chapter asks, where would all these pipes be? Simply, the pipe bends; or even more simply, "the pipe is".

Table 3 Evolving does not necessarily imply an apparent discontinuity of being.

R13b (P89) – About J. M. E. Mc Taggart: the ideality of time.

On the substance, I fully agree with J. M. E. Mc Taggart's proposal, which although formulated in a somewhat different way from mine is compatible with it: non-existence and pure ideality of time.
For me, time is an imaginary concept (cf. "pure ideality" in Mc Taggart's terms), and the aim of this concept in the broad sense is to characterize the permanence-change duality of the real (cf. "... there could be no time if nothing changed" in Mc Taggart's terms).
In my opinion, the possible illusion would not concern, strictly speaking, the specific perception of time (because we do perceive the aspects of permanence and change of the real) but rather the perception of the past or the future, which are purely imaginary.

R13c (P89) – About St-Augustin; it is in the present that we think about the past and the future.

Etienne Klein reports an opinion of St-Augustin about time with which I completely agree: "It is in the present that we think about the past and the future".
The *real* is in the present and provides the infrastructure capable of creating and animating the *imaginary* ("thinking", in the words of Augustine of Hippo), of creating and animating arbitrary and hypothetical models, oriented towards both the past and the future.

R13d (P93) – About Carnap and Einstein; the challenge of the "Now".

The difficulties mentioned by EK in taking into account the present, as presented by Carnap ("...all that occurs objectively can be described in science...") and reported by Einstein ("...there is something essential about the Now which is just outside the realm of science."), I think I understand. But I see things from a different angle.
In my opinion, the abyssal difference exists between the real and the imaginary. Although science is focused on modeling the real, it is entirely confined to the imaginary. There everything is possible; the worlds of the past, of the future, as well as any alternative world can be created and transformed without any constraint (let us consider separately the stewardship, the very real and necessary infrastructure in support of the imaginary, notably in

the form of memory, cognitive engine, and communication support). Carnap can see that science proposes representations of the present as well as of the past and the future; as such, the present reported by science is indeed similar to the rest. But the present moment, the now, is also the exclusive domain of the real! And this real has its own laws, inviolable, and its complexity is infinite: the real has probably been there since always, will last, even cold, even apparently other, for always too; we know no limit to its size neither towards the small, nor towards the big; its instantaneous precise state is impossible to apprehend and it even seems that the only observation of the real modifies it! I thus share Einstein's perplexity, such as it is reported to us, in front of the desire to know and to give an account of the present, that is to say of the real, that is to say of the being, in the sense notably of Parmenides.
Thus Carnap's opinion fits perfectly with the general theme of the chapter, the present, in the context of time, and from this point of view the present is only a post-past or a pre-future, it only participates of the same nature of time developed in three complementary phases past-present-future. On the other hand, for Einstein (and for me), the difference is enormous between this phase of the present which - let's imagine a window - is the only one to open onto the real, whereas the other two only open onto nothingness. This deserves another division than the triptych past-present-future. We must see here the following simple, radical alternative: it is now, ... or it is not.

R14 (PP95-100) – Time, between permanence and becoming

In his title for Part II of his book, EK positions time "*between* permanence and becoming". As for me, time would be rather "permanence and change". In addition to this general remark, several reflections follow, relating to four thinkers mentioned in the beginning of this part. Reflecting certainly well the diversity of existing opinions about time, the title is ambiguous and seems at the same time to exclude that time is either of two possible alternatives, while suggesting an intermediate, possibly fluctuating position.

In the MCS theory of cognition that I have proposed, time is seen as a concept and as such belongs to the imaginary. Time in the strict sense aims at characterizing permanence (with the second as a unit of measurement) and in the broad sense at representing the entire permanence-change duality, where change is the opposite of permanence and is measured in speed (unit 1/s). This is obvious when we observe the real.
Thus, although the reference in both cases is to permanence, and becoming can be understood as synonymous with change, important differences distinguish the proposal concerning time envisaged by this chapter from that provided by the MCS theory (in brief, cf. *A1. Much more than science, life*, and more fully, cf. *AIR* and *CC2*).
The following sections echo the views of Jünger, Parmenides, Heraclitus, Prigogine and Newton, as reported by EK in chapter 6 of his book, FT.

R14a (P97) – Jünger and the understanding of time in a broad sense

I understand Jünger's quotation with the meaning of time in a broad sense, i.e. the permanence-change duality as developed in Table 4.
In Jünger's text, the "quality of time" is permanence, time in the strict sense. As for the "measurability [of time]", it evokes change, the opposite of permanence, allowing in fact to quantify time; for example, a weekend has a duration (i.e. a time in the strict sense of permanence) of two days (i.e. a time in the broad sense of permanence-change duality amounting to two day-night changes).

Ernst Jünger	*Comments*
There will always be men who consider the quality of time more important than its measurability. There is no one who does not know this. Time does not only provide the framework of life. It is also the garment of destiny.	As for most people, it is first of all time in its strict sense, permanence, that Jünger refers to, as a "quality", a state, a "framework of life"; then he introduces the dual notion of change, which in practice can notably serve to quantify this permanence (cf. " measurability "). Change also allows for long-term evolutions (cf. "destiny"). As for the metaphor of clothing, it does not seem to me to be very fortunate. Nevertheless, since it is sometimes necessary to integrate permanence and change, since time is often understood in this way, in the broadest sense, Jünger also brings mobility to his framework, which then seems to get animated, always surrounding things (notably people) in their evolution, and thus becoming a kind of clothing for them.

Table 4 Time is mainly understood as permanence (in Jünger's jargon: quality of time, framework of life); but very often, the meaning of time expands to also include the dual property of change (in Jünger's jargon: measurability of time, garment of destiny).

R14b (P97) – Permanence and Parmenides, Heraclitus and change? No, Parmenides and being!

If, as EK presents it, Heraclitus is indeed emblematic of thinkers sensitive to the changing character of the real, in my opinion the views of Parmenides are more convincing. Parmenides avoids any attempt to model the real, resisting the temptation to fall into the imaginary, the interpretation, the doxa; whether it is in particular to project there the notions of permanence, of change, or even of both.

To better understand Parmenides' thesis, it may be useful to make a "desensitization". We are too sensitive to the imaginary and the real tends to escape our attention.

Let us take the example of a television screen. The culture poses it to us in a space-time, a system with four dimensions. But if we represent the screen in this way in a model, in an imaginary structure, additional dimensions to the first four mentioned may also be of interest, such as two-channel sound or economic value; in doing so, we increase the number of dimensions from four to seven. Conversely, the essential thing in this case is the television content, and this is all contained in the signal received from outside, which brings us back to a single dimension, temporal. Well, with Parmenides we focus on the real, modestly, and we can drastically reduce the dimension of the case to zero: "the screen is".

R14c (P98) – Prigogine sees Chronos; Newton is nevertheless a wise pragmatist

In my humble opinion, Prigogine, indeed well in line with Heraclitus, has not fully understood the concept of time. Time is only an idea, and in a broad sense refers to the permanence-change duality that can characterize the real. But Prigogine retains only the part of change, that is, in his terms, the "becoming".

The being, the true being, that of Parmenides in particular, although obviously in constant evolution, is always there, and if we embark on the imaginary of time, the latter characterizes precisely the permanence. The change, in this context, has only an ancillary value, that of measuring the duration of this permanence, that therefore of measuring time!

But it is true that although time is mainly permanence and therefore the business of Aeon, in Greek mythology, it is however often its dual property, change, deified by Chronos, which attracts most of the attention.

As for Newton, as is typical of physicists, and like everyone else after all, he has a pragmatic approach. He proposes models, i.e. minimalist representations of real that are sufficient to

reach his goals, to explain, to replicate a relevant part of his experiments. It is not a question of knowing the real in the absolute and in all completeness, which is an impossible task, but of describing some aspects of it. So why not accept Newton's proposals? Another aspect, another model. This is obviously the right approach, even if unfortunately, the consequences are often misunderstood (cf. *A12. The real, the imaginary, and the "second order error"*).

R15 (Ch.13, P143-150) – Physics or the protocol of becoming

Without any other comment as for pages 101 to 142, here we are at chapter 13 "Physics or the protocol of becoming". where the quotations of Martin Heidegger, Gottlob Frege, and Lee Smolin call for their respective comments.

R15a (P143) – Heidegger or the unfolding and immobility of time

EK quotes Martin Heidegger: "Time itself in the whole of its unfolding does not move and is immobile and at peace".
It is a bit surprising to read such a static view of time in Heidegger, for whom it is typically the idea of change and becoming that dominates in general!
In my humble opinion, time is a matter of the imaginary. Therefore moving, being still, or being at peace do not seem to me to be applicable properties (cf. *A12. The real, the imaginary, and the "error of order 2"*).

R15b (P143) – Gottlob Frege or a certain permanence to be the foundation of knowledge

Page 143 also includes a statement by Gottlob Frege, "If, in the perpetual flux that carries everything along, nothing remained fixed and eternally retained its being, the world would cease to be knowable and everything would be lost in confusion".
I largely agree with Frege; permanence and change form a duality underlying the notion of time. However, it does not seem necessary to me to require eternity: for example, even without being eternal, a bridge over a river is sufficiently permanent to characterize the change in the flow of water that it spans, and conversely the changes in this flow are typically sufficient to highlight the relative permanence of the bridge.

R15c (P148-149) – Lee Smolin or a certain pragmatism in the consideration of physical laws

Etienne Klein relies in particular on Lee Smolin's opinion[7] to renounce absolutely invariant physical laws, in favor of a kind of Darwinian adaptive process in order to make these laws evolve in the course of time. Obviously, as we have already recalled (cf. *A12. The real, the imaginary, and the "second-order error"*), we must not confuse real and imaginary. I understand the term metaphysical in this text concerning Smolin as synonymous with imaginary, and in principle I agree with it.
In the imaginary, there is no intrinsic, absolute law, and at most one can try to respect postulates. Even when we want to describe the real, like physicists do, and associate laws with it, these laws are part of the imaginary and can therefore change in a pragmatic way according to the goals considered. They do not need to be eternal. In this sense indeed they can perfectly, if one wishes it, and although EK seems to doubt it, also be situated "in the empyrean of the pure Ideas, overhanging the nothingness". As for the real, it is; it changes as it changes; at most, the physicist will be able to say "everything happens as if the real followed certain laws". If there is indeed a natural selection of these laws, it is the intelligent observers who proceed to it, in their models, more or less explicit, as much the physicists as the most ordinary human beings or even biological beings much less developed and from now on even some machines.

[7] Lee Smolin, The Life of the Cosmos, London, Weidenfeld and Nicolson, 1997.

R16 (PP151-159) - Time and time; Newton and thermodynamics

Part III of the FT book opens with an introduction leading me first, mainly, to comment on a quote from André Breton, "Il faisait un temps de temps - *It was a "time" of time*". (The word "temps" in French can not only be linked, like the corresponding word "time" in English, to the two notions of permanence and change, but also, uniquely, the French word can take on a third meaning, relating to climate, "weather".)
The collision of two homonyms of time questions and requires reflection. I will comment on this in two phases, one focusing precisely on the quotation, from the point of view undoubtedly adopted by Breton (cf. *R16a - Homonyms of "time" à la Breton*). The second phase opens on an apparently wider perspective, but in fact more focused on the essential theme of the FT work (cf. *R16b - Homonyms of time à la Mitterrand*).
The rest of this introduction leads me to other reflections (cf. *R16c - Other reflections*).

R16a : Homonyms of "time" à la Breton *(p. 153)*

For me, at first glance, the André Breton quote considered, given the context of its production, is rather nonsense. Breton is a co-founding artist of surrealism, a movement whose emblematic exercise was the creation of "exquisite corpse" (As a student, I had also done this kind of group experiment, where a sheet of paper is circulated, and in turn, each participant, ignoring the text already contained, secretly adds an additional word, and immediately conceals it by one more fold of the sheet). This process can naturally produce the sentence in question, of the same absurdity as the general title of the book from which the quotation is taken, " Le revolver à cheveux blanc - *The white-haired revolver*"[8].
Of course it can be fun to try to make sense of these random ideas, especially since the human brain is very adept at recognizing in them the most improbable products of its imagination. When it comes to producing pseudo-sense, the imagination is generous. Thus, for example, we can imagine, despite the consensus as to the unpleasantness of a corpse, that such and such a thing is exquisite; that, since white hair typically refers to an old person, the gun must undoubtedly specify the sex of that person; and that finally the beginning of the proposal "it was a weather..." taking us on a matter of meteorology, rain or sunshine, we can well imagine that the continuation "... of time" specifies us the current moment, the season, e.g. summer time!
Here in my opinion, EK practices a little humor. The concept of time being already complex, deserving a book in the sense that he explores it, philosophically-physically, EK does even more. He suddenly quotes Breton, adding surrealism and weather to his own discussion of time.

R16b Homonyms of time à la Mitterrand

The collision of two occurrences of the word time, not both in the same sense, but only as homonyms of each other, as it is the case in André Breton's quote, is not exceptional. Thus, in particular, "It is necessary to leave time to time", this quotation with multiple and sometimes

[8] « Il faisait un temps de temps », *André Breton , Extrait du poème « Le Verbe Être », lui-même extrait de l'ouvrage "Le révolver à cheveux blanc" Poésie/Gallimard.* 1937.

ancient forms[9] and made popular in particular by Mitterand[10], seems to me to serve the purpose of EK's book better than that of André Breton.
This quotation is perfectly understandable through the prism of time that I propose (or to which I adhere, if "everything has already been invented"?).
Let us analyze the beginning. "It is necessary to leave time …"; here it is indeed time in the strict sense of permanence, a certain duration, for example a second (physical unit of the International System), a day, a dodo (24 hours in language already understood by a child), or finally here a season, in the agricultural or political environment ("from sowing to harvest", explicitly stated in the context of Mitterrand's quote).
Then let's look at the end of the quote, "... to time". This is time in the broadest sense, which calls for the duality of permanence-change. And it is more precisely about change, which progressively unfolds its effects, which is about, in our respective examples, a heartbeat, a rotation of the Earth on itself, an alternation of day and night, or again, a production cycle where change progresses from the seed that germinates to the fruit that ripens; just like an idea, or like a government action.

R16c : Further reflections (pp. 153-159)

I have little to say about this part III of the book beyond my remarks on the entry citation (cf. *R16a-b*).
It seems to me mostly that we are dealing with a false problem. Of course two different models are proposed (say Newtonian mechanics and thermodynamics). But in my opinion each one aims at different goals and each one does it very well respectively.
Let's illustrate this with an example, a certain apple. One adds up the errors if one believes that any model must and can exhaustively represent the real (Where does this apple really come from? What is its state at the instantaneous atomic level? Will I like the calvados that this apple will give me? Etc.); or one is still mistaken if one believes that only one model can be validated for the same element (about this apple, a certain theory stating that this apple is sweet will not invalidate de facto another theory according to which the apple is red).
Once again I have the feeling that we too often confuse the *real* and the *imaginary*, and that we forget that in the establishment of a model it is much less the real that is determining than the goal, the *values*, the intentionality. "Less" must be understood here concretely, quantitatively: the theory giving red limits its interest to the color, and it is then some bit of information that does the trick. On the other hand, the complexity of this singular apple considered in all its elements is practically infinite, the quantity of information that would be necessary to describe it exhaustively would exceed by its magnitude all our capacities of estimation. Pragmatism then.

R17 (PP161-168) – Newton and Wells; a journey into the imaginary?

Chapter 14 illustrates in particular how, despite Newton's warnings, many, including Wells, make the mistake of ignoring what fundamentally distinguishes the real from the imaginary. Let us see this, in two comments related to the respective quotations of the two thinkers.

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[9] Sophie Coignard - « Laisser le temps au temps », le mantra empoisonné des présidents français, https://www.google.ch/amp/s/amp.lepoint.fr/2333753 Modifié le 05/09/2019.

[10] Hubert Védrine, site Mitterand.org, 2015 ; https://www.mitterrand.org/de-quelques-formules-de-ou-sur.html ; accédé le 8 mars 2022.

R17a (P161) - For Newton the real is essential, but the imaginary also counts!

Let us analyze the beautiful quotation that Etienne Klein reports from Isaac Newton: "As for the terms of time, space, place and motion, they are known to everyone; but it should be noted that, for having considered these quantities only by their relation to sensible things, one has fallen into several errors". Newton does not say here which errors he is thinking of, but as for me, I agree with every word of this quote. Perhaps less elegantly than he did, but more explicitly, here is how I understand this quote.

The four terms that Newton mentions, time, space, place and motion, are also evident to me. In principle, as to the meaning of these terms, not only is there nothing to add, but it would be impossible to explain it to someone if it were not already obvious to him.

Indeed, the evidence bursts forth when the observer places himself, with all his senses awake, immediately in front of the real.

But the fact remains that the terms we are discussing, and the associated notions, are confined to the imaginary. Although they relate to the same reality, they vary according to the cultures and the contexts of interest.

From then on, there is a great danger that one falls into several errors, and that, as developed in *A12. The real, the imaginary, and the "error of order 2"*, the observer attributes in particular the characters of the model (in the current particular case, a mathematical space of dimension 4, including the four basic axes of which that of time, a point i.e. a place, a curve i.e. a movement, and two half-hyperplanes i.e. the past and the future; arbitrary laws) to the real, which simply "is", imperturbably, in its infinite complexity.

R17b (P162) - Georges Wells and time travel?

According to Etienne Klein, George Wells[11] describes time as a deployment analogous to space in which it would be possible to move forward as well as backward (i.e. in the past as well as in the future): the course of time would appear to be reversible because it would be a kind of space, and because, as in space, it would be possible to move in one direction or the other: " Really this is," he writes, "what is meant by the Fourth Dimension, though some people who talk about the Fourth Dimension do not know they mean it. It is only another way of looking at Time. There is no difference between time and any of the three dimensions of space except that our consciousness moves along it. But some foolish people have got hold of the wrong side of that idea..."

In my opinion, Wells falls well into the trap as feared by Newton (cf. *R17a (P161) - For Newton the real imposes itself but the imaginary counts too!*) and denounced in *A12. The real, the imaginary, and the "error of order 2"*: even if it is quite common that we think of the past and the future, that we travel in this way in time, we must not forget that this is only imaginary, and as expressed curtly, without concession, by Parmenides, that all this is not!

Not only this type of temporal travel, so easy in the imaginary, is not possible in the real, but even more fundamentally, neither the past nor the future are; never; nowhere.

The real is; appearing to us more or less changing; permanent; always in the present; always in the moment.

R18 (PP169-178) – Carnot and thermodynamics by evidence.

In chapter 15, Etienne Klein presents the genesis of thermodynamics and notably the contributions of Sadi Carnot[12] in this context. Carnot explores and models.

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[11] Herbert George Wells, La Machine à explorer le temps, Paris, Gallimard, 1990, p. 17. (FT, EK, P162)

[12] Sadi Carnot, Réflexions sur la puissance motrice du feu, Paris, Jacques Gabay, 1990, p. 10. (FT, EK, P170)

In Carnot's opinion, "the principles of thermodynamics claim to echo the most immediate experience"; then the arguments brought in prove convincing in this sense; these principles are well up to the goal.
Thus, in my opinion, it is equivalent to say that the principles of thermodynamics are self-evident, and this is of course the best we can hope for in epistemological terms.

R19 (PP179-202) – Ostwald, energy, and the boundary between real and imaginary, also marked out by Boltzmann.

In chapter 16, Etienne Klein presents thermodynamics in the context of a discussion of energy and energetics. For this he relies heavily on the work of Wilhelm Ostwald. I will comment on several points in this chapter, agreeing with Stendhal on the substance, but also disagreeing strongly with Ostwald's positions[13]. First of all, let's put the concept of energy back into perspective.
Classical scientists define the concept of energy in an extraordinarily ambiguous, even almost contradictory way: on the one hand, the first principle of thermodynamics states that energy is constant; but on the other hand, in practice, it is free ("exploitable") energy that concerns us most, and the second principle of thermodynamics implicitly states that this free energy, globally, only reduces.
In my opinion, it is wise to remain as close as possible to real. In this sense, the concepts of change and permanence, founding the duality of time and speed, are sufficient to support the definition of energy in both static terms, i.e. the energy itself, and dynamic terms, i.e. as the power that characterizes the evolution of this energy.
Generally speaking, energy is a quantity of potential change. In particular, in physics, this energy is measured in Joule. *As for the power, it is linked to the intensity of the change that occurs*, it is linked to the speed at which the energy is transformed (or, in practice, that is to say, by focusing on the exploitable energy, linked to the speed at which the exploitable energy is exhausted); in physics, the power is measured in Watt.
Thus, the quotation from Stendhal on page 179 seems to me to be well chosen ("Shouldn't the true pride of a woman lie in the energy of the feeling she inspires?"). Without pronouncing myself on the pride of a woman, it makes sense to me to consider as important the possible energy of a feeling, that is to say the quantity of change that this feeling can bring about; in full coherence with the definition given in the preceding paragraph.
Although he is on favorable ground, Ostwald unfortunately seems to me to repeatedly make errors of the type described elsewhere (cf. *A12. The real, the imaginary, and the "second-order error"*). A greater rigor is needed in the definitions. Let us attempt to do so.
Ostwald's wish to rely exclusively on the real, and his intuition that the real is very complex, just as there is also a "metaphysical" way of looking at things, with all of this I agree; although instead of the word "metaphysical", I use "imaginary", in the same sense it seems to me, that is to say, of a nature relative to ideas rather than to the real, rather than to the physical world (cf. *A7 The imaginary is notably the world of symbols, words, images and theories; even when it aims at representing the real*).
But the articulation between real and imaginary is badly placed by Ostwald. He places it between the notions of mass and matter, and therefore refuses to consider the latter notion, matter, wanting to limit his attention to phenomena. However, the passage to the imaginary is much earlier than the notion of matter (as also very well expressed by Boltzmann[14], also

[13] Wilhelm Ostwald, L'Énergie [1908], Paris, Alcan, 1910, p. 146. (FT, EK, P179).
[14] Ludwig Boltzmann, « Über die Grundprinzipien und Grundgleichungen der Mechanik», conférence présentée à l'université Clark de Worcester en 1899, Populäre Schriften, Leipzig, J. A. Barth, 1905, p. 253-307. p.286. (FT, EK, P230)

abundantly quoted in EK's book; see in particular pages 190,192,199, 229-230). This articulation, or to be even clearer, this frontier between the real and the imaginary is immediately between the physical world and the most elementary of concepts, any concept even simpler than weight, volume, mass or even all of Newton's mechanics, which Ostwald classifies as for him in the real. And in his view of the real, although he rejects matter as not real, he adds to the real imaginary concepts that are even more abstract, such as energy, which he sees even in biology (which implies notions of values and tropism, not to say intentionality), and even in sociology (which implies the notion of the collective, transcendent to the individual).
If Newton's theories are not suitable for the atomic scale, it is not that they are not true, i.e. that they do not correspond to reality, but that they are not good in this context. The priority parameter for adopting a theory is not that it is true (this is anyway possible, at most, only in an infinitesimal way), but that it is good, i.e. appropriate for the current goals. Thus, for example, one will not necessarily call upon the theory of relativity to establish the time of the 100 meters in athletics.
Although formulated differently, in a more global way, this view of what is a true theory is quite compatible with that of Pierre Durhem[15], which is quoted by EK on p. 185.

R20 (P203) Boltzmann the misunderstood.

In chapter 19, Etienne Klein reports how much Boltzmann felt misunderstood[16]. And in my opinion, this example is very important. Boltzmann made extremely significant scientific and philosophical contributions, and yet he did not receive the recognition that might have been due to him during his lifetime. My experience is also that beyond a good exploration of the world and the acquisition of knowledge at the individual level, which are already great challenges, the dissemination of possible new results to the social body is still a formidable step!

R21 (P235-236) A good synthesis!

At the end of chapter 21, Etienne Klein, relying mainly on Boltzmann's work, gives an excellent synthesis of the necessary complementarity to be found between real and imaginary in order to advance in science.
The real is important but complex, and, given the parsimony of the means, many mysteries remain. To overcome this, life succeeds by betting on the imaginary to found the expected certainties.
In science, it is fundamentally a question of knowledge, and in particular of creating in the imagination a mirror model of the real world. This generalizes, in a way, virtually to the whole of nature, the ancient and close links binding the notions of "nascency" (etymology e.g. nascor) and "knowledge" (etymology e.g. nosco): for the child coming into the world, traditionally already, filiation was established less on the basis of the real link to the mother, concretized by the placenta (cf. nascor), than on the basis of the imaginary link to the father, founded on the latter's recognition of the child (cf. nosco).

R22 (P257) By way of conclusion

After about twenty chapters rich in references and various considerations, very stimulating for my curiosity, the book ends a little abruptly devoting its last tens of pages to the pretext of justifying by advanced physical theories the "arrow of time", i.e. the irreversibility of physical

[15] Pierre Duhem, La Théorie physique : son objet, sa structure [1914], Paris, Vrin, 1981, p. 26. (FT, EK, P185).
[16] Ludwig Boltzmann, Leçons sur la théorie du Paris, Gauthier-Villars, 1905, t. II, préface, P. VII

phenomena, without really concluding. As for my own vision of time, it was able to go through the reading of the book without being affected, on the other hand my field of attention widened, in particular to consider the problem of causality and to clarify my understanding of energy. These two notions, causality and energy, are intimately linked to the notion of change, that is to say to the concept of time in the dual sense that I propose, of permanence and change.

Time is a matter of the imaginary and gives an account of more or less permanent or changing aspects in the observation of real. In the strict sense, time characterizes permanence, and uses for that as unit the second. In the broad sense, time covers the permanence-change duality, where change is characterized in particular by speed, which is the inverse of time; change (of an auxiliary element) typically constitutes a means of measurement for permanence (of a considered state).
Causality is a logical link between the origin of a change (the cause) and what this change produces (the effect). In fact, it is the detour of the causal link via the imaginary world, of which the living is notably capable, which finally brings to the real, the effects of freedom and, in a word, existence.
Generally speaking, the interesting energy is in practice mainly the free energy, the exploitable energy, that is to say a quantity of potential change. In physics, this energy is measured in Joules. But, and this is an immeasurable weakness of the book, physics is only concerned with the real. Energy however can also be imaginary, like the causal link via its reasons, like Stendhal's feelings (cf. 179), or even like the nature of time itself! And in the imaginary, the laws of nature no longer apply! Only the arbitrary laws that the free cognitive agent wants to give himself remain.

Appendix A – In short, my opinion on time

Time is only an idea, and is therefore a matter of the imagination, and translates what the experience of real teaches us in terms of permanence and change, in coherence with our culture.
These two lines are quite short and deserve to be developed in a larger context, as follows.

A1. Much more than science, life.

I am interested in more than science, I am interested in life. And for this, 4 pillars, or in other words, a prism with 4 colors, seem useful to me: the real ("blue"), the imaginary ("green"), the values ("red"), and finally the collective ("silver-gray").

A2. The real "is".

The real "is". That is to say, in a very redundant way, the real is everything; it is what is, and everything that seems to us to exist. The real is the physical, material, corporeal, practical, or objective world, among other synonymous qualities, varying according to the authors and the jargons considered.
To say anything about the real is a matter of the imaginary, beginning with the first three words of the preceding paragraph. To know the real, one must confront it directly. Hence the importance of exploration, experimentation, laboratories, museums, travel, etc.

A3. The imaginary in itself "is not".

The imaginary in itself "is not", although it is very often useful and requires an infrastructure in the real, and its object is mainly the real. The imaginary is the world of ideas, of thought, of reason, of models, of representations, of logos, of language, of theories, of the spiritual, of the

digital, of the virtual, or of the subjective, among other synonymous qualities, varying according to the authors and the jargons considered.
"Not being", the imaginary has no other law than those it gives to itself, its own laws. And the first one it sets for itself, typically, is to be logical, i.e. that its propositions form a coherent whole. This is typically the domain of the " right " (in the sense of correctness, and not of justice).

A4. Values denote priority goals.

Values denote priority goals and are at the center of intentionality. They distinguish the opportunities from the threats that the real presents, and thus make it possible to steer the imaginary. This is the domain of the "good".

A5. The collective makes it possible to transcend the individual.

The collective allows to transcend the individual. The formation of a group allows performances impossible at the level of the isolated individual. It is the domain of "all together".

A6. The real underlies in particular the traces and the memory.

The real underlies the traces and the memory. Everything happens as if the real followed immutable laws, over which we have no power, but conversely, on which we can count.

A7. The imaginary is notably the world of symbols, words, images and theories; even when it aims to represent the real.

The imaginary is notably the world of symbols, words, images and theories; even when it aims at representing the real.
The first role of the imaginary is to represent the real. To the point that often, many confuse the two worlds. This is, by definition, the domain of the "true", when what is correct in the imaginary corresponds to the real.
In this modeling operation, several aspects deserve our priority attention: complexity of the real, limit of available resources, pragmatism of the modeling, and grouping of resources.
Complexity of the real. The real is infinitely complex, and an infinitesimal part of it is perceptible to us.
Here are some examples. The old maps of geography explicitly included areas of unknown land (Terra incognita); or today in a similar way physicists tell us about a major quantity of "dark matter" of which they say at the same time they are not sure of the existence.
The average human being is not an advanced scientist, and he is quite embarrassed to determine where his possible headaches come from, or whether his shoulder pain is a sign of a heart problem.
And finally, the back cover of EK's book unsurprisingly ends, halfway down the page, with six open-ended questions.
Limit of available resources. Imagination requires a very real infrastructure (cognitive engine, memory, physical energy), and this infrastructure is therefore subject to immutable laws; in practice, this irremediably limits the ambitions that imagination could have.
Pragmatism of the modeling. Given the two previous aspects, the complexity of the real (first pillar, "blue color") and the limit of the infrastructure underpinning the imaginary (second pillar, "green color"), it is useful to consider here our other fundamentals, values (third pillar, "red color") and collective (fourth pillar, "silver-gray color"; see next point, " *Regrouping of resources*").
The values allow us to focus our attention on the goals; the goals to be considered in the moment, the priority goals. From then on, experience shows that the imaginary has its chances, even without great resources, even in the face of the immensity of the real.

In the name of the goal, the representation can be satisfied, while being light. This is Ockham's principle; if it also allows to reach the goal, a simpler model is a better model.
The corollary is that truth is always partial, and at best, that it corresponds to a specific goal, i.e. that this truth is fully established in the singular context of this goal, in that infinitesimal part of the real which must then be taken into account to succeed in reaching the goal.
This is the case, for example, of the view I propose for cognition and life (in four "colors", to live better).
Closer to the theme of the book, this is also true of Newtonian mechanics, of each of the corpuscular, wave, or quantum models of light, or of the "half-experiments" of Goethe and Boltzmann.
To come back to simple examples, the ratio of the circumference of a circle to its diameter can, depending on the application, be 3, 3.14, 3.1416, or require even more of the infinite number of decimals of the number Pi. Or the same apple can show its green side or its red side to two different observers. The often-quoted example (it is a Hindu tale) of the elephant perceived in a different way according to its local characteristics (ear, trunk, legs, etc.), on a tactile basis, by blind people, is of the same kind; but this time the example underlines the dangers of an erroneous extrapolation from a context where the local description is rather true to another context, global, where it is no longer true at all.
Grouping of resources. The limit in terms of the quantity of resources available to support the imaginary (as well as the eventual action that might follow) becomes all the more remote the more individuals group together. This is the principle of the collective. This explains in particular the interest not only in accumulating resources in the real world, but also in developing a common culture in the imaginary world, starting with techniques of communication and preservation of what has been learned.

A8. The challenge of definition

The definition of a concept is a special case of modeling. In view of its importance, here are several elements for reflection.
Purely imaginary. In the purely imaginary world, a definition does not generally pose a great problem and it typically takes place by stating the particular feature (supposedly known) that makes the term to be defined specific, in relation to a more general concept (also supposedly known). For example: a chair is a seat with a backrest. This is naturally understood by those who know what a seat and a backrest are; and it is even better understood by those who already know what a chair is!
From the real to the imaginary. However, to pass from the real to the imaginary, nothing can replace direct experience: Here is a chair! Because the real is infinitely complex. In his book, EK quotes on p. 230 Boltzmann who sees this type of abstraction in an even more constraining way: "from multiple facts of experience".
Communication relative to the real. Therefore, if it is a question of the real, defining or communicating a concept is a real challenge and typically amounts to transmitting a word (e.g. "chair"), counting on the recipient to use this word as a hook, aiming to catch in oneself, i.e. in the recipient's own experience, what the sender wanted to signify.

A9. Probability, aka uncertainty and information

The human being, faced with the real, seems first of all, at the baby stage, to form a notion of probability. This can undoubtedly be generalized to the whole biological world. A notion of probability is for example also implicit in Pavlov's reflex.
The capacity to estimate probability being operational, permanence can be distinguished from change and one is ready to perceive time.

Let us note by the way that once the probability is known, the quantities of uncertainty and information are derived from it by a simple transformation, a simple mathematical operation, without intervention of any other quantity.

A10. Time, aka permanence and change

For the observer of the real, it is obvious that some things are rather permanent while others are rather changing.
This is the essence of the concept of time, which is of course imaginary.
Time in the strict sense describes in quantitative terms permanence, and its unit of measurement is the second.
And change is characterized by its speed, which is the inverse of time, its unit being derived from this same second by the inverse function.
In practice, the length of a permanence, its duration, is measured by changes: the flow of an hourglass, a diurnal cycle, etc.
The intimate relation between permanence and change, the inverse function that links them, leads to a duality. And in the broadest sense, time also precisely describes this duality, thus integrating a notion of change to its fundamental permanence.

A11. Comparison by marked masses

Estimating probability and change seems to involve some comparison between two different states. Making this comparison seems to be done in a way analogous to an ordinary two-pan balance, which would be dynamic.
In the case of the balance, as everyone knows, the load on one side must be balanced on the other side of a central pivot, by a beam supporting the appropriate range of standard weights, a combination of marked masses, judiciously selected from a set of decreasing weights.
In a more abstract way, at the cognitive level, in our imaginary, the load on one side would be notably here for us the direct perception of the real, including traces and memories, and the operation then consists in making it correspond to an appropriate range of predefined elements, already known, easily reproduced by our imaginary.
The scale would be dynamic here, in the sense that once weighed, the load could now be marked in its turn, and added to the pre-existing marked masses, in view of future accelerated weighings. This is exactly the principle of operation of the LZW (Lempel-Ziv-Welch) information compression coding[17] mode.
There are many examples that support this view. Here is one of them. In psychology, the Rorschach test allows, with the help of random ink blots, rich in variety of forms, presented to a person, to lead this person to express the dominant elements populating his or her imaginary. In a similar way, and probably easier to understand, the same shock of a hammer on metal, for any number of bells, will lead each bell to resonate according to its own frequencies (cf. marked masses of the scale).

A12. The real, the imaginary, and the "error of order 2".

It is no doubt evident to everyone that there is a real world on the one hand, and on the other, innumerable conceptions of another world, of the imaginary. Nevertheless, at least two types of error are common in this respect; the first consists in mistaking one world for the other; the second consists in applying to one world the properties that are specifically those of the other. It is this second type of error that we refer to here as the second-order error.
The error that seems to me to be fundamental and common is to distinguish badly between the real and the imaginary in a given case. For example, a dictionary is essentially imaginary. A

[17] Welch, T. A. « A technique for high-performance data compression», *Computer*, vol. 17, p. 8-19, June 1984.

paper dictionary is real in the sense that it can be burned to make a fire, or that it is a practical memory for fixing ink to. But even though its vocation is to describe the real, a dictionary is essentially imaginary: for example, the cow that the dictionary describes is only a "typical" representation, shared in a given cultural context, and does not exist as such in reality. Even a possible photo could only recall the appearance of a long dead cow.
At this point it is worth recalling two important characteristics, which entail strong constraints on the imaginary world:

- the relative poverty or the necessary economy of real means, at the level of the infrastructure required for the imaginary to unfold, always force, on the one hand, to concentrate these means towards a very particular, singular goal, a priority at a given moment, as well as, on the other hand, to simplify the representations as much as this single goal allows it.
- unlike reality, the imaginary imposes no law of its own in its world, and can accept the most arbitrary conceptions.

The error of order two designates here the confusion resulting from the taking into account of properties which do not correspond to the nature of the world concerned: ignoring the inviolable laws and the complexity of the real when one wrongly believes that one is dealing with the imaginary and that it is in fact the real; or conversely supposing the existence of inviolable laws and the exhaustiveness of representations when one wrongly believes that one is dealing with the real and that it is in fact the imaginary.

Appendix B. Notes to the first passage, order of drafting

While we have the gist here, Appendix B is available elsewhere, in a more complete version of the document, including intermediate developments of the text.

Appendix C. Table of Contents

C.-N., JDD, 18 janvier 2022 ... 17 avril 2022.

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