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Preface
Models of Time

In the last fifty years, the formal philosophy and the logic of time have gained an increasing interest by specialists. Stemming mainly by the work of Arthur Prior (1914-1969), a variety of topics has evolved by crucial remarks to the condition of solid fields of research.

The logic of branching time originates from a philosophical problem (*indeterminism*) and in the last twenty years has had a number of applications in the logic of agency and in computer science, going beyond philosophy (at least as traditionally conceived) and the issues it was designed for.

At the same time, a number of philosophical debates has been advantaged by the use of temporal logics and temporal languages, two of the many formal devices that allow us to settle traditional problems with higher rigour and precision. Far from being a mere embellishment, these tools have increased our mastery of the problems and our chances of facing them with the highest clarity (if not of solving or dissolving them). The traditional debate on presentism and eternalism has been thus reshaped, and has witnessed a tremendous development in the way its issues are settled and its many facets are acknowledged. The cognate discussions in the metaphysics of time (time realism vs time antirealism, threedimensionalism vs fourdimensionalism) have gained similar benefits, as the discussion of the subjective experience of time.

Remarkably, this growth in the analysis of the problems and the use of a formal language has determined a better connection between different areas of philosophy. Compatibility between a metaphysical view on time (say, time antirealism) and the view on time emerging by contemporary physics is now a fundamental issue, and both metaphysicians and philosophers of physics actively take part on it. This could not hold unless shared basic linguistic and logical devices disclose connections that were previously hard to notice. In this case, also the autonomous growth of the philosophy of physics and of analytic metaphysics has played a key role: a convergence on the topics of time would have been impossible if the two disciplines had not developed specialist and refined research on the different topics.

The studies in the history of philosophy have connected to this general situation. Different views about time abounded since the very beginning of philosophy, and the flourishing we are experiencing today is a formal renaissance, not the inception of a new set of subjects. Yet the new frameworks have contributed to fresh perspectives on many earlier theories of time. Such studies have often the merit to connect those theories to the present debate or to show suitable formal rendering of them. The philosophy and the logic of time are already rediscovering their past, with an attitude that is far from “museology” and that aims at contributing to the current state of the art.

The situation I have depicted is lively and complex. In many cases, a synopsis of these different areas of research lacks: though interdisciplinary research is the rule, the output of such research is often confined to very specific and separate publication. In particular, there is today a great gap between the logic of time, as developed in the past twenty years, and the

philosophy of time. Some sporadic attempts to reduce this gap are done by researchers of both field, but separation is still the rule. This can hardly be considered desirable, because it brings philosophy far from the incredible development of techniques that has made the logic of time great, and prevents the logic of time from getting in touch with valuable pre-formal insights on time.

In the present issue, *Humana.mente* wants to witness the great importance of the present situation and to break the lack of a synoptic presentation. The papers here presented investigate different topics concerning time in many fields of research: logic, history of philosophy and history of logic, metaphysics and the phenomenology of time, the philosophy of physics. Connections between formal machineries and main philosophical topics (as agency, choices, determinism) clearly emerge. The debate between threedimensionalism and its rival is discussed at length in one of the papers, while a perspective on physics and time-realism is offered in another one. The links between change and contradictions are present also in an investigation on Leibniz's theory of time, while connections between the metaphysics of time and our experience of time are highlighted in one of the works you find in the volume.

Time is not the only topic appearing in the present volume, though. It is an attitude of this journal to provide a review of some major conferences, since they are the best chance to be acquainted with the works in progress and the researches in their making. In this volume, two international conference of great significance have been reviewed. For reasons that are easy to understand, this part of the issue is not strictly connected with the main theme. In any case, it constitutes an interesting insight on recent, important events.

The title *Models of Time* aims at stressing a feature that puts together all the different fields above: they all build up models of time, representations of how time is, being them metaphysical, physical, logical or through the analysis of previous theories. The researches in the logic of agency or in indeterminism represent a certain way in which it is suitable to conceive time, the physicians embarked a given view on how to think about it in the physical realm, the metaphysicians try to tell us if time really flow, if it is a construction of us, or if it is "statically" there, if non-instantaneous objects are all given at any instant of their existence, or just temporal parts of them are given in such a way. In other words, they aim at telling us what the nature of time is (how it *really* is), and how objects interact with it (how they find their way through time).

By stressing this aspects, we do not want to attribute to our authors a model or instrumental perspective on time. In other words, we do not want to ascribe them the idea that physics, logics or metaphysics just draw representations of reality, rather than they tell us what reality is. Their position about this point is left unprejudiced by our choice. Its only aim is pointing at a fact that seems to be inseparable from our reflection on time, even as a by-product: when we theorise about time, we build a number of different, sometimes incompatible models of time. Probably a sign of the fact that time is a really puzzling topic, and not just an assortment of pseudo-problems.

Beside the papers, other works ensure that synoptic view I have advocated above.

Some *Reviews* are presented in connection with the main theme, since they are a tool that helps to easily cross over different disciplines time is related to. Volumes on logic (the logic of agency) and metaphysics of time (presentism, realism, the experience of time flow) are here analysed and discussed.

The *Commentaries* focus on classical volumes or papers in the logic and ontology of time and help to understand not only the history and the development of those subjects, but their theoretical connections with current research and their stimulating nature.

An *Interview* to a prominent specialist closes the volume, as usual. The rationale of the interview is to propose valuable insights in a number of topics, and to do it a way that, may provide the reader with a number of suggestions and ideas. In addition, interviews are good chance to break the usual scheme of scientific communication through papers, and to reconnect our philosophical exchanges to one of the most direct and important ways of doing philosophy: by questions and answers.

A value that should not underestimated, especially in a field (the philosophy of time) where interdisciplinary discussions play a central role.

Roberto Ciuni

Conference
Ειδος Metaphysics Conference

Geneva, July 15-18, 2008

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The *Ειδος* Metaphysics Conference, hosted by the Philosophy Department of the University of Geneva on July 15-18, has been the international launch event of the *Ειδος* Center for Metaphysics. The conference ranged on four main topics of contemporary analytic metaphysics, each represented by a thematic session: *Time and Change*, *Modality and Essence*, *Object and Property*, and *Meta-Metaphysics*. Every session featured both plenary and parallel talks. For reasons of space and due to the size of the event, I will here focus only on some of the plenary talks.

The session *Time and Change* centered on two questions: Is time possible without change? and 2) Why does time pass? The first question was addressed by Robin Le Poidevin in *Time and Change: the Argument from Contingency*. Le Poidevin defends the thesis that there can be time without change. Central in the construction of Le Poidevin's position is the argument from contingency". Applied to a world containing only three spheres, the inference schematically goes:

It is possible for any one of the spheres to exist in a state of temporal changelessness.

Whether or not any individual sphere exists in a state of temporal changelessness is logically independent of the other spheres.

Therefore, it is possible that all three spheres exist in a state of temporal changelessness.

The conclusion expresses Le Poidevin's thesis of the independence of time from change. To elucidate his argument, Le Poidevin refers to Sidney Shoemaker's thought experiment of the frozen world-zones. The gist of the thought experiment is that there can be a world consisting of three different zones *A*, *B* and *C*, each experiencing a complete stop in change (a “freeze") with different frequencies. As a consequence time keeps existing (since a zone keeps changing while another freezes). This is admissible also for the opponent of time without change, since a frozen zone is seen as experiencing temporal changelessness by the inhabitants of the other (un-frozen) zones. Yet the frequencies are such that every *n* years *A*, *B* and *C* freeze concurrently. During this time all three zone experience temporal changelessness, so the whole world experiences it. This shows, concludes Shoemaker, that there can be time without change.

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Brad Skow tried to revive a proposal that has gained very few adherents, the *moving spotlight theory of time*. Theories of time are classified according to two orthogonal criteria. One is the distinction between eternalism and presentism. Eternalists believe that present, past and future are all on par, in the sense that they all exist (timelessly); presentists attribute existence only to present events. The other distinction is between A-theories and B-theories of time. A-theorists regard the present as determined absolutely, whereas B-theorists think that what is present is relative to some parameters. The moving spotlight theory of time is an A-theory for the eternalist: the NOW is absolute and flows along the (timelessly) existing instants of time. As the absolute NOW moves forward, new instants of time become present, while others sink into the past.

However, there are two key questions that remain unanswered: Why does time pass? And why does time pass at the rate at which it does? Facts about passage of time and the rate of its flow are taken as primitive in the received theory. In his version, Skow addresses this explanatory gap.

The new moving spotlight theory links change to the passage of time. We know already from the old theory that the NOW's movement makes time pass. But what pushes the NOW forward? According to Skow, change is what moves the NOW. Combining these two facts leads to the submitted solution to the First puzzle: facts about the passage of time are explained in terms of more primitive facts about change. Clearly, this explanation is a good one only if the NOW does not move in funny ways. Accordingly, the moving spotlight theory is enriched with principles regulating how the NOW behaves. From these principles a few desiderata follow: the NOW does not skip time points; things change only if the NOW moves; the NOW always moves. This last condition is required to guarantee that time never stops, and follows from the (crucial) assumption that change is necessary. In other words, time never ceases passing because things never cease changing.

Skow answers the second question along the same lines. Since change is what determines why and how time passes (via the movement of the absolute NOW), the rate at which this happens is also determined by change. Namely, the constant rate of time is determined by a constant rate of change in the world.

As Ned Markosian pointed out, the idea that passage of time entails change leads to trouble. For if we admit that there can be parts of the universe that are changeless for extended periods of time, we can use Lewis' mereological principle of recombination to show the possibility of an unchanging world in which time passes. In general, the proposed version of the moving spotlight theory is incompatible with the conclusions reached in Le Poidevin's paper. Skow replied that we should drop the unrestricted principle of recombination. Incidentally, one may think that the moving spotlight theory is inconsistent with special relativity. For A-theorists regard present as absolute, while in Einstein's theory coexistence is relative to an inertial frame of reference. Although he did not elaborate on this point, Skow claimed that the theory can be easily reconciled with special relativity.

L.A. Paul focused on the metaphysics of phenomenal experience. It is often argued that subjective or first-person knowledge cannot be derived from objective or third-person knowledge. For example, my experiencing the brightness of this computer screen cannot be reduced to knowledge of the cognitive processes instantiated in my brain. This is the point Thomas Nagel makes when he argues that a complete knowledge of a bat's brain will not tell us what it is like to be a bat. Let us call this the “epistemic gap". Anti-reductionists have relied on this fact to infer the existence of an ontological gap - which is, a gap between objective and subjective ontology, or between the objects of third-person experience and the objects of first person experience. This ontological dualism results in postulating consciousness and its properties as a primitive phenomenal ontology. The ontological irreducibility of consciousness is then used to explain why we cannot have objective knowledge of qualia. In other words, the ontological gap is both inferred from and used to explain the epistemic gap.

Paul accepts the epistemic gap but claims that neither is the inference from epistemic to ontological gap justified nor does primitive phenomenal ontology fill the epistemic gap. Her thesis is that, if we reject the inference and endorse physicalism, the epistemic gap can be explained by clarifying the ontology of cognitive properties. How so? An individual *S* is in the first-person state of seeing red if she has a relevant cognitive property, call it *R*. This does not mean that the subjective experience of seeing red is identical to the cognitive property *R*. Rather, it is identical to the structured entity *S's having R*. But what our scientific theories quantify over are cognitive properties like *R*, i.e. the properties instantiated in our brains, and these properties have less structure than relational complexes of the form *S's having R*.

Why does this explain the epistemic gap? After all, one might react, a complete scientific description of my brain will describe *S*'s having cognitive property *P*, for every cognitive property *P* had by *S*. The problem is that the epistemic gap is filled if the scientist, by means of sole objective knowledge, can have subjective experience of each cognitive property *S* has. But this can happen only if the scientist *is* the individual *S* having *R*. This fact shows that, if Paul is right about the ontology of cognitive properties, a physicalist cannot fill the epistemic gap but at least can explain why the gap cannot be filled. Consequently, the epistemic gap does not entail either an ontological or an explanatory gap.

Modality and Essence has discussed 1) some application of the notion of *essence* to the philosophy of language, and 2) the worth of treating *metaphysical de re modalities* in terms of *essence*. Possibility (necessity) is *de re* if it is a possibility (necessity) for an individual, or a collection of individuals. For example, by saying “Cicero is necessarily provided with a genetic code" I am making an assertion about a necessary property of the individual Cicero.

In the past few decades it has become standard to reduce facts about essence to facts about de re necessity, as per the definition: *x* is essentially a *P* iff *x* is necessarily a *P*. In possible-worlds semantics, this becomes: *x* is essentially a *P* iff *x* is a *P* at every world (or: at every world where *x* exists). Kit Fine has criticized this reductive approach, pointing out that there are necessary properties of individuals that are not their essential properties. For example, Cicero belongs necessarily to his own singleton, but not essentially, since the fact that Cicero belongs to singleton-Cicero is not part of the (real) definition of Cicero. Fine revived

the Aristotelian idea that not only expressions but objects as well have definitions, and essences of objects are their definitions. This allows to rid an object's essence of properties that are “merely" necessary. Accordingly, the *essence* of an object *x* is a set of properties on which *x* is identity-dependent, where *x* is identity-dependent on *P* iff the (real) definition of *x* involves *P*.

The session opened indeed with a talk by Kit Fine, titled *Essence and Modality in Language*. Fine suggested to regard meaning as a special case of essence. Roughly, the idea is that the *meaning* of an expression is something on which the expression is identity-dependent. The word 'snow' could not be itself if it referred to something different from its actual reference and if its sense would differ form the actual one. Central in this view is the notion of *semantic requirement*: a set of conditions an expression must satisfy to perform its given linguistic role. In order to shape its position Fine touched upon a crucial issue of semantics, the determination of sense and reference of expressions. Semantics has traditionally been ruled by the following principle:

> *Standard View*: The determination of the sense of an expression is prior to the determination of its reference and the latter derives form the former.

Fine proposes to reverse the order imposed by the standard view: the assignment of a sense to an expression will encode a semantic requirement on the reference of the expression. In other words, the sense of an expression is determined by a way of determining its reference. For example, the reference of the true identity sentence 'Cicero is Tully' is the proposition ⌜Cicero is identical with Cicero⌝. A given way of determining such a reference contributes as well to determining the sense of 'Cicero is Tully'. The new theory has a great advantage: it avoids a problem that jeopardizes the standard view. Indeed, it obtains that

> $\mathbf{T_1}$ 'p_1' is true iff p_1
> .
> .
> .
> $\mathbf{T_n}$ 'p_n' is true iff p_n

are theorems of the semantic theory. They are biconditionals as "'the snow is white' is true iff the snow is white", and the like. However, since any of $\mathbf{T_1}$,..., $\mathbf{T_n}$ are theorems, it follows that

> 'the snow is white' is true iff the snow is true and $\mathbf{T_1}$ and... and $\mathbf{T_n}$.

But suppose the above theorems are to assign a sense to a sentence (a widespread posit) and the sense of a sentence *p* contributes to determining the reference of *p*, as the standard view suggests. As a consequence, the sense of *any* sentence contributes to determining the reference of *p*. Yet it is implausible that, say, the reference of 'the snow is white' should be established also by means of "'the apple *a* is red' iff the apple *a* is red".

This problem about expressions and their meanings mirrors the above point on objects and their essences. The received semantic theory defines the meaning (essence) of an expression via its necessary properties, that is the conditions it necessarily satisfies. But some of these necessary conditions may not be constitutive of the meaning of the given expression. Fine's proposal skirts this problem, as the semantic requirement for 'the snow is white' does not apply to any other proposition. Indeed, the meaning of 'the snow is white' is determined by a requirement that depends on the requirements for 'snow' and 'white', and the latter do not coincide with the requirements for other expression (say 'apple', '*a*', 'red'). Thus, the account proposed by Fine avoids a redundancy affecting the standard theory.

The notion of essence has his opponents, too. In *Disagreeable Essences*, Daniel Nolan has questioned the notion of essence. A theoretical notion, argues Nolan, should be used only if we have good reasons to endorse the theories that employ it. What may these reasons be? According to Nolan, *theoretical appeal* and *explanatory power* are the main reasons to endorse a theory. A natural way to determine appeal and power of a theory is by *inference to the best explanation*. By extension, one may be tempted to apply this criterion to the case of essentialist theories, too. Yet it is not clear what "the best explanation" could be in metaphysics, and how it should be established. Indeed, the role of metaphysics is allegedly to decide what kinds of entities populate the world. But if it is our prejudice that there is nothing like essences in the world, no explanation that relies on essences can be the best" explanation. In other words, we cannot appeal to inference to the best explanation of what there is in order to decide what there is, namely whether there are essences. As a consequence, inference to the best explanation seems not to be a valid method to settle the debate.

Object and Property has hosted a symposium with Peter Simons, Ralf Busse, Joseph Melia and Benjamin Schnieder. In his *Tropes and part relations*, Peter Simons addressed some problems that ensue when we model properties as tropes. There are two traditions regarding the relationship between tropes and their bearers. One is the Aristotelian, according to which tropes are not parts of their bearers. The bundle theorists, on the other hand, regard a *concretum* as a bundle of tropes. It is not clear how else tropes could be instantiated if not by being parts of their bearers. For this reason Simons elaborates on trope theory within the bundle-theoretic tradition. Now, let us suppose that mereological parthood formalizes the trope-bearer relation. Some paradoxes will then arise. For example, any sphere contains a cube as a proper part, therefore a sphere is a cube by having a cube-ness trope as a part. Also, a connected sphere contains two disconnected spheres as parts, therefore a sphere is the fusion of two disconnected spheres. Likewise, a white shirt with a black fleck is a black shirt - and so on.

How can we block these conclusions without rejecting either trope or bundle theory?

There are three candidates that may take the blame:

1. parthood is transitive;
2. tropes are parts of their bearers;

3. *a* is *X* iff *a* contains an *X*-ness trope.

But we cannot drop (1) without abandoning classical mereology, and (2) amounts to bundle theory. So, if anything can be done at all, we must revise the third condition. Simons proposes the following version of (3):

1. If a trope *T* of kind *K* is part of a concretum *C* and not part of any concretum *D* which is a proper part of *C*, then *C* has *T* directly, and has the kind of property imparted by *K*.

As desired, this modification blocks the above paradoxes. For instance, every cube contained in a sphere as a proper part is also contained in a proper part of that sphere. Hence, the sphere does not have the property of being a cube.

The session *Meta-metaphysics* dealt with some methodological issues in metaphysics, with a particular attention to the status of existential statements and the value of the ontological commitment they carry.

The moral we can draw from the *Ειδος* Metaphysics Conference is twofold. In only a few decades analytic metaphysics has become a highly sophisticated discipline, with its own machinery of concepts, principles and goals. Although most central topics are being debated and some of them are still controversial, it cannot be denied that metaphysics has as defined a shape as it has ever had. On the other hand, current metaphysics is not fragmented as many other technical disciplines are, both inside and outside of philosophy. It is still possible for metaphysicians of all breeds to convene and discuss each other's views in a thorough and competent way. Metaphysics has avoided the risk of becoming a label for groups of philosophers with different interests, methods and backgrounds. One can only hope that this fortunate coincidence of sophistication and intellectual breadth will lead to further surprising results.

However, the event also had one remarkable absentee, the metaphysics of science. A good deal of today's metaphysics happens at the intersection with natural sciences, especially physics, as witnessed by the work of Tim Maudlin, James Ladyman, Steven French and Simon Saunders. But the challenges coming from quantum mechanics, relativity and biology - to mention a few - have barely been touched upon at the *Ειδος* Metaphysics Conference. This is even more striking as it happens at a time when Geneva kicks off the Large Hadron Collider experiment, the largest high-energy physics experiment yet. It is my conviction that we can hardly have a full-blown metaphysics without the physics.

One short remark on today's geography of metaphysics is due as well. It is a natural consequence of adopting the analytic method that metaphysics is being propelled mainly by the work of philosophers from English-speaking countries. Yet Geneva has become a central node for metaphysics in continental Europe and beyond. Hopefully this is the beginning of a more widespread trend.

I would like to thank Roberto Ciuni for his very helpful comments, as well as the Boston University Center for Philosophy and History of Science and the Boston University Philosophy Department for supporting my trip to Geneva.

Conference

The current state of Analytic Philosophy in Europe
ECAP 6: Sixth European Congress of Analytic Philosophy

Krakow, August 21-26 2008

Daniele Santoro[*] *& Vera Tripodi*[**]

It is a common opinion that the history of analytic philosophy tells the story of a diaspora of many and talented thinkers who were forced by the dreadful growing of fascism in Europe to escape to the United States, where they found safety and intellectual freedom. Europe was thus deprived of their best minds. The post-war period witnessed the rising of analytic philosophy as a distinctive academic discipline, whose role became dominant in the United States thanks to many of those emigrated intellectuals. With the exception of British and Scandinavian philosophers, analytic philosophy did not arise as a paradigm in continental Europe and the contributions to the analytic community appeared peripheral to the core Anglo-American debates. There are a number of reasons that explain why this happened beyond the mere historical contingency. However, in the last three decades, the situation has dramatically changed.

The European Society for Analytic Philosophy (ESAP) testifies to this change and shows that the presence of analytic philosophy in Europe is no longer a matter of the occasional interests of individual academics. Founded in 1991, ESAP has the explicit intent of regaining the universality of values and aspirations of analytic philosophy and to contribute to the revival of this tradition in continental Europe.

The main event organised by ESAP is its general conference (European Congress of Analytic Philosophy – ECAP), held on a regular basis once every three years. Since the beginning in 1993, Ecap meetings attracted many scholars from different countries (mainly, but not only European) and rapidly became one of the main international happenings in world philosophy. Nowadays, ECAP conferences represent a significant opportunity to assess the state of art and the direction of analytic philosophy with regard to the European culture.

The Sixth European Congress (Ecap 6) took place in Krakow last summer (August, 21-26), in collaboration with the Institute of Philosophy of the Jagiellonian University and the Polish Academy of Sciences. The large number of speakers (over 500) was spread out on an entire week of parallel sessions, and organised into nine sections (history of philosophy, logic, philosophy of language, epistemology, metaphysics, philosophy of science, philosophy of mind, ethics, and social philosophy). The congress hosted also five focus workshops ("Formal Methods in Philosophy", "Structured Meanings", "Minimalism", "Methods of Analysis in Metaphysics", "Values and Value Bearers"), while the plenary lectures were given by Dorothy

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Edgington (University of London), Zoltan Gendler Szabò (Yale University), and Andrea Bottani (University of Bergamo), who was the invited speaker for the 2008 *Dialectica* lecture.

In the opening lecture, "Counterfactual Thinking and Why it Matters", Dorothy Edgington examined the role that counterfactual judgments play in empirical reasoning by showing their usefulness and importance in coming up with reliable factual conclusions. According to Edgington, judgments explain and justify not only doxastic beliefs but also some of our reactions such as "being glad" or "sorry", "relieved" or "regretful". Widening the spectrum of counterfactual justification from modal validity to empirical reliability represents an important advancement in several directions: on one hand, it shows that the metaphysical presuppositions of counterfactual capacities (whether or not modelled in terms of possible worlds) are at work also in empirical reasoning, *pace* modal sceptics. On the other hand, it shows that the range of justifiability does not follow exclusively from a top-down notion of validity, but requires a bottom-up account of its reasonableness, a way of looking at counterfactuals that recalls Goodman's original proposal of a reflective equilibrium between inferences and rules of inferences. Finally, Edgington's lecture opened up the space of counterfactual analysis to reactive attitudes, which are essential cases both in the attribution of responsibility and, more generally, in moral psychology.

Dialectica, one of the most prestigious international journals of philosophy and official organ of ESAP, sponsors since 2005 a lecture series. Lecturers are chosen among distinguished international scholars, in recognition to their philosophical achievements. This year's guest speaker, Andrea Bottani addressed the topics of the metaphysics of time in relation to the problem of change. He focused on timeless properties by sketching the difference between the theories of persistence (the view that things exist at a number of times as more than a collection of things, each of which exists at just one time) and anti-reductionist theorists of persistence (the view that ordinary things exist at many times, partly or wholly). An interesting conclusion drawn by Bottani's careful analysis of timeless properties (say "being flat"), is that change requires ontic indeterminacy, i.e., for any entity, having a property at one time and not at another cannot be just a matter of tense, but – and more fundamentally – it is possible only if "it is indeterminate whether it is timelessly flat or not"[1].

Szabò's closing lecture on "The ontological attitude" was an overarching analysis of the meta-ontological implications of the different theories of the contemporary debate. A common concern of these theories is to resist a sort of trivialization of the nature of existing entities, without repudiating common sense and scientific intuitions about what it means for an entity to exist. In particular, Szabò's analysis concentrated on fictionalism, showing some difficulties with this strategy. The criticisms of fictionalism serves as a premise for Szabò's own proposal: believing ontological claims is not a sufficiently strong criterion for a general ontological theory, as we often believe things without really understanding what believing them amounts to. Any viable ontological theory must be consistent with the aim of inquiry "in order to understand a claim about certain putative entities one needs an explanation of what

[1] Volume of Abstracts, p. 10. Readers interested in single contributions can find the volume to Abstract at: http://ecap.phils.uj.edu.pl/welcome

those entities are"[2]. Such attitude requires a Cartesian attitude – the right ontological attitude according to Szabò – that is a quest for those beliefs that are composed by the clear and distinctive ideas. These beliefs (far from being trivial) express the core elements of ordinary and scientific knowledge, which any ontology should take into account if it wants to be explanatorily fruitful.

Szabò's lecture on meta-ontology is indicative of a promising development of analytic philosophy in Europe, whose most original contributions, one might say, rely upon its origins (both recognized, such as Frege, or overlooked, as in the case of Brentano). Evidences of this general trend are both the section on Metaphysics and Ontology (perhaps the most attended) and the workshop organised by Arianna Betti (Vrije Universitet - Amsterdam) on "Metaphysics and its methods". The workshop started from an anti-semanticist standpoint: "In contrast with traditional analytic philosophy, recent works in metaphysics area show dissatisfaction with linguistic or semantic arguments for or against entities"[3]. The speakers invited to the workshop discussed several issues deriving from the rejection of a semanticist criterion, and possible ways to give substance to the idea of a serious non-semanticized metaphysical work. However, setting up criteria of metaphysical admissibility calls into question the justifiability of those very criteria. As an example, consider whether naturalism should be in the list of what a good metaphysics should explain. If yes, a posteriori methods seems required; on the other hand, even if we reject armchair philosophy in name of a naturalistic approach, one might wonder whether primitive metaphysical notions would be intelligible without presupposing some basic semantic or conceptual analysis.

The workshop on "Kinds of value and kinds of value Bearers", organised by Kevin Mulligan (University of Geneva) and Wlodek Rabinowicz (Lund University), was dedicated to theories of value across different fields of research: aesthetic and ethical values, epistemic values, values in terms of personal welfare. The discussion was framed around concerns in formal axiology (the logic of value, the conceptual distinctions and connections between different value types, the relationships between value concepts and normative notions). Among the topics we should mention: what kinds of objects bearers of value can be (persons, things, actions, character traits, social systems, states of affairs, facts, etc.) and how these kinds of values are to be distinguished or related.

The workshop entitled "Formal Methods in Philosophy" - organised by Stephan Hartmann (Tilburg University) and Hannes Leitgeb (Bristol University) - focused on the recent revival of formal methods in philosophy by addressing its origin and general limits of formalization in different areas of philosophy.

Problems connected with the set-theoretical conceptions of meanings and concepts were the subject of the "Structured meaning and concepts" workshop organised by Pavel Materna (Masaryk University in Brno) and Marie Duzí (VSB-Technical University of Ostrava). Set-theoretical conceptions of meaning are typically functions from intensions to possible worlds. These approaches to semantics are subjected to several criticisms (e.g.: linguistic competence cannot be explained as a matter of knowing such functions). The workshop proposed a

[2] Volume of Abstracts, p. 8.
[3] See the workshop description in the Volume of Abstract, p. 40

procedural semantics invulnerable to these attacks. According to this model, "meanings are algorithmically structure abstract procedures that are encoded by language expressions via linguistic conventions"[4].

The workshop on minimalism – organised by Filip Buekens (Tilburg University/TILPS) – explored the limitations of the classical account of truth minimalism and discussed some recent attempts to accommodate minimalism with substantial accounts of truth.

As for what concerns the parallel sessions, the variety of topics was so wide–ranging that we will not even attempt to give a summary. Here, we will just recall the contributions from the invited speakers to the thematic sessions.

Kristòf Nyíri (Hungarian Academy of Science – Budapest) addressed the lecture for Section 1 (history of philosophy). Nyíri presented an interpretative talk on McTaggart's argument against the reality of time, showing that McTaggart's ideas were indeed not as path breaking as one might expect, and "undeserved respectability" was given to his argument from the Einstein-Minkowski conception of space-time.

Section 2 (Logic and Computation) hosted Gabriel Sandu (IHPST, Paris) who presented an interesting attempt to systematize the notions of logical dependence and independence between terms, quantifiers and operators according to a game-theoretic paradigm (as opposed to the compositional one).

In Section 3 (Philosophy of Language), Genoveva Martì (ICREA & Universitat de Barcelona) defended the idea that a good philosophical methodology should not dismiss conceptual analysis; rather, far from being another case of armchair philosophy, conceptual analysis should be a guide for experimental philosophy, not the other way round. The case discussed by Martì was Kripke's claim that names are not descriptive and Stich's objections based on cognitive experiments.

Mike Martin (University of London) was the invited lecturer for Section 4 (Epistemology). He addressed the well-known McDowell's reflections on non-conceptual content in his *Mind & World,* and showed how McDowell's argument rests primarily on some assumptions about the self-awareness of our perceptual experience.

Achille Varzi (Columbia University) – invited lecturer for Section 5 on Metaphysics – discussed the classical problem of the metaphysics of natural properties: whether they belong or not to the furniture of the world. Varzi assumes the correctness of Dummett's idea that Nature, as such, is not yet articulated in discrete objects, kinds, and properties. However, the Dummettian assumption does not imply any of the classical solutions to the problem of how can we provide a knowledgeable description of the world. The paper worked out an original position, which rejects strong realism on one side, without falling within any of the given views on the market (either idealism, irrealism, projectivism, relativism, or even post-modern anarchism). A sort of nominalist view was adumbrated during the discussion, although not explicitly addressed in the paper.

[4] Volume of Abstract, p. 31.

In section 6, Thomazs Placek (Jagiellonian University, Krakòw) presented a fine-grained analysis of the implication of John Bell's theorem, namely the thesis that "no physical theory [that] is realistic and also local in a specified sense can agree with all of the statistical implications of Quantum Mechanics"[5]. The philosophical significance of Bell's theorem consists of the experimental analysis of the metaphysics required by the theorem, namely which metaphysical premises justify the discrepancy between the results of a physical theory and the quantum mechanical statistical expectations. In particular, problems with the metaphysics of causation arise which call for an adequate explanatory framework. Placek proposed Nuel Belnap's branching space-times as the framework capable of capturing the spatiotemporal, probabilistic, and modal aspects involved by the theorem.

In section 7, Katalin Farkas outlined a new theory of the intentionality involved in sensory experience. In particular, Farkas defended the – quite heterodox - position that the best way to describe the intentional objects of perceptual experience is by conceiving of them as independent of the occurrence of the experience in question. This way, Farkas provides a basis for a theory of non-conceptual content, where the intentional features of sensory experience can be explained in terms of features belonging to the objects as such.

Section 8 (Ethics, Aesthetics, and Action Theory) hosted the lecture by Robert Hopkins (University of Sheffield), who presented a talk in which he discussed the idea of 'inflected' pictorial experiences. Inflected pictures involve an awareness of the features of their design. Hopkins clarified the properties which characterize pictures of this sort can be understood in turn only by reference to their design. Hopkins discussed some proponents of inflected experiences (notably, Lopes) and argued that, once we have a clear theory of inflection, it is hard to understand why it matters, beyond mere triviality.

The last section (Social & Political Philosophy, Philosophy of Law) hosted Peter Koller (Institute of Legal Philosophy – University of Graz), who addressed the relationship between the goals of the market (efficient coordination of economic activities) and the requirements of contractual justice. After an overview on some alternative approaches, Koller argued that the preconditions of market efficiency (free access, rationality, information, etc.) converge with the demands of contractual justice. In particular, Hopkins defended the claim that a theory of *fair market* should include a conception of distributive justice (an acceptable distribution of rights and endowments) in terms of contractual justice.

One might ask, in conclusion, whether a distinctive contribution to the analytic approach in philosophy can be found in Europe, or rather dismiss the expression "European" analytic philosophy as merely a geographical label. A growing opinion is that this latter dismissive judgment would be ungrateful and – after all - substantially wrong. However, it is not easy to say in what such newly gained (or re-regained?) distinctiveness would consist. Participants to ECAP 6 might wonder whether contemporary analytic philosophy in Europe is dispersed among different streams that hardly converge. But this impression could be generalized to philosophy in general, and does not seem to be an informative judgment. Rather, recurrent discussions among leading philosophers and schools in Europe shows a revival of metaphysical

[5] Shimony, Abner, "Bell's Theorem", *The Stanford Encyclopedia of Philosophy (Fall 2008 Edition)*, Edward N. Zalta (ed.), URL = <http://plato.stanford.edu/archives/fall2008/entries/bell-theorem/>.

concerns, but beyond the legacy of the semantic program of the founding fathers of analytic philosophy. Whether this is a way to revalue some neglected origins of the discipline we are not sure. But a growing importance tributed to metaphysics and ontology in recent years has no parallel in the American departments.

On a more sociological ground, so to speak, we should say that the importance of analytic philosophy in Europe has become stronger in countries traditionally associated with a different culture of philosophical thinking like France, Spain and Italy (as one can notice by the number of scholars from these national communities). This is also a sign, perhaps, of a more general trend in contemporary analytic philosophy, where the constant enlargement to new communities of research has changed – to some extent- the traditional centrality associated with the predominance of American academia.

Moreover, the contributed papers showed a good average quality and many young scholars exhibited an impressive technical competence beyond their strict area of competence.

On a less positive note, two aspects should be mentioned: first, whilst the conference drew a fairly international crowd, there still were few women philosophers in attending and giving papers (especially at the most prestigious and attended sessions). Second, the conference showed that some areas of philosophical analysis are still neglected and left aside from its core program. In particular, session sessions in practical philosophy (8 and 9) were less attended, and fewer papers were presented. Whatever reasons might explain under-representation in the case of women and of some disciplines, an improvement should be made, if as analytic philosophers we want to be faithful to the democratic ideal of a community led by principles of rigorous critical evaluation and discussion by peers.

This is, we think, a task for the new president of ESAP, Michele Di Francesco (Università San Raffaele, Milano), who was elected by the general assembly along with a new steering committee. Di Francesco's office will lead the society to the next European Congress, announced for 2011 in Milan, Italy. In the meanwhile, for more information about ESAP's activities, visit the following website: http://www.dif.unige.it/esap/. This webpage is regularly updated with information about other workshops and middle term conferences sponsored by ESAP and by other national societies of analytic philosophy.

Modalities in Temporal Logic*

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ABSTRACT

In logics of branching-time, 'possibility' can be conceived as 'existence of a suitable set of histories' passing through the moment under consideration. A particular limit case of this is the Ockhamist notion of possibility, which is explained as truth at some history. The tree-like representation of time offers other ways of defining possibility as, for instance, truth at any history in some equivalence class modulo *undividedness*. In general, we can consider representations of time in which, at any moment *t*, the set of histories passing through *t* can be decomposed into indistinguishability classes. This yields to a new general notion of possibility including, as particular cases, other notions previously considered.

1. INTRODUCTION

The modal notions considered in this paper are closely related to the assumption that, according to Indeterminism, moments in Time have many different, incompatible, possible futures.[1] If a coin is tossed at moment t_0, we can think of two moments t and t', both in the future of t_0, in which it comes out tails and heads, respectively. This means in particular that Time is *branching*: it does not consist of a single linear sequence of moments; it is made of different *possible courses of events*. A further assumption of Indeterminism is that only the future (of a given moment) is manifold; the past is unique. Then, if two courses of events share a common moment, they also overlap in the past of that moment.

From a set-theoretical point of view, the above considerations lead to conceive Time as a *tree*. In the context of branching-time semantics, a *tree* is a pair $\mathbf{T} = \langle T,< \rangle$ in which T is a set and $<$ is a binary relation on T with the following properties: *irreflexivity* ($t \not< t$ for all $t \in T$), *transitivity* (if $t < t'$ and $t' < t''$, then $t < t''$), and *left-linearity* (if $t' < t$ and $t'' < t$, then either $t' < t''$, or $t'' < t'$, or $t' = t''$). The elements of T represent (and are called) *moments*, and $<$ is the *earlier/later* relation between them. Thus, $t < t'$ can be read as 't is in the past of t'', or as t' is in the future of t'. By irreflexivity, no moment is in the past or in the future of itself. Left-linearity is the set-theoretical correspondent of the uniqueness of the past. Figure 1 below represents a tree in which $t' < t$ whenever t can be reached from t' moving upward along a line. Then t_0 is in the past of both t_1 and t_2, but these two moments are not temporally comparable.

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[1] I will not consider, then, notions of possibility defined in terms of temporal notions like, e.g., the *Diodorean possibility* which is defined as "truth now, or in the future". For such notions, see (Denyer 2009) and (Ciuni, 2009), in this volume.

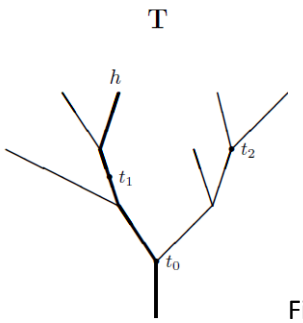

Figure 1

A *linear order* < on the set *X* is an irreflexive and transitive relation on *X* such that, for all $x \neq y$ in *X*, either $x < y$ or $y < x$. A history in a tree **T** is a subset *h* of *T*, which is linearly ordered by < and is maximal for inclusion: for every $X \subseteq T$, if $h \subseteq X$ and < linearly orders *X*, then $X = h$.[2] The marked line *h* in Figure 1 represents a history. Histories correspond to (complete) courses of events and play a crucial role when possibilities are involved in branching-time contexts. Sentences like "it is possible that it will come up tails" allow representations in terms of (first-order) quantification over moments: "there is a future moment in which it comes up tails". But sentences like "it is possible that it will *never* come up heads" involve a (second order) quantification over courses of events.

Quantification over histories is a peculiar aspect of Prior's Ockhamist and Peircean semantics for branching-time (Prior, 1967), which are defined in Section 2. In both these semantics, possibility is viewed as existence of a history: 'possible at moment t_0' in Figure 1, means 'true in (at least) one of the histories passing through t_0'. This agrees with the above example of the toss of a coin.

There are other ways, though, in which possibility can be conceived. Considering Figure 1 again, we can observe that, at t_0, Time branches out in *only two ways*, despite the fact that there are six histories passing through that moment. Possibility at t_0 can be viewed as openness with respect to take one path or the other. From the set-theoretical point of view, this notion of possibility is based on the *undividedness* relation between histories (Section 3), which is particularly relevant in Belnap's *s.t.i.t.* logic of agency (Belnap et al. 2001).

The notion of undividedness can be generalized by considering other ways of 'grouping histories together'. In (Zanardo, 1998) I have considered the notion of *indistinguishability* (possibly for a given agent) between histories. Intuitively, we can assume that, at any given moment in Time, some histories passing through that moment cannot be distinguished from one-another.

Consider for instance a game G with two players, P_1 and P_2, and let *M* be the set of all possible moves. Then a match is a sequence $m^1_0, m^2_0, m^1_1, m^2_1 \ldots$ of moves, where the superscripts denote the player and m^i_n belongs to a set $M^i_n \subseteq M$. The set M^i_n is determined by the situation reached at that step of the match. The rules of G might establish, for instance, that the match ends (and P_i loses) when M^i_n is empty. The set of all possible matches of the game can be

[2] Histories are sometimes *chronicles*, for instance in (Øhrstrøm and Hasle, 1995) and (Øhrstrøm, 2009)

viewed as the set of histories in a tree structure $\mathbf{T}_G$.[3] At any stage t_0 of a match, the choice of the player in turn depends, among other things, on the investigation of the possible evolutions of the match after that stage. In this context, it is quite reasonable to assume that the player is unable to distinguish different evolutions if they agree (overlap) on a sufficiently large number of moves. That number depends of course on the complexity of the game as well as on the computing ability of the player.

Differently from undividedness, indistinguishability is a primitive notion. Thus, in Section 4, I will consider temporal structures consisting of a tree endowed with a family of binary (indistinguishability) relations, indexed on the set of moments. This will allow us to define other kinds of possibilities. In particular, in Section 5, I will consider the notion of possibility related to the notion of choice. It will be shown that indistinguishability provides a general framework for dealing with all these modal notions.

2. OCKHAMIST AND PEIRCEAN SEMANTICS

In this paper only propositional languages are considered: starting with a denumerable set $\{p_0,p_1,...,p_n,...\}$ of propositional variables, complex formulas are built by means of the usual Boolean operators.[4] Temporal languages have in general two further operators, P and F, which are read as 'at least once in the past' and as 'at least once in the future' (of the moment under consideration). The interpretation of the past operator is rather obvious: if α is true at a moment t, then $P\alpha$ is true at any t' in the future of t. When Time is given a tree-like structure, the interpretation of the operator F is more controversial. This issue is widely discussed in (Prior, 1967), where Ockhamist and Peircean semantics are proposed as solutions to the problem of interpreting formulas of the forma $F\alpha$ in branching-time contexts.[5]

The peculiar aspect of the Ockhamist reading of the operator F is that, in general, it makes no sense to ask whether formulas of the form $F\alpha$ are true or false at a given moment. Ockhamist truth is relative to pairs $\langle t, h\rangle$, where the moment t belongs to the history h. This means that the truth value of $F\alpha$ at $\langle t, h\rangle$ is established on the basis of the truth value of α at pairs $\langle t', h\rangle$, where t' is in the future of t and belongs to h.[6]

Since histories are linear orders, Ockhamist logic of the operators P and F is linear-time logic. In order to deal with the branching aspect of Time, Ockhamist language has a modal operator $\Diamond$ which is read "at some history passing through the moment under consideration".

[3] The technical details of the definition of T_G are a bit complex since a single move m can occur in different matches. Thus, we have to consider as elements of T_G the finite sequences $\sigma = \langle m_0, m_1,...,m_n\rangle$ that are compatible with the rules of G, and we set $\sigma < \sigma'$ whenever σ is an initial segment of σ'.

[4] The restriction to the propositional case agrees with most of the works on the subject of this paper. The extension to first-order languages are technically very complex and the quantification within or without tense operators raises difficult, but extremely intriguing, philosophical problem

[5] It is interesting to observe that Ockhamist and Peircean logics are quite similar to the logics CTL* and CTL (*Computation Tree Logic*), which were independently defined as application of temporal logic to Theoretical Computer Science (Clark et al., 1986; Emerson and Halpern, 1986).

[6] Sometimes, truth at $\langle t, h\rangle$ is explained as "truth at t, under the assumption that h is the history that will *actually* take place". But, as shown in (Belnap and Green, 1994) and (Belnap et al., 2001), the notion of *actual future* is rather debatable. This matter is widely discussed in (Øhrstrøm, 2009) in this volume.

Then, as observed in the introduction, the first notion of possibility that we find in a branching-time context is "truth, at some course of events".

Given any tree **T**, the set of all histories in it will be written as **H**(**T**). We write $\mathbf{H}_t(\mathbf{T})$, or $\mathbf{H}_t$ when **T** is given by the context, to denote the set of histories passing through the moment *t*. An Ockhamist evaluation of the propositional variables in **T** is a function *V* assigning each propositional variable a set pairs $\langle t', h\rangle$ in which $t \in h \in \mathbf{H}(\mathbf{T})$. We read $\langle t', h\rangle \in V(p_n)$ as "p_n is true at $\langle t', h\rangle$".[7]

Ockhamist truth relation will be written $\vDash_{Ock}$ and is recursively defined by rules $\mathbf{O}_0$ to $\mathbf{O}_5$ below. $\mathbf{T},V \vDash_{Ock} \alpha\ [t, h]$ means that "α is true at $\langle t', h\rangle$ in **T** with the evaluation *V*".

$\mathbf{O}_0 : \mathbf{T},V \vDash_{Ock} p_n\ [t, h]$	iff	$\langle t',h\rangle \in V(p_n)$
$\mathbf{O}_1 : \mathbf{T},V \vDash_{Ock} \neg\alpha\ [t, h]$	iff	$\mathbf{T},V \nvDash_{Ock} \alpha\ [t, h]$
$\mathbf{O}_2 : \mathbf{T},V \vDash_{Ock} \alpha \wedge \beta\ [t, h]$	iff	$\mathbf{T},V \vDash_{Ock} \alpha\ [t, h]$ and $\mathbf{T},V \vDash_{Ock} \beta\ [t, h]$
$\mathbf{O}_3 : \mathbf{T},V \vDash_{Ock} F\alpha\ [t, h]$	iff	$\exists\, t' \in h : t < t'$ and $\mathbf{T},V \vDash_{Ock} \alpha\ [t', h]$
$\mathbf{O}_4 : \mathbf{T},V \vDash_{Ock} P\alpha\ [t, h]$	iff	$\exists\, t' < t : \mathbf{T},V \vDash_{Ock} \alpha\ [t', h]$
$\mathbf{O}_5 : \mathbf{T},V \vDash_{Ock} \Diamond\alpha\ [t, h]$	iff	$\exists\, h' \in \mathbf{H}_t : \mathbf{T},V \vDash_{Ock} \alpha\ [t, h']$

Universal closures of $\mathbf{T},V \vDash_{Ock} \alpha\ [t, h]$ (with respect to *V*, or $\langle t, h\rangle$, etc.) are written in the usual way. For instance $\mathbf{T},V \vDash_{Ock} \alpha$ means that $\mathbf{T},V \vDash_{Ock} \alpha\ [t, h]$ holds for all *t* and $h \ni t$. If $\vDash_{Ock} \alpha$, then we say that α is an Ockhamist *validity*.

The dual operators *H*, *G*, and □ are defined in the usual way as $\neg P\neg$, $\neg F\neg$, and $\neg\Diamond\neg$, respectively, and their meaning is given by the obvious universal quantification over moments or over histories.

Ockhamist truth of formulas of the form $\Diamond\alpha$ or $\Box\alpha$ is history independent, in the sense that $\mathbf{T},V \vDash_{Ock} \Diamond\alpha\ [t, h]$ implies $\mathbf{T},V \vDash_{Ock} \Diamond\alpha\ [t, h']$ for all $h' \ni t$, and similarly for $\Box\alpha$.[8] Also formulas of the form $P\alpha$ enjoy a sort of history independency: the truth of $P\alpha$ at $\langle t, h\rangle$ does not depend on *h* whenever α is built from formulas of the form $\Box\alpha_1,\ldots, \Box\alpha_n$ without any use of the operator *F*. If history independent evaluations are adopted (see Footnote 7), then we have only to assume that α is *F*-free. There is a substantial difference, though, between the independence from histories of formulas of the form $\Diamond\alpha$ and that of formulas $P\alpha$. In the first case, the property is due to the quantification over histories in the semantics of the operator ◊, while, in the second case, the property is due to the tree-like structure of time: all histories passing through the

[7] Some authors consider *history independent* evaluations, that is, evaluations assigning sets of *moments* to propositional variables. With these evaluations, the truth condition $\mathbf{O}_0$ below would be simply $t \in V(p_n)$ and $p_n \equiv \Box p_n$ would be a validity. This corresponds to the idea that propositional variables represent atomic facts (like "it is raining") and hence their truth depends only on the moment under consideration. Prior himself discusses this issue in (Prior, 1967). A brief discussion can also be found in (Zanardo, 2006b).

[8] The logic CTL* distinguishes between *state formulas* and *path formulas*. The former are those equivalent to formulas of the form $\Box\alpha$, whose truth depends only on the moment (state) and does not depend on the particular history (path) we are considering.

moment at hand agree in the past of that moment.

Peircean truth is relative to moments and the quantification over histories is implicit in the operator **F** which is interpreted as "at some future moment, *on each history*". Peircean language has also a 'weak' future operator, **f**, whose meaning is "at some future moment, *on some history*".
Peircean evaluations on a tree $\langle T,<\rangle$ are functions V assigning a set of moments to each propositional variable. Peircean truth relation $\vDash_{Peir}$ is defined by rules $\mathbf{P}_0$ to $\mathbf{P}_5$ below. We read $\mathbf{T},V \vDash_{Peir} \alpha\ [t]$ as "α is true at t in **T** with the evaluation V".

$\mathbf{P}_0$: $\mathbf{T},V \vDash_{Peir} p_n\ [t]$ iff $t \in V(p_n)$
$\mathbf{P}_{1,2}$: the usual rules for $\neg$ and $\wedge$
$\mathbf{P}_3$: $\mathbf{T},V \vDash_{Peir} \mathbf{F}\alpha\ [t]$ iff $\forall h \in \mathbf{H}_t, \exists t' \in h$: $t < t'$ and $\mathbf{T},V \vDash_{Peir} \alpha\ [t']$
$\mathbf{P}_4$: $\mathbf{T},V \vDash_{Peir} \mathbf{f}\alpha\ [t]$ iff $\exists h \in \mathbf{H}_t, \exists t' \in h$: $t < t'$ and $\mathbf{T},V \vDash_{Peir} \alpha\ [t']$
$\mathbf{P}_5$: $\mathbf{T},V \vDash_{Peir} P\alpha\ [t]$ iff $\exists t' < t : \mathbf{T},V \vDash_{Peir} \alpha\ [t']$

As observed above, in Peircean semantics the second-order quantification over histories is implicit in the truth rules for the operators **F** and **f**. Thus, we don't have modal operators in the usual sense.[9] On the technical side, it must be observed that in rule $\mathbf{P}_4$ the expression $\exists h \in \mathbf{H}_t, \exists t_h \in h : t < t'$ ... is equivalent to $\exists t' > t$... and hence this rule is expressible by a first-order quantification over moments.

The dual operator $H = \neg P \neg$ has the obvious meaning also in Peircean logic, and this holds similarly for future universal operators $\mathbf{G} = \neg\mathbf{f}\neg$ which can be read "always in the future". The operator $\mathbf{g} = \neg\mathbf{F}\neg$ is more interesting: by $\mathbf{P}_3$, its meaning is "always in the future, *on some possible history*". If α means "it comes up heads", then the sentence "it is possible that it will never come up heads" considered above is expressed by $\mathbf{g}\neg\alpha$.

Peircean language can be viewed as a fragment of the Ockhamist one because the operators **f** and **F** can be expressed as $\Diamond F$ and $\Box F$.[10] Despite this technical relation, it is evident that the two approaches correspond to deeply different conceptions of the meaning of tensed assertions in branching-time contexts.

2.1 BUNDLED TREE SEMANTICS

The Ockhamist operator $\Diamond$ and the Peircean operator **F** quantify over the set $\mathbf{H}_t$ of *all* the histories passing through the moment t at hand. Various works in the literature have

[9] In the *neighborhood semantics* of (Segerberg, 1971), or in the *minimal models* of (Chellas, 1980) we can actually see a semantics for modal logic similar to Peircean semantics for the operator **F**.
[10] Since, in Peircean semantics, propositional variables are evaluated at sets of moments, this embedding of Peircean language into Ockhamist one preserves truth on if history independent (Ockhamist) evaluations are considered -see Footnote 7.

considered branching time semantics in which these operators quantify over a fixed set of histories passing through *t,* possibly different from $\mathbf{H}_t$. Formally, a bundled tree is a pair $\langle T, \mathcal{B}\rangle$ in which $\mathcal{B}$ is a set of histories such that $\cup\, \mathcal{B} = T$, that is, every moment in **T** belongs to some element of $\mathcal{B}$. In Figure 2, for instance, every moment belongs to some h_i and hence we can consider a bundle $\mathcal{B}$ consisting of those histories. We have $\mathcal{B} \neq \mathrm{H}(\mathbf{T})$ because $h_\omega \notin \mathcal{B}$.

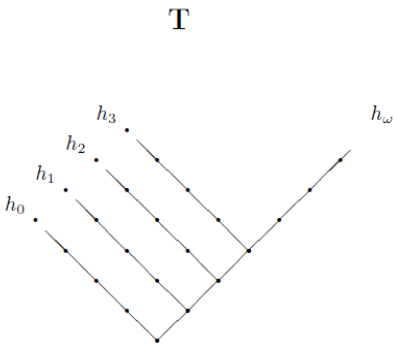

Figure 2

Ockhamist and Peircean semantics can be based on bundled trees: the only difference is that the quantification over $\mathbf{H}_t$ in $\mathbf{O}_5$ and $\mathbf{P}_3$ is replaced by quantification over $\mathbf{H}_t \cap \mathcal{B}$.

From the mathematical logic point of view, moving from trees to bundled trees allows to turn a second-order quantification into a first-order one and the matter offers many technical problems and results (Burgess, 1979; Burgess, 1980; Zanardo, 2006b; Zanardo et al. 1999). On the philosophical side, quantifying over histories in a bundle amounts to hold that, at any moment in Time we can consider a set of *admissible histories* and that there might be maximal linear sequences of moments which are not admissible. This matter is discussed, for instance, in (Belnap et al., 2001) and in (Thomason, 1984), where this point of view is criticized: roughly speaking, excluding the history h_ω in the structure of Figure 2, seems to lead to counterintuitive consequences of some plausible premises -see (Belnap et al., 2001, pp.199-203). In (van Benthem, 1986), instead, the admissible history approach is defended. In private correspondence, van Benthem writes: *putting in a set of runs [*i.e. histories*] explicitly at least invites us to state interesting conditions on them, that explain the temporal reasoning practice we want to analyze.*

In the sequel of this paper I will still consider only *standard structures* in which history quantifiers act on the whole sets $\mathbf{H}_t$, but for all those structures the bundled tree semantics can be adopted as well.

3. UNDIVIDED HISTORIES - IMMEDIATE POSSIBILITIES

Definition 3.1 *The histories* h_1 *and* h_2 *are* undivided *at the moment t in the tree* $\langle T,<\rangle$ *(in symbols,* $\mathrm{U}_t(h_1, h_2)$*) whenever there exists a moment* $t' > t$ *such that* $t' \in h_1 \cap h_2$.

The relation U_t is called undividedness at *t* and is an equivalence relation on $\mathbf{H}_t$. The

equivalence class of h modulo U_t will be written $[h]^U_t$. As observed in the introduction, equivalence classes modulo U_t represent the ways in which Time branches out at t and it is natural to refer to them as *immediate possibilities* at t (Belnap, 1992). For instance, in Figure 1 there are two immediate possibilities at t_0 while at any $t < t_0$ there is only one immediate possibility. In Belnap's *s.t.i.t.* logic of agency (Belnap et al., 2001), undividedness is deeply involved in connection with the notion of *choice* (see also the *Theory of Causation* in (von Kutschera, 1993)). These issues will be discussed below in Section 5.

In (Zanardo, 1998) I have considered an extension of Ockhamist language obtained by adding an operator $\Diamond^U$ quantifying within equivalence classes modulo undividedness. The semantics of this operator is given by the following rule

$$\mathbf{T},V \vDash_{Ock} \Diamond^U \alpha\ [t, h] \text{ iff } \exists h' : U_t(h, h') \text{ and } \mathbf{T},V \vDash_{Ock} \alpha\ [t, h']$$

Some combinations of $\Diamond^U$ with Ockhamist operators are equivalent to Ockhamist expressions. For instance, it easy to verify that

$$\vDash_{Ock} \Diamond^U \Diamond\alpha \leftrightarrow \Diamond\alpha \text{ and } \vDash_{Ock} \Diamond^U \Box\alpha \leftrightarrow \Box\alpha$$

but in general the operator $\Diamond^U$ is not expressible in Ockhamist language: for instance, the formula $\Diamond^U Gp_0$ is not equivalent to any Ockhamist formula (Zanardo, 1998, Prop. 3.1). Beyond the technical details, the non-equivalence between the standard Ockhamist language and the present enriched one reflects the fact that, in general, quantifications over a given equivalence class modulo U_t cannot be simulated by quantifications over the whole $\mathbf{H}_t$.

In this enriched version of Ockhamist language, the possibility operators, $\Diamond$ and $\Diamond^U$, still quantify over histories, but a quantification over immediate possibilities can be simulated by combining those operators. For instance, the formula $\Diamond\Box^U\alpha$ expresses the fact that α holds at (every history of) some immediate possibility.

In the above-mentioned paper I have also considered Peircean-like operators quantifying over the set of immediate possibilities at a given moment of a branching-time structure. For instance, I have considered an operator therein written as $\mathbf{f}^U$ defined by

$$\vDash_{Peir} \mathbf{f}^U \alpha\ [t] \text{ iff } \textit{there is an immediate possibility } \pi \textit{ at } t \textit{ such that}$$
$$\forall h \in \pi, \exists t' \in h : t<t' \textit{ and } \vDash_{Peir} \alpha\ [t']$$

Also this operator is not definable in the usual Peircean language (Zanardo, 1998, Prop. 3.5).

The results sketched above show that, in order to deal with reasonable notions of possibility related to undividedness, new operators are needed. In Section 5 I will show that these notions of possibility can be viewed as a particular case of possibility related to indistinguishability.

3.1 RELATIVE CLOSENESS -TOPOLOGY

Undividedness at t, as a partition of $\mathbf{H}_t$, determines a sort of relative closeness relation in this set: if $U_t(h, h_1)$ holds, but $U_t(h, h_2)$ does not, then it makes sense to say that h is closer, or more similar, to h_1 than to h_2. In general, we can set

$$Cl(h, h_1, h_2) \Leftrightarrow h \cap h_2 \subset h \cap h_1 \qquad (3.1)$$

where $\subset$ is proper inclusion. The ternary relation Cl is called *relative closeness* and $Cl(h, h_1, h_2)$ is read as *h is closer to h_1 than to h_2*.

Differently from undividedness, relative closeness does not depend on a particular moment. It is also worth observing that this relation is not always definable in terms of undividedness. Consider for instance the tree of Figure 3 and assume that the intersection $h \cap h_1 \cap h_2$ has no maximum, while $h \cap h_1$ has just one moment which does not belong to h_2. In this case, for any moment t, $U_t(h, h_1) \Leftrightarrow U_t(h, h_2)$, but we have also $Cl(h, h_1, h_2)$.

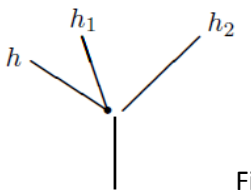

Figure 2

The natural environment for relative closeness issues is topology. Given any tree **T**, we can consider the topology τ_T on H(**T**) generated by the set $\{\mathbf{H}_t : t \in T\}$ (Sabbadin and Zanardo, 2003). It is straightforward to verify that $Cl(h, h_1, h_2)$ holds if and only if there exists an open set X in τ_T such that $h, h_1 \in X$, but $h_2 \notin X$.

The topological approach is not only a different way of describing the usual set-theoretical relations between moments and histories in a tree. This approach provides also a different ontological perspective under which branching-time semantics can be viewed. In the papers (Zanardo, 2004; Zanardo, 2006a) I have inverted (dualized) the usual perspective which describes histories as set of moments. It turns out that we can start from a primitive notion of history with a suitable topology on the set of all histories, or with a (primitive) notion of relative closeness having two suitable, quite natural, properties: (1) *every history is closer to itself than to any other history*, and (2) *if h is closer to h′ than to h″, then it is not the case that h is closer to h″ than to h′*. Representation results can be proved and, as far as Ockhamist validity is concerned, the dual approach turns out to be equivalent to the original one.

4. INDISTINGUISHABLE HISTORIES - RECOGNIZED POSSIBILITIES

In the Introduction I considered an example of indistinguishable histories in the framework of a given game. In that example two histories cannot be distinguished at the moment t if, in the future of t, they overlap on a segment Δt whose length depends on the complexity of the

game and on the computing ability of the player. If $\Delta t > 0$, then indistinguishability can be viewed as a strengthening of undividedness: any two indistinguishable histories are also undivided.

Examples of the opposite situation can be considered as well. Assume for instance that the agent a is at a cross-roads at the present moment t_0, and that he can decide either to turn left or to turn right. Then the set $\mathbf{H}_{t_0}$ can be decomposed into two sets $\mathbf{H}_{\text{left}}$ and $\mathbf{H}_{\text{right}}$ according to the choice of the agent a. Given any $h_l \in \mathbf{H}_{\text{left}}$ and $h_r \in \mathbf{H}_{\text{right}}$ we have that h_l and h_r are divided at t_0 because, in the near future of t_0, they differ, at least, in a's choice. If the notion of indistinguishability we are considering is relative to the knowledge of some other agent b who has no access to a's activity, then h_l and h_r might be indistinguishable at t_0. This happens, for instance, when the only difference between h_l and h_r in the near future of t_0 is just the choice of the agent a.

In any case, any reasonable notion of indistinguishability seems to have a temporal dimension: if two histories are distinguishable now, they cannot become indistinguishable at some future moment. This justifies the following formal definition.

Definition 4.1 *An* **I**-tree *is a pair* $\langle \mathbf{T}, \mathbf{I} \rangle$ *in which* **T** *is a tree and* **I** *is an* indistinguishability function *on* **T***: the domain of* **I** *is T and, for all* $t \in T$, $\mathbf{I}_t$ *in an equivalence relation on* $\mathbf{H}_t$ *such that,* $\mathbf{I}_t(h, h') \;\&\; t' < t \Rightarrow \mathbf{I}_{t'}(h, h')$.

At any moment t in Time, we can consider the partition of $\mathbf{H}_t$ into equivalence classes modulo $\mathbf{I}_t$. The class of the history h, that is $\{h' : \mathbf{I}_t(h, h')\}$, will be denoted by $[h]^{\mathbf{I}}_t$. According to the intended meaning of the relations $\mathbf{I}_t$, single histories cannot be recognized at that moment: the only recognizable entities at t are classes $[h]^{\mathbf{I}}_t$. Each of these classes represents a recognized way in which Time branches out at t, and hence we will refer to them as *recognized possibilities at t*. Sometimes we will write $i \in \mathbf{I}_t$ to mean that i is an equivalence class modulo $\mathbf{I}_t$; this will make the notation lighter.[11]

The set of all recognized possibilities in an **I**-tree $\langle \mathbf{T}, \mathbf{I} \rangle$ will be written as $T^{\mathbf{I}}$. In the technical definition of this set we have to take into account that there might be recognized possibilities $[h]^{\mathbf{I}}_t = [h]^{\mathbf{I}}_{t'}$ with $t \neq t'$. No confusion can arise if we consider pairs $\langle t, i \rangle$:

$$T^{\mathbf{I}} = \{\langle t, i \rangle : t \in T \text{ and } i \in \mathbf{I}_t\} \tag{4.2}$$

Quantifying over $\mathbf{I}_t$ or within some element of It give rise to different new notions of possibility at t.[12] In (Zanardo, 1998) I have considered a language containing Ockhamist-like operators, as well as Peircean-like ones. The starting point is an Ockhamist notion of truth, but,

[11] In mathematical terms, this means that the equivalence $\mathbf{I}_t$ and its quotient set are identified.

[12] A more exhaustive treatment of indistinguishability would have required a notion of agent-indexed indistinguishability functions $\mathbf{I}_a$, where a ranges over a set of agents: two histories may be distinguishable for an agent, but indistinguishable for another one. Accordingly, we would have different, simultaneous, notions of possibility and the language would have agent-indexed possibility operators. Such a distinction, though, goes beyond the aim of this work, where we consider only the basic properties of possibility related to indistinguishability.

since some histories may be indistinguishable from one-another, we consider truth at pairs $\langle t, i\rangle$: *at the moment* t, truth at $\langle t, h\rangle$ and truth at $\langle t, h'\rangle$ cannot be distinguished if $\mathbf{I}_t(h, h')$. On the other hand, differently from $\mathbf{O}_3$, we interpret the operator for the future in a Peircean way, because i is generally constituted by many histories.

An evaluation on an **I**-tree $\langle \mathbf{T}, \mathbf{I}\rangle$ is a function V assigning a set of pairs $\langle t, i\rangle$, with $i \in \mathbf{I}_t$, to each propositional variable. Then truth is relative to recognized possibilities. We write $\vDash_{\text{Ind}}$ for truth in **I**-trees. The following rules provide a semantics for a language with an Ockhamist operator $\Diamond$, and the Peircean operators **F** and **f** (in addition to the past operator P).

$\mathbf{I}_0$: $\langle \mathbf{T},\mathbf{I}\rangle, V \vDash_{\text{Ind}} p_n\ [t, i]$ iff $\langle t, i\rangle \in V(p_n)$

$\mathbf{I}_{1,2}$: the usual rules for $\neg$ and $\wedge$

$\mathbf{I}_3$: $\langle \mathbf{T},\mathbf{I}\rangle, V \vDash_{\text{Ind}} \mathbf{F}\alpha\ [t, i]$ iff $\forall h \in i, \exists t' \in h$: $t < t'$ and $\langle \mathbf{T},\mathbf{I}\rangle, V \vDash_{\text{Ind}} \alpha\ [t', [h]^{\mathbf{I}}_{t'}]$

$\mathbf{I}_4$: $\langle \mathbf{T},\mathbf{I}\rangle, V \vDash_{\text{Ind}} \mathbf{f}\alpha$ [t, i] iff $\exists h \in i, \exists t' \in h$: $t < t'$ and $\langle \mathbf{T},\mathbf{I}\rangle, V \vDash_{\text{Ind}} \alpha\ [t', [h]^{\mathbf{I}}_{t'}]$

$\mathbf{I}_5$: $\langle \mathbf{T},\mathbf{I}\rangle, V \vDash_{\text{Ind}} P\alpha\ [t, i]$ iff $\exists t' < t : \langle \mathbf{T},\mathbf{I}\rangle, V \vDash_{\text{Ind}} \alpha\ [t', [h]^{\mathbf{I}}_{t'}]$

$\mathbf{I}_6$: $\langle \mathbf{T},\mathbf{I}\rangle, V \vDash_{\text{Ind}} \Diamond\alpha\ [t, i]$ iff $\exists i' \in \mathbf{I}_t : \langle \mathbf{T},\mathbf{I}\rangle, V \vDash_{\text{Ind}} \alpha\ [t, i']$

We observed above that the second-order quantification in Rule $\mathbf{P}_4$ is equivalent to a first-order quantification moments. This does not happen for the quantification over histories in $\mathbf{I}_4$ because this quantification is restricted to the elements of the recognized possibility i. The quantification over $\mathbf{I}_t$ in $\mathbf{I}_6$, instead, can be replaced by a quantification over $\mathbf{H}_t$: the right side of this rule is equivalent to $\exists h \in \mathbf{H}_t : \mathbf{T}, V \vDash_{\text{Ock}} \alpha\ [t, [h]^{\mathbf{I}}_t]$. Like in the case of Ockhamist semantics, the truth of $\Diamond\alpha$, or of $\Box\alpha$ at $\langle t, i\rangle$ does not depend on i.

The set $T^{\mathbf{I}}$ of recognized possibilities in an **I**-tree can be endowed with an order relation and with an equivalence relation in a natural way. We set

$$\langle t, i\rangle \prec \langle \tau, j\rangle \overset{\text{Def}}{\equiv} t < \tau \text{ and } j \subseteq i$$
$$\langle t, i\rangle \sim \langle \tau, j\rangle \overset{\text{Def}}{\equiv} t = \tau \tag{4.3}$$

The following proposition is a straightforward consequence of Definition 4.1.

Proposition 4.2 For every **I**-tree $\langle \mathbf{T},\mathbf{I}\rangle$,
(1) $<$ *is a tree relation on* $T^{\mathbf{I}}$; *and*
(2) if $\langle t, i\rangle \sim \langle \tau, j\rangle$, *then the restriction of* $\sim$ *to* $\{\langle t', i'\rangle : \langle t', i'\rangle < \langle t, i\rangle\} \times \{\langle \tau', j'\rangle : \langle \tau', j'\rangle < \langle \tau, j\rangle\}$ *is an order isomorphism*.

The tree $\langle T^{\mathbf{I}}, <\rangle$ will be denoted by $\mathbf{T}^{\mathbf{I}}$. On the basis of Proposition 4.2, the evaluation rules $\mathbf{I}_0$ to $\mathbf{I}_6$ can be rewritten as evaluation rules in structures $\langle T^{\mathbf{I}}, <, \sim\rangle$. It turns out that the semantics

for the operators **F**, **f** and *P* in these structures is just Peircean semantics in the tree $\mathbf{T}^{\mathbf{I}}$, while $\Diamond$ is interpreted as the modal S5-operator with accessibility relation $\sim$.

An interesting peculiarity of the **I**-tree semantics is that it can be viewed as a unified framework having Ockhamist and Peircean semantics as limit cases (Zanardo, 1998). If in fact it is the total relation for any t, that is $\mathbf{I}_t(h, h')$ for all $h, h' \in \mathbf{H}_t$, then every It contains only one equivalence class which is $\mathbf{H}_t$. In this case the map $\varphi : \langle t, i\rangle \to t$ is an isomorphism from $\mathbf{T}^{\mathbf{I}}$ onto **T**, and the equivalence $\sim$ is equality. This means in particular that **F** and **f** have the same meaning as in Peircean logic and that the possibility operator is vacuous, i.e. $\langle \mathbf{T},\mathbf{I}\rangle \vDash_{\mathrm{Ind}} \alpha \equiv \Diamond\alpha$ for all formulas α.

If conversely It is the diagonal relation for all t, that is $\mathbf{I}_t(h, h')$ iff $h = h'$, then every class in It contains exactly one history. In particular, the operators **F** and **f** coincide - i.e. $\langle \mathbf{T},\mathbf{I}\rangle \vDash_{\mathrm{Ind}} \mathbf{f}\alpha \equiv \mathbf{F}\alpha$ for all α - and $\Diamond$ has the same meaning as in Ockhamist logic. In this case $\mathbf{T}^{\mathbf{I}}$ is the union of disjoint linear orders, and the relation $\sim$ renders the structure an *Ockhamist frame* (Zanardo, 1985; Zanardo, 1996) or, with some minor differences, a *Leibnizian structure*, in the terminology of (Øhrstrøm and Hasle, 1995).

The properties of **I**-trees have of course a topological counterpart. In particular, the topology τ_{TI} is a refinement of τ_{T} (see Subsection 3.1). In the two limit cases considered above we have that τ_{TI} is not a proper refinement when **T** and $\mathbf{T}^{\mathbf{I}}$ are isomorphic, while, in the other case, $\tau_{\mathrm{T}}^{\mathrm{I}}$ is the discrete topology.

5. CHOICES

The general framework provided by the **I**-tree semantics allows us to deal with the particular case in which possibility is meant as possibility (for a given agent, at a given moment) of choosing among different alternatives. The notion of choice we consider here is the one involved in Belnap's logic of agency, as well as von Kutschera's logic of causation.

A *choice function* for an agent a in a tree-like representation of Time is a function C_a assigning a partition $\mathrm{C}_{a,t}$ of $\mathbf{H}_t$ to each moment t. In (Belnap et al., 2001, p. 34) we read (using the notation of the present paper)

> *...the idea is that, by acting at t, the agent a is able to determine a particular one of the equivalence classes from* $\mathrm{C}_{a,t}$ *within which the future course of history must then lie, but this is the extent of his influence.*

The elements of $\mathrm{C}_{a,t}$ can be thought of as the ways in which the world goes on, depending on a's actions. Thus, if a decides to spend the week-end at home, and *this is really a choice allowed to him*, then he constraints the course of events to lie in an element of $\mathrm{C}_{a,t}$ which contains only histories in which a is at home in the week-end. One of the requests on the partitions $\mathrm{C}_{a,t}$ corresponds to the idea that no choice of a at t can distinguish two histories that are undivided at t:

$$\textit{if } \mathrm{U}_t(h, h') \textit{ and } h \in X \in \mathrm{C}_{a,t} \textit{ then } h' \in X \tag{5.4}$$

The other property that choice functions must have in the context of logic of agency is significant when multiple agents are considered. For any set A of agents and any $X_a \in C_{a,t}(a \in A)$, $\cap_{a \in A} X_a \neq \emptyset$. This property is discussed in (Belnap et al., 2001, Sect. 7C.4) where it is called *Independence of Agents*.[13] As observed in Footnote 12, considering more than one agent is beyond the goals of the present paper; thus, in the sequel, we denote choice functions by C and the index a is suppressed.

Choice functions are particular indistinguishability functions. If in fact $C_t(h, h')$ and $t' < t$, then h and h' are undivided at t' and hence, by (5.4), $C_{t'}(h, h')$ holds as well. On the other hand, if the indistinguishability function I contains undividedness, then it is a trivially a choice function, and hence choice functions are precisely the indistinguishability functions that contain undividedness. The following proposition provides a characterization of the **I**-trees with this property.

Proposition 5.1 (Proposition 4.2 in (Zanardo, 1998)) *For every* **I**-*tree* $\langle \mathbf{T}, \mathbf{I} \rangle$

$$\langle \mathbf{T}, \mathbf{I} \rangle \vDash_{\mathrm{Ind}} Pp \rightarrow \Box Pp \Leftrightarrow$$
$$\Leftrightarrow \forall t \in \mathbf{T}, \forall h, h' \in \mathbf{H}_t, U_t(h, h') \rightarrow \mathbf{I}_t(h, h')$$

It is interesting to observe that this characterization of choice functions involves the formula $Pp \rightarrow \Box Pp$ which expresses the unpreventability of the past: if something happened, then it is necessary (now unpreventable) that it happened.

In Ockhamist logic, the formula $P\alpha \rightarrow \Box P\alpha$ is valid when α is constructed from formulas of the form $\Box\alpha_1,\ldots, \Box\alpha_n$ without any use of the operator F. If propositional variables are evaluated at sets of moments (see Footnote 7), then the equivalences $p_i \equiv \Box p_i$ are Ockhamist validities, so that the formula $Pp_n \rightarrow \Box Pp_n$ is valid as well. Also in this case, though, it is not difficult to find counterexamples to the Ockhamist validity of, e.g., $PFp \rightarrow \Box PFp$.

Adopting the **I**-tree semantics, instead, the assumption that **I** is a choice function (that is $U_t \subseteq I_t$ for all t) guarantees that $P_\alpha \rightarrow \Box P\alpha$ is true for any formula α, possibly containing future operators. I think that this unexpected relation between the notion of choice in branching-time and unrestricted formulation of unpreventability of the past is rather intriguing and deserves further investigations.

The following proposition shows that the case in which indistinguishability is contained in undividedness is definable as well. Then, we can characterize the particular case in which indistinguishability is exactly undividedness.

Proposition 5.2 *For every* **I**-*tree* $\langle \mathbf{T}, \mathbf{I} \rangle$,

$$\langle \mathbf{T}, \mathbf{I} \rangle \vDash_{\mathrm{Ind}} \mathbf{f}p \wedge \mathbf{g}\neg p \rightarrow \mathbf{F}(\Diamond \mathbf{g}\neg p \wedge \Diamond(p \vee \mathbf{f}p)) \Leftrightarrow$$

[13] In many works on Belnap's theory of agency this property is expressively described as "something happens".

$$\Leftrightarrow \forall t \in \mathbf{T},\ \forall h, h' \in \mathbf{H}_t,\ \mathbf{I}_t(h, h') \rightarrow \mathrm{U}_t(h, h')$$

Proof. Assume the right side of $\Leftrightarrow$ and $\langle \mathbf{T},\mathbf{I}\rangle$, $V \vDash_{\mathrm{Ind}} \mathbf{F}p \wedge \mathbf{G}\neg p\ [t, i]$ for some evaluation V, moment t, and $i \in \mathbf{I}_t$. This means that there are two histories h_1, $h_2 \in i$ such that, for some $t_1 > t$ in h_1, and for all $t' > t$ in h_2,

$$(*)\ \langle \mathbf{T}, \mathbf{I}\rangle, V \vDash_{\mathrm{Ind}} p\ [t_1, [h_1]^{\mathbf{I}}_{t'}] \text{ and } (**)\ \langle \mathbf{T}, \mathbf{I}\rangle, V \vDash_{\mathrm{Ind}} \neg p\ [t, [h_2]^{\mathbf{I}}_{t'}]$$

Let h be any history in the recognized possibility i; then $\mathbf{I}_t(h, h_1)$ and $\mathbf{I}_t(h, h_2)$. Since we are assuming that indistinguishability is contained in undividedness, there is a moment $t_0 \in h \cap h_1 \cap h_2$ such that $t < t_0$.

Two cases can be considered: either t has an immediate successor in $h \cap h_1 \cap h_2$, or t has no immediate successor in $h \cap h_1 \cap h_2$. In both cases we can assume that $t_0 \leq t_1$. By $(*)$, $\langle \mathbf{T},\mathbf{I}\rangle, V \vDash_{\mathrm{Ind}} p \vee \mathbf{F}p\ [t_0, [h_1]^{\mathbf{I}}_{t0}]$, and, by $(**)$, we have also $\langle \mathbf{T}, \mathbf{I}\rangle, V \vDash_{\mathrm{Ind}} \mathbf{G}\neg p\ [t_0, [h_2]^{\mathbf{I}}_{t0}]$. Then $\langle \mathbf{T}, \mathbf{I}\rangle, V \vDash_{\mathrm{Ind}} \Diamond \mathbf{G}\neg p \wedge \Diamond (p \vee \mathbf{F}p)[t_0, [h]^{\mathbf{I}}_{t0}]$. Since h is an arbitrary element of i, this implies that $\langle \mathbf{T},\mathbf{I}\rangle, V \vDash_{\mathrm{Ind}} \mathbf{F}(\Diamond \mathbf{G}\neg p \wedge \Diamond (p \vee \mathbf{F}p))\ [t, i]$. This concludes the first part of the proof. Conversely, assume that there exist t_0, h_1, h_2 in $\langle \mathbf{T},\mathbf{I}\rangle$ such that $\mathbf{I}_{t0}(h_1, h_2)$, but not-$\mathrm{U}_{t0}(h_1, h_2)$. Consider any evaluation V such that

$$V(p) = \{(t, [h]^{\mathbf{I}}) : h \in [h_1]^{\mathbf{I}}_{t0} \cap [h]^{\mathbf{U}}_{t0} \text{and } t_0 < t\}$$

This implies that $\langle \mathbf{T}, \mathbf{I}\rangle, V \vDash_{\mathrm{Ind}} \mathbf{F}p \wedge \mathbf{G}\neg p\ [t_0, [h_2]^{\mathbf{I}}_{t0}]$. Consider any moment t such that $t \geq t'$ for some $t' > t_0$ in h_2. Since h_2 is not $\mathbf{U}_{t0}$-related to h_1, we have that, for every h passing through t, $\langle \mathbf{T}, \mathbf{I}\rangle, V \vDash_{\mathrm{Ind}} \neg \mathrm{p}\ [\mathrm{t}, [h]^{\mathbf{I}}_t]$. This implies in particular that $\langle \mathbf{T}, \mathbf{I}\rangle, V \vDash_{\mathrm{Ind}} \neg\Diamond(p \wedge \mathbf{F}p)[t', [h_2]^{\mathbf{I}}_{t'}]$ for every $t' > t_0$ in h_2. Then $\langle \mathbf{T}, \mathbf{I}\rangle, V \vDash_{\mathrm{Ind}} \mathbf{F}(\Diamond \mathrm{g}\neg \mathrm{p} \wedge \Diamond(p \vee \mathbf{F}p))\ [t_0, [h_2]^{\mathbf{I}}_{t0}]$. ■

6. CONCLUSIONS

We have considered various modal notions in branching-time contexts and in all cases possibility is viewed as existence of a suitable set of courses of events. In Ockhamist logic possibility is 'existence of (at least) one history', while, if undividedness is taken into account, possibility can be conceived as 'existence of an equivalence class modulo undividedness'. In these two perspectives, possibility can be defined on the basis of the set-theoretical structure of Time.

Some examples show that it makes sense to assume that, at any moment in Time, some histories cannot be distinguished from others. We can have various notions of indistinguishability depending on the context to which branching time logic is applied. This yields to consider tree-like structures endowed with (moment relative) indistinguishability relations, and to conceive possibility as existence of indistinguishability classes.

These enriched structures provide a unified semantics for branching-time logics as well as a general framework for dealing with choices. It is shown that the particular indistinguishability relations corresponding to choices and undividedness are definable relations.

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In Defence of the Thin Red Line: A Case for Ockhamism

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ABSTRACT

This paper deals with A.N. Prior's Ockhamism and "the true futurist theory". The introduction contains an outline of the historical background of the theories mainly in medieval theology and logic. In section 2, a formal version of the medieval argument for determinism will be presented without theological references. It will be pointed out that there are two premises used in the argument which are obvious candidates for questioning. In section 3, Prior's Ockhamism will be discussed. The modern criticism of the "the theory of the thin red line" will be presented and evaluated in section 4, and it will be argued that the theory can in fact be defended and that there is after all no strong argument against it.

1. INTRODUCTION

The belief in an indeterministic worldview is closely related to the assumption that there are future contingents, *i.e.* statements which are neither necessary nor impossible. This paper is based on the assumption of an indeterministic worldview (i.e. the idea of an open future). It is assumed that statements like "my mother will go to London" and "there will be a sea battle tomorrow" may serve as standard examples of future contingents. The future contingency problem is the question whether such statements have truth-values already today. In other words: Can it be true (or false) today that my mother will be going to London, or that some possible sea-battle will take place tomorrow, given that the future outcome will depend on future decisions freely made by competent women and men in both cases? And if so: How can truth-values be ascribed to statements about such open questions?

During the Middle Ages, several famous logicians discussed the problem of the contingent future in relation to Christian doctrine. According to Christian tradition, divine foreknowledge comprises knowledge of the future choices to be made by men and women. But this assumption apparently gives rise to a straightforward argument from divine foreknowledge to the necessity of the future: if God knows already now which decision I will make tomorrow, then a now-unpreventable truth about my choice tomorrow seems to be given already today. My choice, then, appears to be necessary, not free. Hence, there seems to be no basis for the claim that I have a free choice between genuine alternatives. This conclusion, however,

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violates the idea of human freedom and moral accountability which is normally presupposed in theology.

The future contingency problem does not have to be formulated in terms of theological doctrines. In fact, the medieval discussion regarding the logic of divine foreknowledge is from a formal point of view very close to the modern discussion concerning future contingency, which is mostly formulated in terms of a secular vocabulary. If "known to God" is simply understood as "true", it is easy to see how, from a formal point of view, the discussion regarding the logic of divine foreknowledge is essentially the same discussion as the modern discussion concerning future contingency. Given that God knows all and only the truths, this understanding of "true" seems to be straightforward.

The argument mentioned above has been presented in several ways during the long history of philosophical logic. It is an argument which can be traced back to Aristotelian and Stoic logic and which was taken up in Scholasticism and reformulated in theological terms. In its medieval form it was briefly sketched by Richard of Lavenham (c. 1380) in the context of his attempt at giving a systematic overview covering all possible responses to the contingency problem. The general structure of the medieval argument can then be represented in a number of steps. In this sequence *E* is some event, which may or may not take place tomorrow (e.g. a sea-battle). Non-*E* is just a state of affairs without *E* occurring. *E* and non-*E* are supposed to be mutually exclusive. Moreover, it is assumed throughout that God's knowledge equates plain truth (i.e. 'God knows that *p* if and only if *p* is true'):

1. Either *E* is going to take place tomorrow or non-*E* is going to take place tomorrow. (Assumption).
2. If a proposition about the past is true, then it is now necessary, i.e. inescapable or unpreventable. (Assumption).
3. If *E* is going to take place tomorrow, then it was true yesterday that *E* would take place in two days. (Assumption).
4. If *E* is going to take place tomorrow, then it is now necessary that yesterday *E* would take place in two days. (Follows from 2. and 3.).
5. If it is now necessary that yesterday *E* would take place in two days, then it is now necessary that *E* is going to take place tomorrow. (Assumption).
6. If *E* is going to take place tomorrow, then *E* is necessarily going to take place tomorrow. (Follows from 4. and 5.).
7. If non-*E* is going to take place tomorrow, then non-*E* is necessarily going to take place tomorrow. (Follows by the same kind of reasoning as 6.).
8. Either *E* is necessarily going to take place tomorrow or non-*E* is necessarily going to take place tomorrow. (Follows from 1., 6. and 7.).
9. Therefore, what is going to happen tomorrow is necessarily going to happen. And, in consequence, there is no proper freedom of choice. (Follows from 8.).

Richard of Lavenham accepted the validity of this argument, and he pointed out that there are four possible reactions to it.

a) The argument (including its premises) is accepted, and the doctrine of proper human freedom is rejected, which is clearly equivalent to fatalism (First possibility).

b) Denial of the doctrine that God knows all truths about the contingent future. (Second possibility).

c) The claim that in general no truth about the contingent future has yet been decided. (Third possibility).

d) Rejection of the necessity of the past in general. (Fourth possibility).

Richard of Lavenham himself rejected the first and the second possibility, a) and b), as contrary to the Christian faith. He insisted that there are future contingents and that God knows them. It seems that Richard of Lavenham, like William of Ockham (c. 1285-1349), regarded the Aristotelian approach to propositions concerning the contingent future as being equivalent with the third possibility, c), according to which some propositions about the contingent future are neither determinately true nor determinately false. A number of scholastic logicians favoured this possibility, for instance Peter Aureole (c.1280-1322). Richard of Lavenham, however, rejected this position. He preferred the fourth possibility, d), and he argued that by rejecting the necessity of the past as a general principle the doctrines of free will and God's foreknowledge of the contingent future can be united in a consistent manner. This solution was first formulated by Ockham, although some of its elements can already be found in Anselm of Canterbury (1033-1109). It is also interesting that, much later, Leibniz (1646-1711) worked with a similar idea as a part of his metaphysics. (See Øhrstrøm 1984). The point is that although past events according to Ockham should be regarded as necessary in the sense of being now unpreventable, there are on the other hand true statements in the past tense which should not be regarded as necessary.

The most characteristic feature of Richard of Lavenham's (and William of Ockham's) solution is the concept of 'the true future'. The view is that God possesses certain knowledge not only of the necessary future, but also of the contingent future. This means that, among the possible contingent futures, there must be one which has a special status, namely that it corresponds to the course of events which is really going to happen or take place in the future. This line of thinking may be called 'the medieval solution', even though other approaches certainly existed. Its justification is partly the observation that the notion of 'the true future' is the specifically medieval contribution to the discussion, and partly that leading medieval logicians regarded this solution as the best one. Richard of Lavenham himself called it 'opinio modernorum', i.e., the opinion of the modern people.

A later contribution by the Jesuit Luis Molina (1535-1600) is relevant for a modern interpretation of the fourth possibility, d). Molina's ideas have been thoroughly discussed in (Craig 1988). Molina's special contribution is the idea of (God's) "middle knowledge", which captures the idea of divine foreknowledge without loss of free will in an unusually succinct way: "…the third type [of divine knowledge] is *middle* knowledge, by which, in virtue of the most profound and inscrutable comprehension of each free will, He saw in His own essence what each such will would do with its innate freedom were it to be placed in this or that or indeed in infinitely many orders of things --- even though it would really be able, if it so willed, to do the opposite" (quoted from (Craig, 1988), p. 175). Craig goes on to explain it as follows: "Thus, whereas by His natural knowledge God knows that, say, Peter when placed in a certain set of circumstances *could* either betray Christ or not betray Christ, being free to do either under identical circumstances, by His middle knowledge God knows what Peter *would* do if placed under those circumstances" ((Craig, 1988), p. 175).

Obviously, Richard of Lavenham knew that William of Ockham had discussed the problem of divine foreknowledge and human freedom in his work *Tractatus de praedestinatione et de futuris contingentibus* (see (Øhrstrøm, 1983) and (Tuggy, 1999)). Ockham asserted that God knows the truth or falsity of all future contingents, but he also maintained that human beings can choose between alternative possibilities. In his *Tractatus*, he argued that the doctrines of divine foreknowledge and human freedom are compatible. Richard of Lavenham made a remarkable effort to capture and clearly present the logical features of Ockham's system as opposed to (what was assumed to be) Aristotle's solution (i.e., the third possibility, c)). Richard of Lavenham's classification of the solutions to the problem of future contingents can be translated into a non-theological language: Identifying "truth" with "God's knowledge" in Richard of Lavenham's analysis, the various positions included in his work can be listed in the following way:

1. There are no future contingents i.e. statements about the future are either impossible or necessary.
2. There are future contingents. But no future contingent is true.
3. There are future contingents. But future contingents in general are neither determinately true nor determinately false.
4. There are future contingents, and all future contingents have truth-values ('true' or 'false'), although these truth-values are still unknown to us.

It is interesting that this list of possible solutions largely covers the positions discussed in modern temporal logic in the tradition of A.N. Prior's founding works, mainly his (Prior, 1967). Position 2 in the above list comes close to what Prior called "the Peircean solution". Position 3 bares several resemblances with the solution Prior labelled as "Ockhamism" according to which the truth-value of a future contingent at a moment depends on the histories passing through the moment in question. Position 4 is the position by William of Ockham, Richard of Lavenham and many others. In a modern context, this position has been called "the theory of

the thin red line" or sometimes "the true futurist theory". This theory has been strongly criticized by several writers. By holding that a future contingent may be true at the present moment, the true futurist differs slightly from a Priorian Ockhamist according to whom the truth-value of a future contingent will depend on the choice of history (or chronicle). In fact, it may be argued that William of Ockham himself was not an Ockhamist in Prior's sense, but rather a true futurist, since he held that God knows today what is going to happen in the future. About this divine foreknowledge, William of Ockham stated:

> … the divine essence is an intuitive cognition that is so perfect, so clear, that it is an evident cognition of all things past and future, so that it knows which part of a contradiction [involving such things] is true and which part is false. ((William of Ockham, 1969), p.50)

However, William of Ockham had to admit that this is not very clear. In fact, he maintained that it is impossible to clearly express the way in which God knows future contingents. He also had to conclude that in general the divine knowledge about the contingent future is inaccessible. God is able to communicate the truth about the future to us, but if God reveals the truth about the future by means of unconditional statements, the future statements cannot be contingent anymore. Hence, God's unconditional foreknowledge regarding future contingents is in principle not revealed, whereas conditionals can be communicated to the prophets. Even so, that part of divine foreknowledge about future contingents, which is not revealed, must also be considered as true according to William of Ockham.

In the following section, a formal version of the above medieval argument for determinism will be presented without theological references. It will be pointed out that there are two premises used in the argument which are obvious candidates for questioning.

2. A Formalisation of the Medieval Argument

In the following, I will make use of the branching time semantics and tempo-modal formalism described by Alberto Zanardo elsewhere in this volume. (See also (Burgess, 1980), (Zanardo, 2006) and (Barcellan and Zanardo, 1999).) Time is conceived as a set of *moments*, *TIME*, partially ordered by a earlier-later relation, <. A linear (*i.e.* totally ordered and maximal) subset of *TIME* is called a *chronicle* or a *history*.

I will, however, make one rather simple extension to Zanardo's language introducing time units in the tense operators:

F(x): "in *x* time units it will be the case that …"
P(x): "*x* time units ago it was the case that …"

I will also make use of the necessity operator, □. It is essential to notice that the necessity at stake here is *historical necessity*. This means that what is not necessary at one moment may

become necessary at another moment. Instead of speaking about what is necessary we might – as already hinted at – talk about what is now *inevitable*, *inescapable*, or *unpreventable*.

The argument may be based on the following five principles, where p and q represent arbitrary well-formed statements within the logic:

(P1) $F(y)p \supset P(x)F(x)F(y)p$

(P2) $\Box(P(x)F(x)p \supset p)$

(P3) $P(x)p \supset \Box P(x)p$

(P4) $(\Box (p \supset q) \wedge \Box p) \supset \Box q$

(P5) $F(x)p \vee F(x)\sim p$

(P5) may be read as a version of the principle of the excluded middle ('tertium non datur'), although it does not take the exact form of $p \vee \sim p$, which is usually identified with the principle of the excluded middle. In order to avoid confusion, we shall use the modified name, 'future excluded middle', for (P5).

Regarding (P1–2) it should be noted that these two principles could be deduced if the following equivalence is adopted as an axiom:

$P(x)F(x)p \equiv p$

However, this equivalence also entails the theorem $p \supset P(x)F(x)p$ which is clearly stronger than (P1).

Let q stands for some atomic statement such that $F(y)q$ is a statement about the contingent future. Formally, then, the argument goes as follows:

(1) $F(y)q \supset P(x)F(x)F(y)q$ (P1)

(2) $P(x)F(x)F(y)q \supset \Box P(x)F(x)F(y)q$ (from P3)

(3) $F(y)q \supset \Box P(x)F(x)F(y)q$ (from 1 & 2)

(4) $\Box(P(x)F(x)F(y)q \supset F(y)q)$ (from P2)

(5) $F(y)q \supset \Box F(y)q$ (from 3, 4, P4)

Similarly, it is possible to prove

(6) $F(y)\sim q \supset \Box F(y)\sim q$

The second part of the main proof is carried out in the following way:

(7) $F(y)q \vee F(y)\sim q$ (from P5)

(8) $\Box F(y)q \wedge \Box F(y)\sim q$ (from 5,6,7)

Remember now that q may stand for any atomic proposition, including statements about human actions. Therefore, (8) is equivalent to a claim of determinism i.e. it implies a denial of the assumption of human freedom of choice — whatever happens, or fails to do so, does so with necessity. So if one wants to preserve the idea of human freedom as it was conceived by the medieval logicians, at least one of the above principles (P1–P5) has to be rejected.

A.N. Prior constructed two systems showing how that can be done, namely the Peircean system in which P5 is rejected (see also (Burgess, 1980)) and the Ockhamist system in which P3 is rejected. It is well known that each of these systems provides a solution to the future contingency problem. Since Prior, several philosophers have discussed which one of these systems should be accepted, or whether other and more attractive systems dealing with the problem can be constructed.

The rejection of (P5) is very problematic. From a common sense point of view, it seems obvious that one of the propositions $F(y)q$ and $F(y)\sim q$ must be true. Let q stand for my going to the cinema. Clearly, it seems straightforward that if it is false now that I am going to the cinema tomorrow, it must be true now that I am not going to the cinema tomorrow. On the other hand, Prior has convincingly demonstrated that the Peircean system with its denial of (P5) is conceivable. According to the Peircean system, the future should simply be identified with the necessary future. More precisely, to say something about the future is to say something about the necessary future. Although the conflation, or identification, of the future with the necessary future makes the position counter-intuitive, A. N. Prior and many of his followers favoured this possibility. The reason is that Prior strongly believed in free choice and held that this freedom is essential for the understanding of the very notion of future. In his *Some Free Thinking about Time*, Prior pointed out that "if something is the work of a free agent, then it wasn't going to be the case until that agent decided that it was" (Copeland 1996, p.48). According to Prior nobody (not even God) can know what a person will freely choose, before the person has made his or her choice. So whatever could make a statement about a future choice by some free agent true now? From Prior's point of view: nothing. For this reason, Prior held, that such statements must be false. – The key question seems to be whether it makes sense to assume the existence of a truth of a statement, which we, in principle, cannot know to be true. If someone says today that I am going to the cinema tomorrow, and I actually make up my mind tomorrow and decides to go to the cinema, then everybody will probably accept the view that the predictor was right. And if he was right when making his prediction, it seems that we have to accept that there was a truth at that time according to which the prediction was true. John MacFarlane (2003, 2008) has suggested an alternative solution to the problem according to which a statement should be relativised to

both a context of utterance and a context of assessment. The context of utterance is the context in which the speech act is made. But the question is whether such theory solves the problem. If we want to hold on to (P5) and if we also maintain that all future contingents are either true or false, then it seems that we are left with something like Prior's Ockhamism or "the true futurist theory".

3. PRIOR'S OCKHAMIST SOLUTION

In *Past, Present and Future* Prior presented his so-called Ockhamist system, which accepts P5 but includes a denial of P3 (see (Prior, 1967), p. 126 ff.). In some ways, it is an attractive system, although it is certainly also possible to criticize the Ockhamist position in various respects — as will be shown in the following.

For any wff p at any time t and for any chronicle c with $t \in c$, the valuation function of an Ockhamist model, $Ock(t,c,p)$ can be defined recursively (given a truth-value for any propositional constant at any moment in *TIME*):

(a) $Ock(t,c, p \wedge q) = 1$ iff both $Ock(t,c,p) = 1$ and $Ock(t,c,q) = 1$

(b) $Ock(t,c, \sim p) = 1$ iff not $Ock(t,c,p) = 1$

(c) $Ock(t,c,Fp) = 1$ iff $Ock(t',c,p) = 1$ for some $t' \in c$ with $t < t'$

(d) $Ock(t,c,Pp) = 1$ iff $Ock(t',c,p) = 1$ for some $t' \in c$ with $t' < t$

(e) $Ock(t,c,\Box p) = 1$ iff $Ock(t,c',p) = 1$ for all c' in $C(t)$ with $t \in c'$

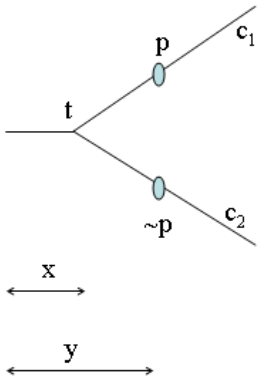
$Ock(t,c,p)$ can be read 'p is true at t in the chronicle c'. A formula p is said to be Ockham-valid if and only if $Ock(t,c,p)$ for any t in any c in any branching time structure, (*TIME*,<,*C*). It should be noted that (a) – (d) are exactly the same definitions as those used in linear tense-logic. C is a function from *TIME* into all subsets of chronicles. $C(t)$ is the set of possible chronicles passing through t. (In Prior's original formulation of the Ockhamist system all chronicles are regarded as possible. In this case, C can be constructed from *(TIME, <)*, and in consequence there is no need for specifying C in the structure.)

To obtain a metric version of the Ockhamist system, a duration function has to be added. Let $dur(t_1,t_2,x)$ stand for the statement 't_1 is x time units before t_2'. Using this formalism, (c) and (d) are replaced by:

(c′) $Ock(t,c,F(x)p) = 1$ iff $Ock(t',c,p) = 1$ for some $t' \in c$ with $dur(t,t',x)$

(d′) $Ock(t,c,P(x)p) = 1$ iff $Ock(t',c,p) = 1$ for some $t' \in c$ with $dur(t',t,x)$

It can be verified that neither $P(x)q \supset \Box P(x)q$ nor $Pq \supset \Box Pq$ are Ockham-valid for all q. Let for instance q stand for $F(y)p$. It is easy to verify that $P(x)F(y)p \supset \Box P(x)F(y)p$ will not hold in general in an Ockhamistic branching time model. This may be illustrated using the following diagram, in which it is easily seen that $Ock(t, c_1, P(x)F(y)p) = 1$, whereas $Ock(t, c_1, \Box P(x)F(y)p) = 0$ since $Ock(t, c_2, P(x)F(y)p) = 0$.



This does away with P3 in the formal version of the medieval argument discussed above. Still, both formulas, $P(x)q \supset \Box P(x)q$ and $Pq \supset \Box Pq$, will hold if q does not contain any reference to the future.

If (P3) does not hold in general, one may reject 2 in the informal argument stated in the first section of this paper. According to Ockham, (P3) (that is, its verbal analogue as he could formulate it with the means then available) should only be accepted for statements which are genuinely about the past, i.e., the truth-values of which do not depend on the future. According to this view, (P3) may be denied precisely because the truth of statements like $P(x)F(x)F(y)q$ has not been settled yet — since they depend on the future.

In this way, one can make a distinction between soft facts and hard facts regarding the past (see (Plantinga 1986)). Following the Ockhamist position, a statement like $P(x)q$ would correspond to a hard fact, if q's truth-value does not depend on the future, whereas statements like $P(x)F(x)F(y)q$ would represent soft facts. Critics of the Ockhamist position, however, may still say that if $F(x)F(y)q$ was true x time units ago, then there must have been something making it true at that time, and that something must have been a 'hard' fact. This clearly makes the distinction between soft and hard facts rather complicated.

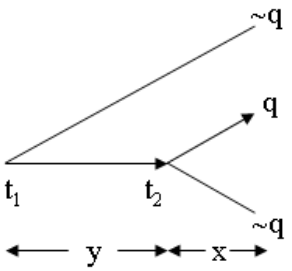
In addition it may be disputed that Prior's Ockhamist system fits the ideas formulated by William of Ockham completely. Although many of Ockham's original ideas are satisfactorily modelled in Prior's Ockhamist system, Prior's system lacks a proper representation of the notion of 'the true future'. This was in fact one of the most basic ideas in Ockham's worldview. Ockham believed that there is truth (or falsity) also of statements about the contingent future, which human beings cannot know, but which God knows. Prior's Ockhamist system cannot be said to include more than the idea of a proposition being true relatively to a moment of time

and a chronicle. A proper theory in accordance with William of Ockham's ideas would have to include the idea of a proposition being true relatively to a moment of time (without any specification of a chronicle and of a given selected history). Let us therefore investigate a truth-theory, which includes the idea of a true future in this sense.

The rationality of Ockham's suggestion according to which human beings can (in a very limited sense) influence the past, has been defended by Alvin Plantinga (1986). It should also be mentioned that Ockham's theory as stated above is relevant for the conceptual analysis of the idea of prophecy.

4. The True Futurist Theory: The Thin Red Line

In terms of modern logic and a branching time model, the medieval assumption of the true future can be rendered as meaning that there is a privileged branch at any past, present or future branching point in the model. Consider, for instance, the following model.



In this model, $F(x)q$ is true at t_2 and $F(x+y)q$ is true at t_1, although none of the propositions are necessary, since $F(x)\ {\sim}q$ is possible at t_2. The reason why $F(x)q$ is true at t_2 is just that the evaluation of a proposition according to the true futurist theory should be based on the specified branch though t_2 representing 'the future' at t_2 within the model. But what makes the specified branch privileged? Is it merely that it represents what is going to happen? Is there anything in the present situation, t_2, which makes one branch ontologically special as opposed to the other branches? It might be tempting to refer to some sort of a 'wait-and-see' status of the privileged branch. However, as MacFarlane (2008) has recently argued such a notion very easily leads to confusion. On the other hand, although the true futurist theory does contain some intricate notions, it has not been shown to be inconsistent, and a supporter of the theory may still hold that the theory correctly explains what reality is like. But of course, it should be borne in mind that true futurist theory was introduced exactly to avoid certain counter-intuitive tenets. Therefore, it should be carefully considered which approach ultimately leads to the least problems.

It would of course be fatal for the true futurist theory if it could be demonstrated that it contradicts assumptions, which we should accept for other reasons. Belnap and Green (1994) have argued that there are in fact such fundamental problems related to the true futurist

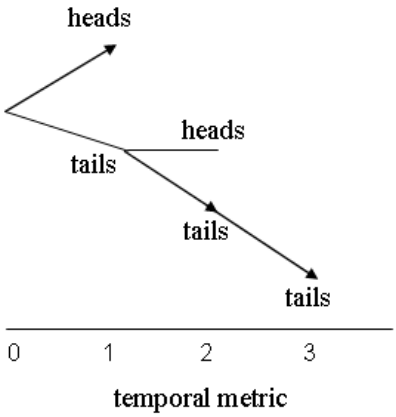
picture. They have tried to demonstrate that the very idea of the true futurist model should be rejected for conceptual reasons — or perhaps even for logical reasons. They have argued that it follows from the true futurist view that it is not sufficient for the model to specify a preferred branch corresponding to the true history (past, present, and future). Belnap and Green argued that in order to maintain a concept of the future, which is "middle ground" between the possible future and the necessary future, it must be assumed that there is a preferred branch at *every* counterfactual moment. They have illustrated their view using the following statement:

> "The coin will come up heads. It is possible, though that it will come up tails, and then later it will come up tails again (though at this moment it could come up heads), and then, inevitably, still later it will come up tails yet again." ((Belnap & Green, 1994), p. 379)

This statement may be represented in terms of tense logic with τ representing tails and η heads, respectively:

$F(1)\eta \wedge \Diamond F(1)(\tau \wedge \Diamond F(1)\eta \wedge F(1)(\tau \wedge \Box F(1)\tau))$

and in terms of the following branching time structure:



The example shows that if the model is taken seriously, then there must be a function TRL, which gives the true future for any moment of time, t. More precisely, $TRL(t)$ yields the linear past as well as the true future of t, extended to a maximal set; Belnap and Green call it "the thin red line". But how can $TRL(t)$ be specified? Belnap and Green have argued that:

(TRL1) $t \in TRL(t)$

should hold in general. Moreover, they have also maintained that:

(TRL2) $t_1 < t_2 \supset TRL(t_1) = TRL(t_2)$

should hold for the *TRL*-function. On the other hand, they have argued that the combination of (TRL1) and (TRL2) is inconsistent with the very idea of branching time. The reason is that if (TRL1) and (TRL2) are both accepted, it follows from $t_1 < t_2$ that $t_2 \in TRL(t_1)$, i.e. that all moments of time after t_1 would have to belong to the thin red line through t_1, which means that there will in fact be no branching at all. However, it is very hard to see why a true futurist would have to accept (TRL2), which seems to be too strong a requirement. Rather than (TRL2), the weaker condition (TRL2′) can be employed:

(TRL2′) $(t_1 < t_2 \wedge t_2 \in TRL(t_1)) \supset TRL(t_1) = TRL(t_2)$

This seems to be much more natural in relation to the notion of a true futurist branching time logic. Belnap has later accepted that (TRL2′) is a relevant alternative to (TRL2) (see ((Belnap et al. 2001) p.169).

Belnap and Green have also argued that any such TRL-function should give rise to a logic in which the following theorems hold:

(T1) $PPq \supset Pq$

(T2) $FFq \supset Fq$

(T3) $q \supset PFq$

Belnap and Green state no formal semantics, but they seem to assume that the tense operators are interpreted only relatively to a moment of time. This amounts to interpreting tenses using a two-place valuation operator:

$T(t,Pq) = 1$ iff $\exists t'$: $t'<t$ & $T(t',q) = 1$

$T(t,Fq) = 1$ iff $\exists t'$: $t<t'$ & $t' \in TRL(t)$ & $T(t',q) = 1$

With such a semantics and (TRL2′), (T1) and (T2) are valid. However, with this semantics and (TRL2′), (T3) will not be valid. To see why this is the case, consider a situation with a moment of time t such that $t \notin TRL(t')$ for any $t'<t$. Assume that t is the only moment at which q is true. Then PFq, hence also $q \supset PFq$, will be false at t.

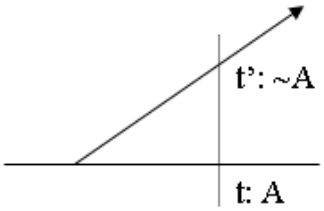
Even the formula

(T3′) $q \supset P(x)F(x)q$

is false when evaluated with the following semantics:

$T(t,P(x)q) = 1$ Iff $\exists t'$: $dur(t,t',x)$ & $T(t',q) = 1$

$T(t,F(x)q) = 1$ Iff $\exists t'$: $dur(t',t,x)$ & $t' \in TRL(t)$ & $T(t',q) = 1$



With this interpretation of the tenses, (T3′) becomes invalid as illustrated above. (The vertical line in this diagram represents a set of co-temporaneous moments i.e. what is sometimes called an instant.)

It is, however, possible to ensure the validity of (T3) even if one wants to insist on the assumption of the 'thin red line' by using the system described in (Braüner et al. 2000). Adopting Belnap and Green's basic idea, a function *TRL* is defined which to each moment assigns a branch such that the conditions (TRL1) and (TRL2′) are satisfied. A novel feature of this semantics is the notion of a (counterfactual) branch with the following property: At any future moment, it coincides with the corresponding thin red line. Given a moment t, the set $C(t)$ of such branches is defined as follows:

$C(t) = \{c \mid t \in c$ & $TRL(t')=c$, for any $t' \in c$ with $t < t'\}$

Note that (TRL1) and (TRL2′) together say exactly that $TRL(t) \in C(t)$. Also note that $C(t)$ may contain more branches that just $TRL(t)$. This allows for counterfactuality. In this semantic model truth is relative to a moment of time, t, as well as to a branch belonging to $C(t)$. By induction, the valuation operator T is defined as follows:

$T(t,c,p) = 1$ iff $T(t,p) = 1$ where p is a propositional letter

$T(t,c,p \wedge q) = 1$ iff $T(t,c,p) = 1$ and $T(t,c,q) = 1$

$T(t,c, \sim p) = 1$ iff not $T(t,c,p) = 1$

$T(t,c,Fp) = 1$ iff $T(t',c,p) = 1$ for some $t' \in c$ with $t < t'$

$T(t,c,Pp) = 1$ iff $T(t',c,p) = 1$ for some $t' \in c$ with $t' < t$

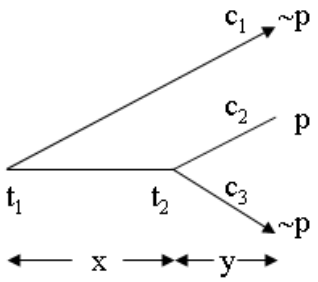
$T(t,c,\Box p) = 1$ iff $T(t,c',p) = 1$ for all $c' \in C(t)$

A formula p is said to be valid if and only if p is true in any structure $(TIME,<,T,TRL)$ for any moment of time t and branch c such that $c \in C(t)$. The tense operators P and F are interpreted as usual in Ockhamist semantics. It is straightforward to introduce metrical tense operators. With this semantics, all of the formulas (T1), (T2), and (T3) are valid. This shows that even if we

accept Belnap and Green's view that (T1–T3) should hold in any reasonable true futurist theory, no strong argument against the position has been established, since there is in fact a structure (*TIME*,<,*T*,*TRL*) according to which (T1–T3) hold. In consequence, Belnap's and Green's analysis does not give rise to any logically inescapable argument against the true futurist position. On the other hand, the possibility operator in the model described in [Braüner et al. 2000] may be somewhat surprising; in the sense that it seems to mean that relatively few (counterfactual) branches are taken into account. In the obvious metrical extension of the system, this invalidates the formula:

(T4) $F(x)\Diamond F(y)p \supset \Diamond F(x)F(y)p$

— which is valid in the usual Ockhamist semantics. The rejection of (T4) may be illustrated with reference to the following model:



Clearly, at t_2 the proposition $\Diamond F(y)p$ holds, since $C(t_2)=\{c_2,c_3\}$. This means that $F(x)\Diamond F(y)p$ is true at t_1. However, the proposition $\Diamond F(x)F(y)p$ is false at t_1, since c_2 is not included in $C(t_1)$. (It is easily verified that $C(t_1)=\{c_1,c_3\}$.) This means that (T4) is false in this model at t_1. This rejection of (T4) amounts to the following idea: Tomorrow some possibilities regarding the following day may emerge even though, today, these possibilities are not available regarding the day after tomorrow. In other words, new possibilities may show up. — However, in order to establish a formal and convincing argument against the true futurist theory, Belnap, Green, and others may of course question the rejection of (T4). However, if insisted that (T1 – T4) should all hold in any acceptable true futurist theory, then in order to have a valid argument, it should first of all be demonstrated that no structure (*TIME*,<,*T*,*TRL*) can meet the extended requirement. In addition, a convincing philosophical argument should be provided to the effect of showing that (T4) should be included in the set of requirements. As long as no such arguments have been established, the true futurist position must be regarded as a possible answer to the problem of future contingency.

4. CONCLUSION

The medieval analysis of the classical argument about the inconsistency of the doctrines of divine foreknowledge and human freedom, respectively, can be confirmed using modern temporal logic. The modern analysis also reveals the same obvious responses as the medieval analysis. As we have seen, Prior's Peircean solution certainly gives rise to some conceptual problems. If this solution is ruled out for such reasons, and the principle of future excluded middle as well the principle of all future contingents being true or false, then we are left with the true futurist theory (and the idea of the thin red line), unless we want to accept determinism. As we have seen, however, although the true futurist theory has been criticised by several writers, all known arguments against the theory appear to be rather weak. It has been shown that the theory can meet even rather strong requirements. So far, nobody argued convincingly against the theory. On the contrary it seems that the theory can be defended against all attacks so far. For this reason, the true futurist theory (and the idea of the thin red line) should be taken into serious consideration when dealing with the problem of future contingency.

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Diodorus Cronus: Modality, the Master Argument and Formalisation

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ABSTRACT

In his Master Argument, Diodorus used the premisses that "Every past truth is necessary" and "The impossible does not follow from the possible" to conclude "Nothing is possible that neither is true nor will be." His ultimate aim was to defend a definition of the possible as that which either is true or will be. Modern scholars have deployed a wide variety of formal notations in order to formalise the ideas of Diodorus. I show how, with one exception, those notations are simply not adequate for this purpose.

A reviewer of an encyclopedia of philosophy once wrote:

> As one who has pretensions to being educated in philosophy, I was distressed to discover that there was a "master argument" due to Diodorus Cronus (who died early in the third century B.C.) of which I knew nothing. Still worse, the argument turned out to be the verbal equivalent of a Rubik's Cube, and I could make nothing of it.[1]

I wrote the encyclopedia article that so baffled the reviewer. Here I would like to make some amends. Unfortunately however I will not always be able to be as clear as I would wish, for I will be criticising various attempts to formalise Diodorus by alternatives to the most obvious and straightforward formalism.

1. THE MAIN TEXTS

According to our amplest ancient report, Epictetus 2.19.1:

> The Master Argument was apparently based on some such assumptions as these. There is a mutual conflict of these three with each other:
>
> Every past truth is necessary;
> The impossible does not follow from the possible; and
> Something is possible that neither is true nor will be.
>
> Seeing this conflict, Diodorus relied on the plausibility of the first two to establish:
>
> Nothing is possible that neither is true nor will be.

Diodorus' purpose was to establish a definition of the possible, whereby the possible is that which either is true or will be. And this definition was one of a family of such definitions.

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[1] (Meynell, 1996), review of (Honderich, 1996).

According to our amplest ancient report of these, Boethius, *Commentary on the* De Interpretatione *of Aristotle* 234.22-26:

> Diodorus defines as possible that which either is or will be; the impossible as that which, being false, will not be true; the necessary as that which, being true, will not be false; the non-necessary as that which either already is or will be false.

Our direct evidence about the Master Argument does not extend much further than this. We do indeed learn from elsewhere that the Master Argument was, at least in some circles, a topic of conversation during and after dinner (Plutarch, *Moralia* 133 b-c and 615a, Aulus Gellius 1.2.4, Epictetus 2.19.8). We are advised to infer from this that the Master Argument "cannot have been unduly complex in structure".[2] The advice, correct though it is, does little to constrain reconstructions of the Master Argument: for there are dinner tables (*experto credite*) at which people discuss Gödel's proofs of his Incompleteness Theorems, and Wiles' proof of Fermat's Last Theorem. Equally unhelpful in reconstructing the Master Argument is the assertion of Michael Psellus *Theologica* 3.129-135 that the Master Argument got its name as a conceit of a pattern then standard: the Heaper Argument was an argument about heaps that itself heaped up many inferences ("One grain does not make a heap; if one grain does not make a heap, then two grains do not make a heap;...; so ten thousand grains do not make a heap"); the Horned Argument was an argument about horns that itself presented victims with the horns of a dilemma ("Either you have lost your horns or you have not lost your horns;…; either way, you have at some time had a cuckold's horns"); so too the Master Argument was a masterly argument about mastership. The consequence is that an adequate reconstruction of the Master Argument should be applicable to mastership ("Suppose that it is possible for Dion to be in charge, even though he is not now nor ever will be"), and should not be conspicuously weak. This consequence cannot be denied. But it cannot rule out any reconstruction that would otherwise be plausible.

There are other texts from the ancient world with a bearing on the Master Argument. But their bearing is in each case fairly indirect. We will encounter them in later sections of this article.

2. FOUR FORMALISMS

Scholars who attempt to reconstruct the Master Argument often do so by formalisation. They have very different beliefs about what sort of formalism is appropriate. My own belief is that, to formalise Diodorus' ideas, the only appropriate formalism is that of Arthur Prior. I will here expound that formalism, and explain why three of its rivals are of no help in formalising Diodorus' ideas.

[2] (Long and Sedley, 1987), p. 233.

2.1 TENSE-CUM-MODAL LOGIC IN THE STYLE OF PRIOR

This is the formalism devised by Arthur Prior, and used in his "Analysis of the Master-argument of Diodorus", in his (Prior, 1967) pp. 32-4. The atomic formulae of this formalism are tensed sentences (e.g. "Dion is ruling") that may be combined with truth-functional operators, tense operators *P* and *F* ("It has been the case in the past that" and "It will be the case in the future that"), and modal operators *M* and *L* ("It is possible that" and "It is necessary that"), in any order, to make further tensed sentences (e.g. "It never has been possible that Dion will always be ruling").

Those who seek a formal semantics for this notation can develop one along these lines: a model contains a set of possible moments of time, one of which is singled out as the actual present moment; on this set are defined two relations, the relation of being later than and the relation of being accessible from; the sentence *Fp* is true at a possible moment if and only if the sentence *p* is true at some later possible moment; the sentence *Pp* is true at a possible moment if and only if the sentence *p* is true at some earlier possible moment; the sentence *Mp* is true at a possible moment if and only if the sentence *p* is true at some possible moment accessible from that moment; the sentence *Lp* is true at a possible moment if and only if the sentence *p* is true at every possible moment accessible from that moment; a sentence is true in the model if and only if it is true at the actual present moment of the model.

2.2 TENSE-CUM-MODAL LOGIC IN THE STYLE OF GASKIN

This is the formalism devised by Richard Gaskin in (Gaskin, 1999).[3] Gaskin's tense logic draws on a distinction between sentence-radicals and sentences proper. Sentence-radicals are the lower-case letters *p*, *q*, *r*, etc., and all formulae that can be compounded from sentence-radicals by truth-functional connectives, the past tense operator *P*, and the future tense operator *F*. No sentence-radical is a sentence proper, and so no sentence-radical has a truth-value. A sentence-radical may be converted into a sentence proper by prefixing it with an *N* (the "closing operator", to be pronounced as "It is *now* the case that"). And sentences proper are all the formulae that can be compounded from sentences proper by truth-functional connectives, and the modal operators *L*, *M* and *Q* for necessity, possibility and contingency. That, at any rate, is the official notation. For practical purposes however, Gaskin usually omits the *N*s. This is because, when we can add *N*s to a string of symbols to produce a sentence of the official notation, the various sentences that we produce are all equivalent.

Gaskin gives no semantics for this notation. Nor is it at all easy to see how a semantics might be developed.

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[3] Gaskin's tense-logical version of the Master Argument was first presented in his (Gaskin, 1996), which was a response to my (Denyer, 1996), pp. 166-180, which was a review of his (Gaskin, 1995), which on pp. 290-1 reconstructed the Master Argument in a formalism based on predicate calculus.

The closing operator *N* makes Gaskin's favoured formalism very different from any standard modal-cum-tense logic. For a standard modal-cum-tense logic would count as well-formed various formulae in which a modal operator occurs within the scope of a tense operator: *FMp*, *PLp* and the like. There is however no way of inserting *N*s into such formulae so as to make them well-formed formulae of Gaskin's official notation, for "the closing operator must be placed *inside* the scope of modal operators but *outside* the scope of tense operators" ((Gaskin, 1999), 211). This means that Gaskin's favoured formalism cannot express the modal notions employed in, for example, Diodorus' claim that, as e.g. Sextus Empiricus *Pyrrhoniae hypotyposes* 2.110 puts it, a conditional is sound if and only if: "it neither was able nor is able to have a true antecedent and false consequent".

It is unlikely that Diodorus, although using these modal notions in his account of conditionals, should then use different modal notions in his Master Argument. It is therefore unlikely that Gaskin's favoured formalism can express the modal notions used in the Master Argument.

2.3 QUANTIFIED MODAL LOGIC WITH INDEXICALS

This is the formalism favoured by, for example, (Vuillemin, 1996).[4] Its basis is the first-order predicate calculus, with moments of time taken as the domain of quantification. It includes not only names of constant denotation (e.g. "noon-GMT-on-22.8.2005"), but also names—or quasi-names—whose denotation can vary (e.g. "now", "this time tomorrow"), and combines these with predicates of times to make sentences that are liable to vary between truth and falsehood. Thus this formalism would render the present tense "Dion is ruling" by a formula to be read as "Now is-a-moment-during-rule-by-Dion", and it would render the past tense "Dion has been ruling" by a formula to be read as "For some *x*, *x* is-a-moment-during-rule-by-Dion, and now is after *x*." To this basis the formalism adds modal operators that produce formulae when applied to a pair of expressions, of which one is a name for a time, and the other a formula. An example might be "It is at the present moment necessary that noon on 1 January 1999 is-a-moment-during-rule-by-Dion."

This formalism can give no apt rendering of the first assumption of the Master Argument that "Every past truth is necessary." For it can render the first assumption only along such lines as, most simply:

If *x* is before now and *Fx*, then it is at the present moment necessary that *Fx*,

or a generalisation of this, such as:

If *x* is before *y* and *Fx*, then it is at *y* necessary that *Fx*,

[4] I have reviewed this at greater length in (Denyer, 1998).

or, more elaborately still:

> If for some *x*, *x* is before now and *Fx*, then it is at the present moment necessary that for some *x*, *x* is before now and *Fx*.

But, on any such rendering, the first assumption has the grotesque implication that all truths are necessary. Let us see how this works in detail for the simplest such rendering, and leave as an exercise for the reader the extension to the other renderings. "55 B.C. = 55 B.C." is logically true. Hence any formula is logically equivalent to its conjunction with "55 B.C. = 55 B.C." But 55 B.C. is before now. So any formula is logically equivalent to a proposition mentioning some time before now. In particular therefore, any true formula will be logically equivalent to some formula that is now necessary. But a formula has the same modality as any proposition to which it is logically equivalent. So any true formula will be necessarily true.

No less grotesque is the way that this formalism would render Diodorus' definitions of modal concepts. For this formalism makes those definitions imply both that every truth is necessary, and that none is. To see this, let us recall that any formula *p* is logically equivalent to, and has the same modality as, the formula *p & now = now*. From this latter formula, we can produce the open sentence *p & x = x*, which is true of all times if *p* itself is true. So *p* implies a formula that may be read as "*p* and now is identical to itself, and for every time later than now, *p* and that time is identical to itself." Such a formula will be a rendering in this formalism of "It is and always will be true that *p & now = now*." But Diodorus defined the necessary what is and always will be true. So, if we are to accept this formalism, *p* implies that *p* is necessary, and every truth is a necessary truth. Moreover, from *p & now = now*, we can also produce the open sentence *p & now = x*. So Diodorus' definition of necessity will equate "It is now necessary that *p*" with a formula to be read as "*p* and now is identical to now, and for every time later than now, *p* and that time is identical to now." But no such formula is true, and hence no truth is a necessary truth.

2.4 QUANTIFIED MODAL LOGIC WITHOUT INDEXICALS

This is the formalism favoured by Nicholas Rescher in (Rescher, 1966). This is like the formalism favoured by Vuillemin, except that it allows as names for times only those that, like "noon-GMT-on-22.8.2005", are of constant denotation. Because it is based on predicate calculus, it has all the faults of Vuillemin's formalism. And because not one of its formulae is capable of varying between truth and falsehood, it has a distinctive fault of its own. For changes of truth-value are envisaged in the Master Argument itself (e.g. "Nothing is possible that neither is true nor will be"), in Diodorus' own definitions of modal concepts (e.g. "the non-necessary as that which either already is or will be false"), and in his own teaching that, as Sextus Empiricus *Adversus mathematicos* 10.97-99 puts it:

> it is possible to have true pasts whose presents are false. E.g. suppose someone married one year earlier, and someone else one year later. So in their case the proposition "These men married" is, being past, true; whereas "These men are marrying" which is a present is false. For when the one

> was marrying, the other was not yet marrying. And "These men are marrying" would have been true of them if they married simultaneously. So it possible for a true past to have a false present. Also like this is "Helen had three husbands". For neither when she had Menelaus as her husband in Sparta, nor when she had Paris in Ilium, nor when, on his death, she married Deiphobus, is the present "She has three husbands" true, although the past "She had three husbands" is true.

Diodorus was in no way eccentric to envisage such changes of truth-value. Carneades took them for granted, when he gave the oversimplified account of tensed statements that is reported in Cicero *De fato* 27 as:

> Just as we call true those past-tense propositions whose present was true at some previous time, so we should call true those future-tensed propositions whose present will be true at some later time.

Such changes are taken for granted also by Chrysippus, as reported in Cicero *De fato* 14:

> For all truths in past tenses are necessary, as Chrysippus declares, in disagreement with his master Cleanthes, since they are immutable, and being past-tensed cannot change from true to false.

For although Chrysippus was happy to reason in this way that all past truths are necessary, he nevertheless maintained that some truths are contingent. Other examples could be given.[5]

When an entire philosophical culture is so ready to believe that truth-values can change, it is hard to accept that we are being faithful to their ideas when we formalise them in a formalism that expressly precludes such changes.

3. THE FIRST ASSUMPTION OF THE MASTER ARGUMENT

The first assumption of the Master Argument is reported by Epictetus as "Every past truth is necessary." Three interpretations of this assumption deserve mention here, of which only the first is plausible.

3.1 PRIOR ON PAST TRUTHS

Prior's interpretation depends on the thought that we should not count as past truths absolutely all truths that somehow or other involve the past tense. For example, "Claire has never yet had a son" involves the past tense, but it is quite unlike anything that Carneades had in mind when he said that those past statements are true whose presents have been true, and it is quite unlike anything that Chrysippus had in mind when he said that all past truths are

[5] Perhaps the most striking would be Aristotle *Categories* 4a16-4b5 and Alexander of Aphrodisias *De fato* 177.15-22, passages where the author agrees without argument that propositions can change truth-value, although it would be in many respects more convenient for him if no such change were possible.

necessary, since they cannot change from truth to falsehood; for the fact that "Claire has no son" has been true hardly means that she has never had a son, and the fact that she has never yet had a son hardly means that she never will. Indeed, it is evident that when Carneades and Chrysippus talked of past truths they had in mind only truths of the form *Pp*. If we take this as our guide, we should formalise the first assumption as *Pp* → *LPp*.

Could this be all that the first assumption means? Diodorus, we have seen, offered "These men have married" and "Helen had three husbands" as past truths that manifestly are not of the form *Pp*, for they are true even though "These men are marrying" and "Helen has three husbands" never have been true. Yet these past truths look just as necessary as past truths of the form *Pp*, like "This man has married" and "Menelaus was Helen's husband." Should we modify our formalisation of the first assumption to allow for this? Probably not. For if a proposition of the form "These men have married" is true, then there will be truths of which it is a logical consequence, and which are necessary by the principle that *Pp* → *LPp*; for it will be a logical consequence of some truths of the form "This man has married." But a logical consequence of necessary truths is itself necessary. So any truth of the form "These men have married" will be necessary, according to the first assumption as we have formalised it, quite without any modification. The same holds also for "Helen had three husbands." So we have no reason here to take the first assumption to be other than *Pp* → *LPp*.

3.2 WEIDEMANN ON PAST TRUTHS

Hermann Weidemann takes the first assumption to claim more than that *Pp* → *LPp*.[6] He takes it to be, in effect, the claim that *p* → *L(p v Pp)*. For he takes past truths to be, not truths of the form *Pp*, but truths of the form *p v Pp*; so he takes the first assumption to be the claim that *(p v Pp)* → *L(p v Pp)*, which is equivalent to the conjunction of *p* → *L(p v Pp)* with *Pp*→ *L(p v Pp)*, which is an immediate consequence of *Pp* → *LPp*, which is equivalent to *Pp* → *L(Pp v PPp)*, which results from substituting *Pp* for *p* in *p* → *L(p v Pp)*. It would be convenient if the first assumption does claim that *p* → *L(p v Pp)*, for this claim seems no less plausible than *Pp* → *LPp*, and with this claim as its first assumption the Master Argument would be incontestably valid: suppose some proposition is possible that neither is nor ever will be true; then from the actual present moment (call it *a*) there is accessible some moment (call it *m*) that is neither identical to nor later than *a*; now let *p* be a proposition true at *a*, but at no other moment; it follows that ¬*(p v Pp)* is true at *m*, and therefore that *L(p v Pp)* is false at *a*; and this contradicts the claim that *p* → *L(p v Pp)*. But although convenient, Weidemann's rendering of the first assumption looks implausible. For there is no sign that any ancient classified as past truths, not truths of the form *Pp*, but those of the form *p v Pp*.

[6] See (Weidemann, 2008), pp. 131-148, at p. 141. The point should not be obscured by the fact that Weidemann would formalise the first assumption by a formula that looks just like our *Pp* → *LPp*. For *Pp* in his notation is the same as *p v Pp* in ours.

3.3 GASKIN ON PAST TRUTHS

Gaskin too takes the first assumption to claim more than that $Pp \rightarrow LPp$. For he takes past truths to include, not only truths of the form Pp, but also truths of the form $\neg Pp$, and so takes the first assumption to claim also that $\neg Pp \rightarrow L\neg Pp$. Gaskin therefore makes Diodorus' notion of past propositions very different from the one we saw Chrysippus and Carneades take as obvious. However, he offers no evidence that anyone apart from Diodorus had such a notion of past propositions. Nor does he say why anyone at all, whether Diodorus or another, should find plausible an assumption which claims that $\neg Pp \rightarrow L\neg Pp$, when truths of the form $\neg Pp$ can so readily change from truth to falsehood.

There is, on Gaskin's account, more to the first assumption even than this. For $Pp \rightarrow LPp$ and $\neg Pp \rightarrow L\neg Pp$ together amount to $\neg QPp$, which implies $Q(Pp \vee p \vee Fp) \rightarrow Q(p \vee Fp)$, which is only one half of the biconditional $Q(Pp \vee p \vee Fp) \leftrightarrow Q(p \vee Fp)$ whereby Gaskin formalises the first assumption. Thus, on Gaskin's account, the first assumption claims additionally that $Q(p \vee Fp) \rightarrow Q(Pp \vee p \vee Fp)$.

Gaskin has vacillated about this additional claim. At one stage, he said it was "uncontroversial" ((Gaskin, 1996), 190); at a more recent stage, he said it was "not guaranteed to be true" ((Gaskin, 1999) p. 216). His second thoughts were wiser. For in making this additional claim, the first assumption rules out cases like these: Dion has been in power (where p is "Dion is in power", this means that Pp, and therefore that LPp, and therefore that $L(Pp \vee p \vee Fp)$, and therefore that $\neg Q(Pp \vee p \vee Fp)$), but was deposed yesterday; he might yet be back in power (this means that MFp and therefore that $M(p \vee Fp)$), but he is not in power at the moment, and might never be in power again (this means that $M\neg(p \vee Fp)$, and therefore that $Q(p \vee Fp)$). Neither at the earlier nor at the later stage has Gaskin offered any explanation of why, if the first assumption makes such a claim, Diodorus should have been able to rely on its plausibility. Nor has he offered any explanation of how to derive such a claim from Epictetus' wording about the necessity of all past truths.

4. THE SECOND ASSUMPTION OF THE MASTER ARGUMENT

The second assumption of the Master Argument is reported by Epictetus as "The impossible does not follow from the possible." The obvious interpretation is that Diodorus was reasoning from the assumption that if p is possible and q is impossible, then q does not follow from p.

Gaskin however formalises the second assumption in a way quite different from this. For he treats it as formulating and endorsing this rule of inference:

> If $(A \ \& \ \neg A)$ follows from A taken together with some other assumptions, then $\neg QA$ follows from those other assumptions alone.

Here is an example of how to apply this rule of inference: since $p \,\&\, \neg p$ follows from p taken together with $\neg p$, then $\neg Qp$ follows from $\neg p$ alone. Alternative formulations of essentially the same rule of inference would be that Lp follows from p, and that p follows from Mp.

Gaskin does not attempt to explain how to extract his rule of inference from the wording in Epictetus.

There is however one difficulty about Gaskin's interpretation of the second assumption to which he is alert. It is that Gaskin's rule of inference seems to imply that every truth is a necessary truth, which would make the rule lack the plausibility of which Epictetus speaks. Gaskin's solution to this difficulty is that the full panoply of classical logic was not widely accepted in Diodorus' day, and that what follows from his rule of inference by principles that were widely accepted is not the objectionably fatalistic claim that the conditionals $Mp \rightarrow p$ and $p \rightarrow Lp$ are always true. Specifically, the rule of inference is tantamount to the principles that Lp follows from p and that p follows from Mp; Aristotle, who was no fatalist, accepted these principles; to get from these principles to the objectionably fatalistic claims, we need the principle of Conditional Proof; but the principle of Conditional Proof was not universally accepted; it would have been contested by, among others, Aristotle ((Gaskin, 1996), 186-9; (Gaskin, 1999), 215).

Gaskin's solution to this difficulty faces a further difficulty of its own. It is that, whatever Aristotle may have thought, Diodorus himself and his successors had no hesitation about accepting the principle of Conditional Proof. It was the consensus among them all, we learn from Sextus Empiricus *Against the Learned* 8.112, that: "a conditional is sound whenever its consequent follows from its antecedent". Their only dispute was over what it is for one proposition to follow from another. Indeed, Gaskin himself points out (his ((Gaskin, 1996), 191; (Gaskin, 1999), 216 n. 29) that, in his own reconstruction, Diodorus uses Conditional Proof and kindred principles.

5. THE THIRD ASSUMPTION OF THE MASTER ARGUMENT

The third assumption of the Master Argument was given by Epictetus "Something is possible that neither is true nor will be," where "*dunaton*" is the Greek word that I translate as "possible". The obvious way to formalise this in standard modal-cum-tense logic is as saying that for some p, $Mp \,\&\, \neg(p \vee Fp)$.

Gaskin formalises the third assumption in his notation as saying that for some p, $Q(Pp \vee p \vee Fp) \,\&\, \neg(p \vee Fp)$. It says, in other words, that for some p, it is possible that p be true sometime, it is possible that p be true never, and p neither is nor will be true. In effect then, Gaskin formalises the statement that p is *dunaton* by the formula $Q(Pp \vee p \vee Fp)$. How reasonable is this? As evidence that "*dunaton*" can bear such a meaning, Gaskin cites the way that Aristotle uses it and its cognate "*dunasthai*" in his discussion of two-way capacities in *De Interpretatione* 12-13 ((Gaskin, 1999), 213). A typical passage would be 21b12-15, where Aristotle says:

> The same thing appears to have a capacity both for being and for not being. For what is capable of being cut or of walking is also capable of not being cut or of not walking. The reason is that whatever is in this fashion capable is not always actually operating, so that the negation too will be present in it.

However, such passages do not support Gaskin's interpretation of "*dunaton*". For Aristotle's idea is that if a thing has the two-way capacity of walking, then it is possible that the thing walks sometimes, and possible also that the thing sometimes fails to walk. In consequence, the existence of an Aristotelian two-way capacity for *p* should be formalized in Gaskin's notation as *M(Pp v p v Fp) & M(P¬p v ¬p v F¬p)*; and this is quite different from Gaskin's *Q(Pp v p v Fp)*.

6. ARE THE THREE ASSUMPTIONS CONSISTENT?

If the three assumptions were as we have interpreted them, then all three assumptions can be true together, and all are true together so long as these conditions are met: every moment earlier than the actual present moment is earlier than every moment accessible from the actual present moment; and some moment accessible from the actual present moment is neither identical to nor later than the actual present moment. Nevertheless, the first and second assumptions come close to ruling out the third, for the first and second assumptions imply that no proposition can be for more than an instant as the third assumption takes some proposition to be: both possible and such that it neither is nor ever will be true. In consequence, we can easily move from accepting the first two assumptions to rejecting the third once we accept the principle that nothing is ever so for only an instant. This principle was accepted by all parties to the debate over the Master Argument.[7] We can thus explain why, even though the three assumptions of the Master Argument are in fact consistent, those who wanted to accept the third assumption felt constrained by the Master Argument to reject either the first or the second (Epictetus 2.19.2-4).

7. DIODORUS' DEFINITIONS OF THE MODAL TERMS

Upon rejecting the third assumption of the Master Argument, Diodorus concluded that nothing is possible that neither is nor will be true. When combined with the scarcely contestable idea that what is or will be true can be true, this conclusion promptly gives Diodorus' definition of the possible as what is or will be true. And from Diodorus' definition of the possible, it is easy enough to derive what look like his other definitions. For example, since a thing is necessary if and only if its negation is not possible, a thing will be necessary if and only if its negation is not such that it either is or will be true; in other words, a thing will be necessary if and only if it is and always will be true.

[7] For details, see (Denyer, 1999).

7.1 DIODORUS' DEFINITIONS AND PRIOR'S FORMALISM

All this is very straightforward when formalised in Prior's formalism. The definition of the possible can be formalised as equating *Mp* with *p v Fp*. This means equating ¬*M*¬*p* with ¬*(*¬*p v F*¬*p)*. But ¬*M*¬*p* is equivalent to *Lp*, and ¬*(*¬*p v F*¬*p)* is equivalent to *p &* ¬*F*¬*p*. So the definition of the possible is, by implication, equating *Lp* with *p &* ¬*F*¬*p*. The definition of the necessary can be formalised as making precisely that equation. And all is simple.

7.2 DIODORUS' DEFINITIONS AND GASKIN'S FORMALISM

Things are much more complicated on Gaskin's interpretation. According to Gaskin (Gaskin, 1999, 210-13), the sort of possibility of *p* that Diodorus defined by *p v Fp* cannot be expressed in his notation by *Mp*. For that formula, recall, is an abbreviation of *MNp*, and says that it is possible that it is now the case that *p*, not that it is possible that *p*. Hence, Gaskin tells us, the possibility of *p* that Diodorus defined by *p v Fp* is expressed instead by *M(p v Fp)*. The sort of necessity that goes with this sort of possibility—the sort of necessity that a proposition has if and only if its negation lacks this sort of possibility—should then be expressed in Gaskin's notation by ¬*M(*¬*p v F*¬*p)* or some equivalent formula such as *L(p &* ¬*F*¬*p)*. And if Diodorus had this sort of necessity in mind when he defined the necessary as that which is and always will be true, then his definition of the necessary would be a straightforward consequence of his definition of the possible. However, Gaskin tells us, Diodorus had in mind another sort of necessity altogether: the sort of necessity that he equated with *p &* ¬*F*¬*p* is to be expressed in his notation by *L(p v Fp)*. So, if, as it is easy to suppose, Diodorus did infer his definition of necessity from the conclusion of the Master Argument, then he was guilty of a fallacy.

It is difficult to assess this argument of Gaskin's. The chief difficulty is in assessing his claims about the proper way to formalise, in his notation, the sorts of necessity and possibility that Diodorus attempted to define. Gaskin does not tell us enough about his notation for us to be able to assess them ourselves. We simply have to take his word for them.

We should however note that if Diodorus' definition of necessity was as Gaskin supposes, then he was an even worse logician than Gaskin ever suggests. For *LF*¬*p* implies *L(*¬*p v F*¬*p)*, which, by the definition of necessity, implies ¬*p &* ¬*Fp*, which implies ¬*p*. So, by contraposition, *p* implies ¬*LF*¬*p*, which implies *M*¬*F*¬*p*, which implies *M(*¬*F*¬*p v F*¬*F*¬*p)*, which, by the definition of possibility, implies ¬*F*¬*p v F*¬*F*¬*p*. So, since I am now alive, it follows that either I will live for ever hereafter, or at least that a time will come when I will live for ever thereafter. Indeed, there follows an even more optimistic conclusion. For suppose that, before I enter into immortality, there will come a time at which I am not alive. Then it would follow, by exactly the same pattern of argument, that either I will never be alive from that time onwards, or at any rate there will come a still later time after which I will never be alive. But neither of these is consistent with our earlier conclusion, that if I have not already entered into immortality, then I will at some time do so. So we were wrong to suppose that, before I enter into immortality, there will come a time at which I am not alive. So I am immortal already—given merely that I am now alive.

7.3 DIODORUS' DEFINITIONS AND THE MEGARICS

Diodorus was sometimes classified as a Megaric.[8] According to Aristotle *Metaphysics* 1046b29-32, the Megarics held that:

> a thing is able to act only when it is acting, and that when a thing is not acting it is unable; e.g. that someone who is not building is unable to build, but someone who is building is able, when he is building, and likewise also for other cases.

Diodorus' view is, in large and obvious ways, different from that of the Megarics.[9] Yet it is possible to see Diodorus' view as what results from the Megaric view after a few rounds of debate.

The Megarics' initial position, equating the possible with the actual, is refuted by the obvious objection that it rules out all change, for if things never can be different from the way they are, they never will be (Aristotle *Metaphysics* 1047a10-17). In the face of this objection, Megarics can abandon the letter of their initial position while still retaining much of its spirit. Let us imagine them speaking as follows: "There is no way of differentiating falsehoods into those that can be true and those that can't. All falsehoods are alike. They're all impossible." Aristotle then points out that if all falsehoods are impossible, then nothing ever changes. The Megarics can respond: "Very well. Things do change, and so not all falsehoods are impossible. Nevertheless, there is still no way of differentiating falsehoods into those that can be true and those that can't. All falsehoods are still alike. For they're all possible, and the only difference between them is that some will continue to be false for ever, while others will change to be true."

It is just such a response that Aristotle considers in the next round of the debate at *Metaphysics* 1047b3-9:

> If the aforesaid [i.e. having no impossible consequences: see *Metaphysics* 1047a24-28] either is or follows from being possible, then it plainly cannot be true to say "'The thing is possible; but it never will be'—the upshot of which is that we thus avoid admitting that things are impossible." I mean e.g. if someone—the man who does not reckon that anything is impossible—were to say "It is possible to measure the diagonal; it is just that it never will be measured; because there is nothing to stop a thing that is capable of being or happening from not being either now or in the future."

"Measuring a diagonal" means finding two integers, *m* and *n*, such that the diagonal of a square is exactly *m/n* times as long as the side of the square. A contradiction follows if we suppose that someone has found two such integers: the same number will be both odd and even (see e.g. *Prior Analytics* 41a25-27). After being reminded that some things imply

[8] For evidence of this fact, and its implications, see (Denyer, 2002).
[9] The view of the Megarics has been examined in (Makin, 1996).

contradictions, only the utterly incorrigible would continue to maintain, in so many words, that anything can happen, including those things that imply contradictions, and it is just that some things never will. But the corrigible can still maintain, if not exactly this, then at least something very like it.

Think, for example, of the relation between these two philosophies of mind: the Disappearance Theory, whose slogan might be "There are no minds; there are only brains"; and the Identity Theory, whose slogan might be "There are minds; for there are brains, and minds are identical to brains." In one respect, these two philosophies of mind could hardly be more different: one affirms something that the other denies, the existence of minds. In another respect, these two philosophies of mind amount to variations on a single theme: they both agree that there are no minds apart from brains. Hence someone who starts from the Disappearance Theory, and who then feels constrained to agree that there are minds after all, will naturally move towards the Identity Theory, as the nearest tenable position.

We can imagine a similar development among intellectual descendants of the Megarics whom Aristotle criticized. The development will allow them to maintain all along that the impossible is nothing other than what is not and never will be true, while taking them from the thought that the impossible is nothing whatsoever, to the thought that the impossible is as Diodorus defined it.[10]

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The Search for the Diodorean Frame

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ABSTRACT

Diodorean modalities are logical notions that specify, in a precise way, how sentences may be true with respect to time: a sentence is diodoreanly necessary at a given instant iff it is true since that instant on. Arthur Prior has treated them as sentential operators and built up a logic for such modalities (**DIOD**) conjecturing that the *frame for* such a logic (the "diodorean frame") was the frame for **S4**. The Conjecture was soon proved false, through a number of counterexamples that played a role in the research on modal logics between **S4** and **S5**. The present paper aims at showing that (i) the search for the diodorean frame benefited from such a research, and that (ii) there has been a mutual interaction between the search of the diodorean frame and some characterisation results. The paper is divided into five parts. In section 1, I will introduce diodorean modalities, while in Section 2 I will be focusing on Prior's reconstruction of the Master Argument and his characterisation of **DIOD**. In section 3, I present a conjecture Prior advanced about the characterisation of **DIOD** and some counterexamples to it. The notions of "*frame*" and "*frame for*" will be also introduced. In section 4 I summarise the connections between the search of the diodorean frame and some researches in modal logic. Section 5 presents a short conclusion.

1. INTRODUCTION

Diodorean possibility and *necessity* constitute the *diodorean modalities*, and are defined as follows: *p* is *diodoreanly possible* (since now on, *d-possible*) at a given instant *t* iff *p* is true at *t or* at *some* later instant, and *p* is *diodoreanly necessary* (since now on, *d-necessary*) at a given instant *t* iff *p* is true at *t* and at *every* later instant.

d-necessity and d-possibility are comprised in the family of modalities, *i.e.* those notions that specify the truth-value of sentences in a non-extensional way. A list of such notions usually include epistemic and doxastic predicates ("... is believed", "... is known"), notions as "possible" and "necessary". Remarkably, also *tenses* are included in the list, since they specify the way a sentence is true with respect to time.

Today all these notions receive an essentially uniform treatment as *sentential operators*, that is operators that transform sentences in other sentences (e.g. "I eat" in "It is possible that I eat"). Such an approach is due to the work of Saul Kripke[1], and is considered one of the major results of contemporary logic. The *operators* that aim at expressing *tenses* are called *temporal*

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[1] (Kripke, 1959) is a milestone of modal logic. There, Kripke focuses on the alethic notion of necessity, but in doing this he provides a semantics that has soon been used for any kind of modality (temporal, epistemic, doxastic, deontic). The formal tools used to Kripke are now the standard ones in modal logic, and I will employ them in the present paper.

operators, and the logics and languages that comprise them are called *temporal logics*[2] and *temporal languages*. When referring to the field in its entirety, the label "*temporal logic*" is often used.

In what follows, we will deal with temporal logic, since diodorean modalities have been defined on the basis of temporal notions. The temporal language will be given in section 2.1.

Throughout the paper we will also meet logics where the notions of logical or metaphysical "necessity" and "possibility"[3] are expressed. They are the so-called "*alethic (modal) logics*". The main difference between these logics and the temporal ones is that, while

$\bullet p \rightarrow p$

is taken as valid when "•" is given an "alethic" reading (as "necessarily"), it is invalid in any plausible temporal reading[4]. Today, "alethic logics" are simply called "*modal logics*". This may create some ambiguities, because temporal logics are often referred to as "modal logics".

In this paper, I will mainly use the label "modal logics" for those logics whose operators can be read in an alethic way, and "temporal logics" for those that fit with a temporal reading. In section 3.1 my use of "modal" will be more ambiguous, but what I say there applies to both temporal and modal logics.

A neat difference in label may not mirror a dramatic divide in the labelled subjects. This is exactly the case with temporal and modal logics: some alethic logics may be built up as fragments of temporal logics. In other words, we may take a temporal logic **L** and define there a "modal operator" on the basis of temporal operators. Then we may extract a modal logic **L'** by taking that fragment of **L** that contains all and only the sentences where just the modal operator appear[5]. Thus, there may be no real divide: some alethic logics may have a temporal reading.

It is easy to see that a logic for diodorean modalities will have this reading, since d-necessity and d-possibility are defined by temporal notions. However, I consider the diodorean logic as a fragment where only operators for d-necessity and d-possibility. In the paper I will also mention two modal logics: **S4** and **S5**. As we will see, **S4** has been related with diodorean

[2] Some insisted on the opportunity of calling them *tense* operators and *tense* logics, in order to distinguish them from other logics that express relations between instants, or between sentences and instants) and drop away tenses. These logic would be "temporal logics" (since dealing with time), but not *tense logics*. However, today the label "*temporal logics*" is used for both of them. It is clear by what follows, that here take into account only logics containing sentential operators for tenses.

[3] The notion of a "logical necessity (possibility)" can be characterised as follows: *p* is a logically necessary (possible) truth if it follows from (is compatible with) the laws of logic. The notion of a "metaphysical necessity" strikes many as unclear. Probably, one of the most perspicuous characterisation is: *p* is a metaphysically necessary (possible) truth iff *p* is true in virtue of the objects it is about (if it is compatible with the nature of the object it is about).

[4] "If always (at least once) in the future (past) [it is the case that] *p*, then *p*" is clearly false.

[5] To be more precise, we take the fragment that contains all and only the sentences where there are just those combinations of tenses that define the modal operator.

modalities, and both logics are very important in other fields of logics: they have been used to study the relations between Intuitionistic logic, Classical logic and logics between the two.

As many modal notions, diodorean modalities have philosophical roots. They represent a view on possibility that was supported in Antiquity, and they was involved in the debates about determinism and free will. Arthur Prior rediscovered such modalities in the half of the past century, and propose a formal approach to them[6].

In what follows, my aim is to highlight the (usually) neglected connections between some researches in modal logic -in the Fifties and the Sixties- and the search for the *diodorean frame*. More precisely, I will show the benefits that Prior's investigation received by researches in *characterisation results* (see Section 3) and in the logics between **S4** and **S5** (that since now on I will call "*intermediate logics*"). Before doing this, in Section 2 I present Prior's reconstruction of the Master Argument, an argument that the greek philosopher and logician Diodorus Cronus used to support the view that gave rise to the modalities that bring his name. Some assumptions made by Prior decisively influenced the search for the diodorean frame. Section 3 presents a conjecture Prior advanced about the characterisation of the diodorean logic **DIOD**, and introduces as well counterexamples to this conjecture. This counterexamples shed light on the existence of previously unknown logics. Section 4 summarises the content of the paper, and is followed by a short conclusion (Section 5). A last remark before starting. In all his works, Prior uses the so-called *polish notation*, a symbolism where logical connectives are prefixed to the sentences they connect. Such a notation is very hard to read and somewhat unfamiliar today. For these reasons, in this paper I will use the contemporary notation (with connectives appearing *in* the sentences, and not prefixed to them).

2. FROM THE MASTER ARGUMENT TO THE DIODOREAN LOGIC

Diodorean modalities have been named thus after the ancient greek philosopher and logician Diodorus Cronus, who defended his conception of modalities in an argument that became famous as "the Master Argument" (see (Denyer, 2009), this volume). By the latter, Diodorus aimed at showing that the only plausible meaning of "possible" is "true either now or at least once in the future". The Master Argument is well-known to us for its quite puzzling character: we have just indirect sources of it, and all of them mention two premises and the supposed conclusion, without reporting the inference from the former to the latter. This is quite problematic, since any reasonable derivation of the conclusion from the given premises seems to require further assumptions.

The premises are:

a) If a sentence *p held*, then it is a matter of necessity that it *held* (the past is somehow necessary).

[6] In (Prior, 1955).

b) If necessarily $\neg q$ and $p \rightarrow q$, then necessarily $\neg p$.

and the conclusion is:

z) if *p* is and will always be false, then *p* is impossible.

In other words, by assuming ***a)*** and ***b)***, it should derive that the notion of "necessity" appearing in the premises collapses on the notion of "d-necessity". Here, it is worth noting that the notion of necessity employed in the premises and steps of the Argument is not d-necessity. Indeed, the aim of the argument is reducing an otherwise characterised notion of modality to the diodorean one, and employing the latter as "the" notion of modality through the Argument would jeopardise it with circularity. This fits well with the fact that the Argument supports the Diodorean Modalities as the right way of conceiving "modalities" (intended on a more general way), and it does not aim at proposing the *definition* of the d-modalities.

The success of the Master Argument is ascribable to the fact that ***a)*** and ***b)*** were widely accepted by ancient philosophers, and that the lost inference from them to the conclusion was considered correct. To us, the problematic aspect of the Argument is due to the fact that we have no direct or decisive evidence for guessing how it should be suitably restored. The combination of the two things has promoted a variety of attempts to reconstruct the Argument in order to make its inferences explicit. Even if we restrict ourselves to the past century, a wide number of such attempts have been proposed, and the debate about them is lively. In addition, since a decisive evidence about the Argument lacks, it is difficult to foresee a conclusion.

Reconstructions of the Master Argument have today the form of precise formalisations[7]. This situation is due to the fact that for about ten years (1955-1965) the Master Argument has held a main position in the crossover field of philosophy and modal logics. This field was fed by traditional philosophical problems but was concerned at the same time with the properties of the formal logics and languages that were employed at that time to shed light on the notions of necessity, eternity, knowledge and the like. Diodorean modalities and the Master Argument have been a very specific example of how philosophical problems have been readdressed by formal tools.

Since we are here interested in diodorean modalities and their connections with the search on frames for modal logics, I will focus just on Prior's reconstruction[8]. Indeed, it has been the starting point of a work on a diodorean logic and on the frame for it (see Section 3.1 and 3.2).

[7] For this aspect, see (Denyer, 2009), this volume.
[8] For comparing Prior's reconstruction with other formal attempts, see (Denyer, 2009), this volume.

2.1 PRIOR'S RECONSTRUCTION OF THE MASTER ARGUMENT

Arthur Prior is the first to put together the exegetical problem and the tools of contemporary modal logic. First he deals with diodorean modalities in (Prior, 1955), where he provides a characterisation of these modalities and his reconstruction of the Master Argument by giving the guidelines he will always follow thereafter. Then, he comes back on the issue in various papers or book's chapters (see (Prior, 1958), (Prior, 1962), (Prior, 1957) and (Prior, 1967)), often correcting or making more precise what he had previously stated.

In order to give a perspicuous and straightforward description of Prior's reconstruction, we need to introduce a formal tool: a language that is able to express tenses and give the definition of the diodorean modalities. The temporal language (l_T) we need is an expansion of the language of propositional classical logic by the operators *P* and *F*. *P* and *F* mean "at least once in the past" and "at least once in the future", respectively. *H* and *G* are their *duals*[9], to be read as "always in the past" and "always in the future". Thus, *PGp* means "at least once in the past [it is the case that] always in the future *p*"[10]. Let me use *L* for the operator of d-necessity, that is defined as follows:

$Lp := p \wedge Gp$

L will be the operator of d-necessity (do be defined as *M*'s dual)[11]. (l_T) must include as well a way for expressing the notion of necessity involved in the premises of the Argument. As we have seen, it cannot be expressed by *L*, on the pain of circularity. Ancient sources give us no precise hint on how to interpret such a notion[12], but it is clear that it should have an intuitive or theory-laden reading (*i.e.* it should correspond to some common or philosophical view on necessity). Indeed, the Argument is interesting as far as it reduces to d-necessity an *otherwise conceived* notion of necessity, as I have already suggested above. If this was denied, the Master Argument would loose any intuitive or philosophical appeal.
Since facing the Master Argument and its problems is beyond the tasks of this work, I will use here the symbol **NEC** for expressing the necessity to be reduced, while keeping myself neutral on the viable interpretations of it. In conformity with the contemporary modal machinery, **NEC** will be treated as an operator. In addition it is implicit in Prior's reconstruction (as in any other one), that the symbol obeys the rules of inference:

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[9] In symbols: $Hp := \neg P \neg p$ and $Gp := \neg F \neg p$
[10] Another example: *HFp* is "always in the past [it is the case that] at least once in the future *p*" is true. Notice that this sentence is nothing but $\neg P \neg Fp$, and its negation is consequently $PG \neg p$.
[11] In symbols: $Mp := \neg L \neg p$.
[12] In any case, the reduction looks implausible if logical necessity involved in the premises: ***a)*** would not sound feasible, and in any case the conclusion would sound hardly acceptable if it was "*p* is true by virtue of the laws of logic iff *p* is and will always be true". In addition, it is clear that the notion to be reduced is not the notion of "possibly" as "at least once", because if "necessary" is read as "always", then the premise ***a)*** is patently false: we may have that *p* was true and that, in some earlier instant, *p had been* false up to that instant.

RNEC $\vdash p \Rightarrow \vdash \mathbf{NEC}p$

(in other words, if p is a theorem, also **NEC**p is) and:

MP $\vdash (p \rightarrow q) \wedge p \Rightarrow \vdash q$

US $\vdash p \Rightarrow \vdash q$ form substitution of propositional variables $r_1, ..., r_n$ in p with formulae whichever $b_1, ..., b_n$

(Modus Ponens and Uniform Substitution). In symbols, ***a)*** and ***b)*** become:

a') $Pq \rightarrow \mathbf{NEC}Pq$

b') $\mathbf{NEC}(p \rightarrow q) \wedge \mathbf{NEC}\neg q) \rightarrow \mathbf{NEC}\neg p$

a')-b') contribute to settle the general framework on which the Argument has to run, and yet tell us nothing of the "inferential gap" that stands between the Argument's premises and its conclusion. To restore the Argument, Prior added two premises to those mentioned by the ancient sources:

c) $PG\neg p \rightarrow \neg p$

d) $(\neg p \wedge G\neg p) \rightarrow PG\neg p$

It is worthy to include premise ***c)*** in the set of sentences that should hold under the Diodorean conception of truth in time. Indeed, it is part of our most basic intuitions about time that, if once in the past [it is the case that] p is going to be true at any subsequent instant, then p is true now (otherwise $\neg Gp$ should hold at any instant previous than now). Things are not that easy for ***d)***, as we shall see below. Once this is settled, Prior's reconstruction reshapes the Argument as follows:

1	$(p \rightarrow q) \rightarrow ((q \rightarrow r) \rightarrow (p \rightarrow r)$	by propositional logic
2	$(p \rightarrow (q \rightarrow r)) \rightarrow (q \rightarrow (p \rightarrow r))$	by propositional logic
3	$PG\neg p \rightarrow \mathbf{NEC}PG\neg p$	by ***a')***, with $G\neg p$ substituting q
4	$(\neg p \wedge G\neg p) \rightarrow \mathbf{NEC}PG\neg p$	by **1**, **3** and ***d)*** via **MP**, with $\neg p \wedge G\neg p$ substituting P, $PG\neg p$ substituting q and **NEC**$PG\neg p$ substituting r
5	$(\neg p \wedge G\neg p) \rightarrow (\mathbf{NEC}(PG\neg p \rightarrow \neg p))$	by ***c)*** and **1** via **RNEC** and **MP**
6	$\mathbf{NEC}(PG\neg p \rightarrow \neg p)$	by ***c)*** via **RNEC**
7	$(\neg p \wedge Gp) \rightarrow \mathbf{NEC}\neg p$	by **3**, **5**, **6**, ***b')*** via **MP** and **RNEC**
8	$L\neg p \rightarrow \mathbf{NEC}\neg p$	by **7** and the definition of L

Thus, if ***a')-d)***, **RNEC** and **MP** are embarked together, then Diodorus' reduction follows. No doubt can be cast on the validity of the argument.

Nevertheless, some perplexities may arise if we consider premise ***d)***. Indeed, ***d)*** is valid only if time is *discrete*. Suppose that time is dense or continuous, and that *p* is false from *t* on. Now take any instant *t'* earlier than *t*. Since there are infinite instants between *t'* and *t*, we cannot exclude that *p* is true in one of such instants, say *t''*. The same for *t''* and *t*, and so on. Thus, *PG*¬*p* and hence ***d)*** are falsified. On the contrary, if time is discrete *t* must have an immediate predecessor. The above situation standing, the predecessor of *t* verifies *PG*¬*p*, since *p* is false from *t* on. Thus ***d)*** is verified. Useless to say, the imposition of a discrete time cannot but rise doubts. However, it seems plausible in a reconstruction of the Argument. Indeed, there is some evidence that Diodorus proposed a form of temporal atomism that included the discreteness of time[13].

It is not the aim of this paper to determine how this should influence our evaluation of Prior's attempt[14]. The main point here is that *discreteness* had a major historical role in dismissing a conjecture that Prior advanced about the frame for a diodorean logic, and that I will introduce in the next section. Consequently, the acceptance of it had an influence in the search of the diodorean frame. In other words: the inclusion of discreteness in Prior's reconstruction of the Argument has been a reason for conceiving diodorean modalities as satisfying them, and consequently for looking at a frame where the condition is fulfilled.

2.2 THE DIODOREAN LOGIC

On the basis of his reconstruction, Prior outlined a logic for the diodorean modalities, *i.e.* a logic where all and only the diodorean tenets (as emerging by Prior's reconstruction) and their consequences where theorems. This is the main task of (Prior, 1955) and (Prior, 1958), and one of the main topics in (Prior, 1957) and (Prior, 1967). The logic was meant to be a modal logic based on a temporal one, and this is one of the reasons for some confusion we find in the above texts. Indeed, Prior insists on the temporal character of diodorean modalities, but at the same time the frame he proposes for them (see section 3.1) is not suitable for temporal logics (for the notion of frame, see again section 3.1). Thus the reader may have the impression that Prior stresses the "temporal meaning" of diodorean modalities just when he deals with them in a non-formal way. When formal topics are considered, Prior seems to treat them with no regard to such a "meaning". This is due to the fact that, when explaining what diodorean modalities are, he presents them through the notions of presentity and futurity. Otherwise, it would be difficult to understand the rationale of introducing them among the modal notions. On the contrary, Prior considered diodorean modalities "in isolation" (as they were joined by no tense operator or defined by no temporal notion) when he aimed at investigating their

[13] See (Denyer, 1981).
[14] In any case, Prior's reconstruction is still one of the most convincing. For this, see (Denyer, 2009), this volume.

formal properties. This is clear by the fact that, when Prior writes about the diodorean logic, he describes it as a logic where just *L* and the dual *M* are the operators.

This twofold approach to them should not induce us to believe that a real division holds here. Indeed, for Prior the diodorean logic should be in accordance with the properties of time that make the Master Argument valid. This is clear by the fact such an accordance is used by Prior to admit or dismiss hypothesis on the diodorean frame. In proposing the principles of such a logic, Prior relied on a very basic intuition about time: the earlier/later relation between instant is *transitive*. Obviously, *discreteness* must be imposed, for the reasons I have suggested in the above section. Given this, Prior settled the following principles settled for the *tense operators* and the *diodorean modalities*:

AG1	$G((p \rightarrow q) \wedge Gp) \rightarrow Gq$	and mirror image
AG2	$Gp \rightarrow GGp$	and mirror image
AG3	$(p \wedge Gp) \rightarrow PGp$	and mirror image
AG4	$PGp \rightarrow p$	and mirror image
AG5	$Gp \rightarrow Fp$	and mirror image
AL1	$L((p \rightarrow q) \wedge Lp) \rightarrow Lq$	
AL2	$Lp \rightarrow p$	
AL3	$Lp \rightarrow LLp$	

together with the following rules of inference:

MP	as above.
RG	$\vdash p \Rightarrow \vdash Gp$
RL	$\vdash p \Rightarrow \vdash Lp$

where the mirror image of a sentence *p* is the result of substituting any occurrence of *P* (or *F*) with *F* (or *P*). **AG1** together with **RG** corresponds to the condition that is usually called *normality*[15], and its presence in **DIOD** is justified by the fact that it was allegedly accepted by the greek logicians. **AG2** is due to the transitivity of the earlier/later relation on time, while **AG3** expresses in the language the discreteness of time. **AG4** is premise ***c)*** under the substitution of $\neg p$ by *p*. **AG5** expresses the infinity of time: if *every* instant later than *t* verifies *p*, *then there is* an instant later than *t* that verifies *p*. If time had an end, this would not be true: in this case, *t* could be the last instant, *Gp* would be vacuously true at it. Indeed, no instant later than *t* would falsify *p*, since there is no such instant. But for the same reason, *Fp* would not be true. The infinity of time may be found questionable. However, Prior explicitly embarked it[16], and I will follow him on this point. In dealing with the Argument, Prior does

[15] Normal temporal logics are those logics where $(\bullet(p \rightarrow q) \wedge \bullet p) \rightarrow \bullet q$ is valid (where $\bullet$ is *G* or *H*).

[16] The matrix Prior uses in (Prior, 1957) to represent diodorean modalities is infinite, and since each number of the matrix should be read as if it is associated to an instant, we must conclude that the matrix suggests a reading of time where infinity is comprised.

never hint for some form of "non-homogeneity" between the past an the future, this meaning that validity might not be preserved by the mirror image of a sentence. Thus, I the mirror images of **AG1**-**AG5** to be valid. The need of including **AL1** among the principles is clear by the Master Argument: since (**NEC**($p \rightarrow q$) $\wedge$ **NEC**$\neg q$) $\rightarrow$ **NEC**$\neg p$ and **NEC**$p \leftrightarrow Lp$ are valid in the diodorean perspective, one can easily infer that ($L(p \rightarrow q) \wedge L\neg q) \rightarrow L\neg p$ is valid too. But it is easy to see that the latter is equivalent to **AL1**. This proves as well the validity of **AG1**[17]. **AL2** is made valid by the definition of L, since Lq is nothing but $p \wedge Gp$ and $(p \wedge Gp) \rightarrow p$ is valid. **AL3**'s validity is due to the definition of L and **AG2**. The validity of the rules may be maintained on the ground of what we know about logic in (greek) antiquity (Modus Ponens was universally taken as a correct rule, a sentence that is proved to be true was taken *ipso facto* as always true).

The axiomatic and inferential apparatus settled above is enough to build a diodorean logic. However, before doing this, something must be said on how Prior read **AG4**. Suppose that each instant may be followed by different, incompatible courses of events. Each "course of events" (or *branch*) is made by linearly ordered instant and is maximal w.r.t. such instants[18]. Well, how should we read $PGp \rightarrow p$ in this case? If we conceive time as linear, reading the sentence is straightforward, but if time branches in the future, the sentence may look ambiguous. What does its antecedent mean? It means that there is a past such that Gp is true with respect to a given instant *and a given branch (or all branches)*? Or does it mean that there is a past such that Gp is true with respect to a given instant *and some branch*[19]? According to Prior, **AG4** should be read on a linear time. However, the linearity of time is usually taken as the main way of representing determinism, that is (in temporal contexts), the view that

DET There is no alternative to what happens, happened or will happen.

In other words, not only the past and the present are beyond any possible attempt to modify them: also what will happen is completely determined[20]. The link with linear time is

[17] Indeed, by **AL1** and the definition of L, it derives that $(((p \rightarrow q) \wedge p) \rightarrow q) \wedge (G((p \rightarrow q) \wedge Gp) \rightarrow Gq)$, by which **AG1** follows.

[18] This means that if b is a branch, then for every t and t', if they belong to b, they are *comparable* (*i.e.* the one is either earlier, or later than the latter, or they are the same instant).

[19] In the first case, **AG4** is true, while in the second it is false: if things *could have gone* as verifying p forever after a certain instant, this does not mean that they *have gone* in such a way. Hence we could have $PGp \wedge \neg p$. Today we have a number of different semantics that allow us to express all this options. *Ockhamist semantics* are able to express all options: at a given instant t and w.r.t. the branch b, "Gp" is read "in every instant later than t and belonging to b, p is true", while "in every instant later than t and belonging to all (some) b, p is true" is expressed by $\neg\Diamond\neg Gp$ ($\Diamond Gp$), respectively. For these semantics and their developments, see (Zanardo, 2009) and (Øhrstrøm, 2009), this volume. The first, important work on semantics for non-linear time has been carried out by Prior. A good overview of this work is present in (Prior, 1967).

[20] When embarking time-reduced modalities as we are doing here, determinism should not be confused with the idea that $Mp \rightarrow Lp$. The latter is stronger than determinism, since stating that what happens now or later, always happens in the future (or that what sometimes happens, always happens, if "possible" is read as "at least once in time".

straightforward: given *t* and *t'* , either they are identical, or the one is earlier or later than the latter, to the effect that any instant is followed *only by one* "possible development" of the events[21].

Determinism and linearity seem far from being conceptually needed in the Argument. Yet for Prior the aim of the Master Argument "was to refute the Aristotelian view that while it is now beyond the power of men or gods to affect the past, there are alternative futures between which choice is possible. Against this, Diodorus held that the possible is simply what either is or will be true" ((Prior, 1962), p.138). In other words, the Master Argument was as well an argument for determinism)[22]. As with discreteness, the very important issue here is that linearity is important to falsify a conjecture by Prior on the diodorean frame. It is for these reasons that I will assume that the diodorean logic requires linear time.

As a consequence of the above, I call **DIOD*** the logic resulting by **AG1**-**AL3**, **RG**-**RL**, the theorems of propositional classical logic and by accepting **DET**. Analogously, I call **DIOD** the modal logic obtaining by the fragment of **DIOD*** where temporal operators per se are excluded (*i.e.* the fragment where the only operators are *M* and *L*[23]). The latter is what Prior calls "the Diodorean Logic"[24].

3. FROM THE FRAME FOR S4 TO THE DIODOREAN FRAME

When one builds a logic **L**, a very natural question is: "which kind of structure does verify all and only the theorems of **L**"?. In modal logics, finding an answer to such a question means finding a *characterisation result*. After building up **DIOD**[25], he proposed a conjecture in (Prior, 1957). A wrong one, as we shall see.

[21] It should be noticed that the linearity of time does not *imply* determinism: if we build a many-valued logic where a sentence about contingent future events is given an "undefined" truth-value, then we can endorse linearity while escaping the commitment to **DET**. Yet, as Prior points out in (Prior, 1955) (p. 211), the task is not straightforward as it seems. In addition, Diodorus and the majority of philosophers of his time seemed to adopted a two-valued logics. Even in the case of Aristotle (the main philosopher that could have been open to may values with respect to statements about the future), his endorsement of a many-value position is far from clear (for this point, see (Mariani 2009), this volume). Consequently, to the purposes of this work I will accept the idea that linearity gives a good temporal representation of determinism.

[22] In other writings, Prior confronted the Argument with non-linear (and thus indeterministic) time. He did it by reading the antecedent of **AG4** as "in every instant later than *t* and belonging to some branch *b*, *p* is true", probably because the Argument should have tried to reduce *this* reading to "in every instant later than *t* and belonging to all *b, p* is true". With such a reading, the Argument turns out to be false. Obviously, we know (as Prior, actually) that other readings of "at least once in the past, it is always in the future [the case that] *p*" make **AG4** true in non-linear time. See (Braüner & Øhrstrøm & Hasle, 2000) for this and others issue concerning Prior's reading of the Argument and non-linearity.

[23] Such a choice may look strange, since the two operators conceals temporal ones. However, in this fragment *G* and *F* may not appear alone, but just in sentences $p \wedge Gp$ or $p \vee Fp$. Since *Gp* and *Fp* cannot be disentangled by such sentences, *G* and *F* are not here acting properly as operators.

[24] Prior called such a logic **D**, but I prefer not to use that name, since it may cause confusion with the basic deontic logic, usually called **D**.

[25] A task that he accomplished in (Prior, 1955), even with some difference with my presentation.

3.1 PRIOR'S CONJECTURE

A structure characterises a (modal) logic iff the former validates all and only the theorems of the latter. To find a characterisation result may be difficult, but it cannot even be pursued without setting a precise formal machinery. In investigating the characterisation of a modal logic, Prior mainly used the device of *matrices*. Each sentence *p* is endowed with a sequence of truth-values 0 or 1. In temporal logics, we may say that this sequence represents the truth-value of *p* at the different instants in time. *Lp* (*Mp*) is given value 1 in a certain position of the sequence iff *p*'s value is 1 from that position on (at that position or some subsequent one). If a sentence is given value 1 in each position of any possible sequence of a matrix, then it is valid w.r.t. that matrix. We may say that a given matrix *characterises* a logic **L** if it validates *all and only* the theorems of **L**.

Matrices have been proven themselves in many formal results about modal logics. However, they are quite complex to handle, at least if compared with another tool that has been elaborated for the semantic of modal logic: *kripkean semantics*[26]. In these semantics, sentences are interpreted on the basis of a *Kripke frame* (or simply a "*frame*"), *i.e.* a structure made by a set of *points* and an *accessibility relation* imposed on the set. The latter determines if a given point has, so to speak, access to the information of another point.

To the sake of simplicity, here I will use *frames*, while neglecting *matrices*, since this will make the assessment of the results easier, and will achieve it by a formal tool many readers are more familiar with.

In the temporal case, sentences are interpreted on *frames* $\boldsymbol{f}$ made by sets *t* of instants and the earlier/later relation < ($\boldsymbol{f} := \langle T, < \rangle$). In order to establish the truth-value of the sentences, we use a function ν that assigns each sentence *p* a set of instants (intuitively, the set of the instants where *p* is true). We then introduce the function ρ that assigns each pair (sentence, instant) to a truth-value, according to the condition that a sentence *p* is true at the instant *t* iff $t \in \nu(p)$:

TC1 $\rho(p, t) = 1$ iff $t \in \nu(p)$
TC2 $\rho(Fp, t) = 1$ iff $\exists t' (t < t' \text{ and } \rho(p, t') = 1$
TC3 $\rho(Pp, t) = 1$ iff $\exists t' (t' < t \text{ and } \rho(p, t') = 1$

The truth-clauses for $\neg p$ or $p \circ q$ (with $\circ$ a dyadic connective) are straightforward, and the ones for *G* and *H* easily derive from **TC2** and **TC3**. A *model* based on $\boldsymbol{f}$ is a pair $\boldsymbol{m} := \langle \boldsymbol{f}, \rho \rangle$. A

[26] Such formal tools have been introduced by Saul Kripke (in (Kripke, 1959) and (Kripke, 1963)), usually considered as the founder of contemporary modal logic. Actually, before (Kripke, 1959) was published, Prior had elaborated a set of truth-clauses for tensed sentences that are similar to Kripke's semantics. This kind of semantics is also known as *possible world semantics*. Here, I prefer not to use it, since the structures employed by this semantics may be made by sets of instants, or event points of space, depending on the context where the logic has to be applied. The notion of "possible world" is then unessential to correctly refer to that semantics.

sentence *p* is true in (or verified by) a model ***m*** iff it is true at any instant comprised in ***m***, and false in it (falsified by it) otherwise.

Validity A sentence *p* is valid w.r.t. a frame ***f*** iff it is true in any ***m*** based on ***f***.

I will also say that a frame ***f*** validates or verifies (falsifies) a sentence *p* if *p* is valid w.r.t. ***f*** (if some models based on ***f*** falsifies *p*). If the relation < comprised in ***f*** has the property *A*, we will say that ***f*** is an *A*-frame. Since < is transitive, the frames for the temporal logics are *transitive*-frames[27]. Concerning a logic **L**, I will say that

In A sentence *p* is *in* **L** iff *p* is a theorem of **L** (**L** $\vdash$ *p*, that is, either an axiom of **L**, or the transformation of an axiom via the admitted rules of inference).

Here, it is important to notice that we need to adjust the above presentation, if we wish to deal with **DIOD** in isolation. Indeed, if we have to consider just an accessibility relation that is suitable for *L*, we cannot use <, since a frame including the earlier/later relation would not verify **AL2**. Instead, we have to use $\leq$, the "earlier/later (or identical)" relation. We may think of $\leq$ as imposed on the set *t* of instants I have mentioned above. Thus we have that $\boldsymbol{f}_{\mathbf{DIOD}}$ is $\langle T, \leq \rangle$, and the truth-clause for *Lp* is :

TCL $\rho\,(Lp, t) = 1$ iff $\forall t'\,(t \leq t' \text{ then } \rho(p, t')) = 1$

the clause can be easily shown to be equivalent to the one for $p \wedge Gp$ if the relation of the frame is <. The truth-clause for *M* is straightforward (since *M* is $\neg L \neg$). The problem we will address on this section is: which frame is a frame *for* **DIOD**? This meaning nothing but "which frame *characterises* **DIOD**?" Some technical notions are helpful here:

For 1 A frame ***f*** is the frame for a logic **L** ($\boldsymbol{f}_{\mathbf{L}}$) iff ***f*** characterises **L** (relatively to a given language *l*).

For 2 The frame for a logic **L** is the frame for a logic **L'** iff it is the frame for **L** and it is the frame **L'**.[28]

It is clear that the frames for **DIOD** are reflexive and transitive (since $\leq$ is). In (Prior, 1955) (p. 209), Prior had already -correctly- guessed that the diodorean frame verifies *all* the

[27] A remarkable exeption is the frame for the *minimal* temporal logic, whose theorems do not include a sentence expressing transitivity. However, the temporal reading of such a logic is somehow questionable.

[28] Please notice that the last definition does not imply that **L** and **L'** coincide: indeed, they may be based on two different languages, and thus the former has ***f*** as its frame relatively to the language **L** while the latter has ***f*** as its frame relatively to the language **L'**. However, if **L** and **L'** are based on the same languages and ***f*** is the frame for both, then **L** and **L'** coincide (since they validate the same sentences).

theorems of **S4**, since the relation in f_{S4} is reflexive and transitive. These conditions correspond in the logic to **AL2** and **AL3**, that is to $Lp \rightarrow p$ and $Lp \rightarrow LLp$ respectively. In addition, **AL1** ($(L(p \rightarrow q) \wedge Lp) \rightarrow Lq$) is valid w.r.t. to f_{S4}. Since the rules of inference are shared by the two logics and preserve validity, all theorems of **DIOD** are verified by f_{S4}.
In (Prior, 1957) Prior tries to go look beyond this simple result. There, he conjectures that that frame verified *all and only* the theorems in **DIOD**. Rephrasing Prior's investigation in the terminology and by the tools employed in this paper, we have the following conjecture:

Prior's Conjecture: The frame for **S4** is the frame for the Diodorean modalities: $f_{DIOD} = f_{S4}$.

The original point of Prior's Conjecture is stating that *only* the theorems of **DIOD** are verified by f_{S4}.

With our current knowledge of the frames for modal logic, it is not difficult to foresee that the conjecture is incorrect. However, it was a reasonable option at those times. Indeed, when Prior was studying the diodorean modalities, the only known logic between **S4** and **S5** was **S4.5**. Prior knew that such a logic includes a sentence that has no plausible diodorean reading[29]. Thus, the frame for **S4.5** had been immediately excluded. In addition, in those very years **S4.5** was later found equivalent to **S5** (thus there exists no "frame for" **S4.5**). The frame for **S5** does not go, since the latter includes $Mp \rightarrow LMp$, and such a sentence is clearly false in a diodorean reading[30]. The only candidate left was **S4**[31].

3.2 COUNTEREXAMPLES: FROM THE FRAMES FOR S4 TO THE FRAMES FOR DIOD

As we have seen, **DIOD** was designed by Prior to be a deterministic logic, on the basis of the idea that **DET** was essential in the diodorean conception of modalities. It turns out that the principle, though very vague, has been enough to expose Prior's Conjecture to relevant counterexamples. Let us consider the following sentence:

lin $\quad Mp \wedge Mq \rightarrow (p \wedge q) \vee M(p \wedge Mq) \vee M(q \wedge Mp)$

It is easy to prove that ***lin*** is valid in a frame where the accessibility relation is transitive *and linear*. Take a linearly ordered set of instants: if $Mp \wedge Mq$ is true at t, then either $p \wedge q$ is true at

[29] For this, see (Prior, 1967), p.23-24.
[30] The fact that now or in the future p is true, does not imply that the same holds for every future instant. If P is true now and false thereafter, Mp is true, while MLp is false.
[31] It should also be considered that modal logic and its formal results were then at their beginnings, and many issues, though looking obvious today, were still hypothesis waiting for a proof or a counterexample. In addition, the device of matrices makes it harder to find counterexamples as the one we have presented. While it is easy for a single researcher to find all them using *frames* and *models*, a much more articulated work is needed if using *matrices*, and just the contribution of many researchers may help to find counterexamples in a short time.

t itself, or the instant that verifies *p* (or *q*) is earlier than the one that verifies *q* (or *p*), or identical to it. This possible combinations give us the consequent of ***lin***.

To see that a non linear frame falsify ***lin***, suppose there is an instant *t* where $M(p \wedge q)$ is true and $(p \wedge q)$ is not. Now take two later instants *t'* and *t''* that are incomparable (they are not earlier, later or identical one with another), satisfying the following:

(i) In all the instants between *t* and *t'* (both excluded), $\neg p \wedge \neg q$ is true. The same at all the instants between *t* and *t''* (both excluded).

(ii) At *t'* we have that *p* is true but *q* is false thenceforth (thus having that $L\neg q$ is true at *t'*).

(iii) At *t''* we have that *q* is true but *p* is false thenceforth (thus having that $L\neg p$ is true at *t''*).

Since *t'* and *t''* are incomparable, ***(ii)***-(***iii)*** are compatible one with another. But as a consequence of ***(i)***-***(iii)***, our sentence is false. Indeed, $Mp \wedge Mq$ is true at *t* (because *p* and *q* are true at *t'* and *t''*, respectively), but $(p \wedge q) \vee M(p \wedge Mq) \vee M(q \wedge Mp)$ is false at *t* (since $p \wedge q$ is and no instant from *t* on verifies $(p \wedge Mq)$ or $(q \wedge Mp)$). The counterexample shows as well that there are transitive but not linear. This has tow main consequences.

(I.1) ***lin*** is not in **S4**. Otherwise, the implication from **AG2** to ***lin*** should be in **S4**. But this does not hold, since some transitive frame falsities ***lin***.

(I.2) ***lin*** is not valid w.r.t. $\boldsymbol{f}_{\mathbf{S4}}$, since there is a model that is *transitive* and yet falsifies ***lin*** (and since $\boldsymbol{f}_{\mathbf{S4}}$ validate all and only the sentences in **S4**).

Prior's attention on ***lin*** was first driven by (Hintikka, 1958) (a review of (Prior, 1957)), where it is suggested that a temporal interpretation of **S4** cannot by given without adding ***lin*** to it[32]. In any case, ***(I.1)*** leads to the conclusion that $\boldsymbol{f}_{\mathbf{DIOD}} \neq \boldsymbol{f}_{\mathbf{S4}}$: the frame for **S4** is not the diodorean frame. This

(I.3) led Prior to dismiss his own conjecture in (Prior, 1958), where he explicitly admit that ***lin*** must be in **DIOD** (in accordance with the links between linearity and **DET**, see section 2.1)[33].

[32] ***lin*** is not the only sentence that readdresses the search for the diodorean frame toward linear frames: $L(Lp \rightarrow Lq) \vee L(Lq \rightarrow Lp)$ (***lin****) requires linearity as well to be valid. The sentence had been pointed out to Prior by Lemmon (see (Prior, 1958), p.226). Prior later proved that ***lin*** and ***lin**** are equivalent ((Prior, 1964)) and that ***lin**** is valid in **DIOD**. The last proof seems to assume that linearity as a condition that is plausible for time *in se*, even out of the diodorean conception of modality.

[33] Actually, Prior's position about ***lin*** is somehow unclear: in (Prior, 1958) and (Prior, 1967), he defends its endorsement in **DIOD** because of its intrinsic "tense-logical plausibility". A consequence is that a linear (and hence deterministic) representation of time is imposed not by the diodorean logic, but by what our intuitions about time take to be plausible. If one argues this way, linearity should be suitable for any temporal logic (**DIOD** included). However, in this way the Master Argument and the diodorean

(I.4) helped to understand that there is a logic that is stronger than **S4** and yet weaker than **S5**. Indeed, ***lin*** cannot be derived by any axiom of **S4** (see ***(I.2)*** above). At the same time, no axiom of **S5** can be derived by it.

A new modal logic was *de facto* discovered through the falsification of Prior's Conjecture. The new logic was called **S4.3** (today the most widespread name for it). Establishing the fatherhood of the logic is beyond the purpose of this paper. In any case, it should be case that at least two works reached to ***lin*** (or equivalent sentences). One is Hintikka, that simply mention it as a sentence that is not in **S4** (see above), the other is actually a duo: Michael Dummett and Edward Lemmon, that in (Dummett & Lemmon, 1959) found the sentence independently from Hintikka and gave the name to **S4.3**. The interesting thing to notice is that the work by Dummett and Lemmon focus on *intermediate modal logics*, and that its rationale is completely independent from Prior's research. Indeed, the two authors focused on intermediate modal logics because they can be used for establishing properties of logics that are stronger than the Intuitionistic one but weaker than the Classical one[34]. Finding out that ***lin*** is not in **S4** has been useful for finding one of such logics and extending the class of modal logics.

Thus, the same discovery had led to a progress both in the search of the diodorean frame and in our knowledge of intermediate modal logics. The philosophical topic of the diodorean logic has benefited from research that was undertook for more specific and technical reasons.

(Dummett & Lemmon, 1959) crosses with the search of the diodorean frame also in another way: it is the first study where it is noticed that $\boldsymbol{f}_{\mathbf{S4.3}}$ is not *discrete*. This is important for us, since the diodorean logic should go together with the second condition Prior added to the Argument (that is *discreteness*).
Now let us take the sentence:

disc $(MLp \wedge (L(\neg p \rightarrow M(p \wedge M\neg p)) \rightarrow p$

It is easy to see that if $\leq$ is non-discrete, the sentence is false, while the discreteness of $\leq$ makes it true[35]. Indeed, take the situation:

(i') There is an instant t that verifies both MLp and $\neg p$.
(ii') There is an instant t' such that $t \leq t'$ and that verifies Lp.
(iii') At any instant from t on, $\neg p \rightarrow M(p \wedge M\neg p)$.

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conception of modality would cease to be a relevant argument and conception for determinism, in contrast with (Prior, 1962), p.138.

[34] This field of study has its roots in the Gödel-Tarski-McKinsey theorem, that states that a sentence p is a theorem of Intuitionistic Logic iff its modal translation is a theorem of **S4**. In those years one of the main works on the topic was (Dummett, 1959).

[35] In (Dummett & Lemmon, 1959) the relevant sentence is: (***disc****) $(L(L(p \rightarrow Lp) \rightarrow p) \wedge MLp) \rightarrow p$. The equivalence of ***disc*** and ***disc**** has been proven by Prior in (Prior, 1967).

Now, $M(p \wedge M\neg p)$ is true at t, by ***(i')*** and ***(iii')***. As a consequence, there must be an instant t'' that verifies $p \wedge M\neg p$. Such an instant is later than t, since the latter falsifies p. But it is also earlier than t', since $M\neg p$ is always false from t' on. For the same reason, there is an instant t''' *between* t' and t'' where $\neg p$ is true: it cannot be t'', t' or any instant later than t'', since they all verify P. At the same time, it must be later than t', in order $p \wedge M\neg p$ to be true there. But in t''', $M(p \wedge M\neg p)$ is true, by ***(i')*** and the fact that t''' verifies $\neg p$. As a consequence, a further instant (strictly) *between* t''' and t' is needed, and so *ad infinitum*. This is perfectly consistence with density and continuity, since between any two instant there are infinite instant. Hence the situation may hold in frames that are based on a dense or continuous $\leq$. Thus proves that ***disc*** is not valid w.r.t. non-discrete frames. On the contrary, if $\leq$ is discrete there will be a last instant between t''' and t'. In this last instant, even if having $\neg p$, $M(p \wedge M\neg p)$ cannot be but false, since the instant is followed by t', where Lp is true. As a consequence, if we have MLp and $L(\neg p \rightarrow M(p \wedge M\neg p)$ at t, we must also have p at t. This shows the validity of ***disc*** w.r.t. discrete frames. This means that:

(d.1) ***disc*** is not in **S4.3** (for reasons analogous to the ones in ***l.1***).

(d.2) ***disc*** is not valid w.r.t. $\boldsymbol{f}_{\mathbf{S4.3}}$, since there is a model that is *transitive*, *linear* and yet falsifies ***lin*** (and since $\boldsymbol{f}_{\mathbf{S4.3}}$ validate all and only the sentences in **S4.3**).

As a consequence, $\boldsymbol{f}_{\mathbf{S4.3}}$ is not the diodorean frame. Here, we have a situation that resembles the one we had with ***lin***: a new logic was discovered. Or better, it had been clarified what axioms **DIOD** needs. And once again, the investigation on diodorean modalities had benefited from some other researches, namely those on intermediate logics.

However, at this point discreteness is the only condition to be unfulfilled. Thus, it is enough to added discreteness to a reflexive, transitive and linear frame to have $\boldsymbol{f}_{\mathbf{DIOD}}$. This is what Prior implicitly suggests in (Prior, 1967), p.29. It is clear that such a new frame validate *all* the theorems of **DIOD**. But does it validate *only* them? In other words: is it a frame *for* **DIOD**. Prior does not prove it in (Prior, 1967), but anyway that was not a conjecture at that time. Robert Bull had already proved in (Bull, 1965) that the frame for **DIOD** is discrete, reflexive, transitive and linear[36]. As a consequence, we may say that (Prior, 1967) (p.29) concludes the search for the diodorean frame.

Few time later, **DIOD** resurfaced in the research on intermediate logics. In (Zeman, 1968) the logic is introduced (together with a cognate logic) with the name most often used today: **S4.3.1**. It was already clear that $\boldsymbol{f}_{\mathbf{S4.3.1}}$ was discrete. In any case, the success of the name is well deserved, since it helps in immediately grasping the place **DIOD** has in the logics between **S4** and **S5**.

[36] Two further different proofs of that are given in an unpublished work by Kripke and in (Segerberg, 1970).

4. THE SEARCH FOR THE DIODOREAN FRAME AND MODAL LOGIC

We have seen that the search for the diodorean frame has benefited from two different researches in modal logics: (i) the research on intermediate logics, and (ii) the research for characterisation results. Thus shows how the work in progress on technical issues of logics helped Prior's investigation.

It is now time to see how Prior investigation stimulated some technical result. We may distinguish two different contributions: (1) indirect ones (mainly to characterisation results), (2) stimulus to works that explicitly mention diodorean modalities. Let look at them separately.

(1) The direction of the benefits has not been just *from* characterisation results *to* the search of diodorean frame. Prior's conjecture has promoted some researches *in* that field.

Kripke, in private correspondence, presented to Prior a matrix *for* **S4**, and that resembles some frames for branching time. The issue is mentioned in (Prior, 1967), p.27, and discussed in detail in (Øhrstrøm & Hasle, 1993). Kripke was also able to find a characterisation result for **S4.3.1**, and contributed as well to the falsification of Prior's Conjecture with finding that $LMp \vee LM\neg p$ that is not valid in the frames for **S4** (the proof is straightforward and so I omit it).

As clear from the same correspondence, Kripke's interest in the characterisation for this kind of logics is rooted in his reading of (Prior, 1957), and on the philosophical relevance of a temporal interpretation of some modal logics. In particular, Kripke thought that temporal specifications are not relevant in scientific theories[37]. This shows that his interest to such logics was linked to the philosophical issues Prior has addressed by using formal methods about modalities and temporal specifications.

Another result came from Lemmon. In (Dummett & Lemmon, 1959) he presented a modification of Kripke matrix to verify all and only the theorems of **S4.2**, that is **S4** plus $MLp \rightarrow LMp$. In (Prior, 1967), Prior presents the sentence as a result of Lemmon's own work, and as preceding the work with Dummett. We may hypothesise a connection between Lemmon's matrix and Prior's work. Lemmon interest in modal logic was triggered by (Prior, 1957)[38], and in addition $MLp \rightarrow LMp$ had a role in the search of the diodorean frame, since it is valid in all linear frames and is falsified by the frame for **S4**[39].

(2) In addition, some works in modal logic take **DIOD** explicitly into account. Examples of this are (Bull, 1965) (already mentioned) and (Makinson, 1966). Beside proving Bull's paper undertakes an algebraic treatment of all the logics that had been involved in Prior's search (**S4**,

[37] see (Øhrstrøm & Hasle, 1993).
[38] To be more precise, it was triggered by the John Locke Lectures that Prior delivered in Oxford (1956).
[39] Indeed, $MLp \rightarrow LMp$ expresses the condition of *convergence*, that is implied by linearity (while the converse does not hold) and it is not implied by transitivity.

S4.3, and obviously **DIOD**). (Makinson, 1966) shows that infinite non-equivalent formulae are contained in the sentences in **S4.2**, **S4.3** and **DIOD**[40], as it is for **S4**. Many years later, Robert Goldblatt applied the notion of diodorean modalities to Minkowski spacetime (see (Goldblatt, 1980)), finding some interesting characterisation results, with the collaboration of Johan Van Benthem.

We may now sum up what has emerged through the paper. The search of the diodorean frame has entwined with research of other fields of modal logics through:

(1) benefits from the research on intermediate logics, as witnessed by the fact that works in that field contributed to falsify Prior's Conjecture ((Dummett & Lemmon, 1959)).

(2) interaction with characterisation results, as witnessed by the fact that (a) the result in (Bull, 1965) ensures that the frame for **DIOD** is reflexive, transitive, linear and discrete, a result that Prior acknowledged in (Prior, 1967), p.31, (b) the research on characterisation results for **S4** and **S4.2** by Kripke and Lemmon (respectively) was probably motivated by Prior's Conjecture or by other issues addressed by Prior.

(3) explicit consideration in technical works on modal logics, as shown by a variety of studies that focuses on logics that extend **S4**. In these studies, the modalities under account are called "diodorean modalities".

5. CONCLUSION

In this paper, I argued that the search for the diodorean frame entwined with the researches on intermediate logics and on characterisation results, that it has benefited from this, and that in some cases stimulated them. Thus, the history of the diodorean modalities can be taken as a fruitful case of interaction between philosophy and logic, and as an example of how philosophical topics have interacted with technical investigations in modal logic.

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[40] Remarkably, this opposes these logics to their non-modal counterparts between Intuitionistic and Classic logic, as Makinson himself stresses ((Makinson, 1966), p. 406).

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PERSISTERE
INTRODUZIONE AL PROBLEMA DEGLI INTRINSECI TEMPORANEI

*Emanuele Coppola**

ABSTRACT

L'articolo si propone tre obiettivi. In primo luogo, introdurre al problema – detto degli intrinseci temporanei – di come un oggetto possa avere differenti proprietà intrinseche nel corso del tempo e, tuttavia, rimanere se stesso, ossia *persistere* (§ 1). Sulla scorta della formulazione *standard* data al problema da David Lewis, vengono illustrate le tre soluzioni fondamentali, costituite dalle teorie del tridimensionalismo (§ 2.1), del quadridimensionalismo (§ 2.2) e del presentismo (§ 2.3), dando conto di parte del dibattito attuale intorno allo sviluppo di ognuna di esse. In secondo luogo, isolare due contrapposizioni metafisiche distinte, quella fra tridimensionalismo e quadridimensionalismo e quella fra eternalismo e presentismo (§ 3), con lo scopo di delineare alcuni aspetti della loro interrelazione. In terzo luogo, mostrare il rapporto che sussiste fra il problema degli intrinseci temporanei e l'argomento di McTaggart contro la realtà del tempo (§ 4).

1. IL PROBLEMA DEGLI INTRINSECI TEMPORANEI

Il problema degli intrinseci temporanei (*temporary intrinsics problem*) è il problema di come gli oggetti che persistono possano avere differenti proprietà intrinseche in tempi differenti. 'Persistere' è un verbo che significa in prima approssimazione: 'sopravvivere al mutamento delle proprietà, continuando ad esistere in momenti diversi'. Una proprietà è 'intrinseca' rispetto a un oggetto se quest'ultimo ne gode grazie a ciò che costituisce la sua natura, senza richiedere collegamenti estrinseci con altri oggetti. Un esempio di proprietà intrinseca sarebbe 'avere un colore'; un esempio di proprietà estrinseca sarebbe 'essere marito'. 'Intrinseci temporanei' abbrevia 'proprietà intrinseche temporanee'. Le proprietà intrinseche sono problematiche perché il ragionamento che le giustifica comporta l'impossibilità che un oggetto possa esistere in due tempi distinti, nei quali differisca appunto nelle sue proprietà intrinseche.

Quella della persistenza attraverso il cambiamento è una delle questioni filosofiche più antiche. Ma in questa circostanza non invocheremo i venerandi nomi di Eraclito e di Parmenide; ci serviremo, piuttosto, di strumenti che sono stati messi a punto nella metafisica analitica degli ultimi venti anni circa. È del 1986, infatti, l'influente libro di Lewis *On the Plurality of Worlds*, che offre una formulazione divenuta *standard* del problema degli intrinseci temporanei: «Le cose che persistono cambiano le loro proprietà intrinseche. Per esempio, la forma: quando sono seduto, ho una forma inclinata; quando sto in piedi, ho una forma diritta. Entrambe le forme sono proprietà intrinseche temporanee; le ho solo in qualche momento. Come è possibile questo cambiamento?» [1].

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[1] (Lewis,1986), pp. 203-204.

Consideriamo la vita di una rosa in un giardino. A un dato istante ha una forma slanciata e un colore rosso vivo. In un istante successivo, invece, il suo gambo è inclinato. La rosa era diritta ad un tempo convenzionale t_1; la rosa è inclinata ad un tempo convenzionale $t_2 > t_1$. Nulla potrebbe essere più ovvio del fatto che gli oggetti cambiano le loro proprietà: la sfida filosofica è spiegare come ciò sia possibile, data la contraddizione generata dall'applicazione del *principio di Leibniz* (indiscernibilità degli identici) all'identità diacronica della nostra rosa. Ripercorriamo la *reductio ad absurdum*[2]:

(1) l'oggetto *x* a t_1 è identico all'oggetto *x* a t_2 [assunzione];
(2) l'oggetto *x* a t_1 ha la proprietà Q [premessa];
(3) l'oggetto *x* a t_2 ha la proprietà non-Q [premessa];
(4) se l'oggetto *x* a t_1 è identico all'oggetto *x* a t_2, allora *x* a t_1 ha la proprietà Q se e solo se *x* a t_2 ha la proprietà Q [principio di Leibniz];
(5) l'oggetto *x* a t_1 ha le proprietà Q e non-Q.

Sulla struttura di questo argomento ritorneremo a più riprese. Per ora accostiamoci al problema nei suoi aspetti intuitivi. Il nostro comune modo di intendere i fatti relativi al cambiamento di proprietà sembrano supportati da almeno quattro intuizioni, solide e non negoziabili[3]. Con riferimento al nostro esempio:

I. La rosa persiste attraverso il mutamento: esisteva nel momento in cui era diritta ed esiste adesso che è inclinata; il mutamento della forma modifica la rosa, ma non la distrugge. Essa ha una identità che sopravvive al cambiamento.

II. Le forme sono proprietà *intrinseche* temporanee, come detto all'inizio: sono proprietà che non dipendono da alcuna relazione esterna con qualcos'altro. Esse sono tali che l'oggetto le ha *simpliciter*: la rosa è *simpliciter* diritta o inclinata, così come l'attizzatoio è *simpliciter* freddo o rovente. Al contrario, le proprietà estrinseche coinvolgono la presenza di qualcosa che è accidentalmente connesso col soggetto che le possiede ('essere uno zio'). Dal punto di vista linguistico, le proprietà intrinseche sono espresse da predicati monadici, mentre quelle estrinseche da relazioni diadiche (sebbene con ciò non si intenda negare l'esistenza di predicati monadici esprimenti proprietà estrinseche).

III. *La rosa stessa* ha le forme: non una sua parte, ma proprio *lei* è stata diritta, e non una sua parte, ma proprio *lei* è adesso inclinata. Se la rosa non fosse inclinata, o non fosse stata diritta, non avrebbe cambiato la *sua* forma.

IV. Le forme sono incompatibili; in caso contrario, non ci sarebbe ragione di parlare di cambiamento. Il cambiamento richiede necessariamente proprietà incompatibili.

[2] Se ne veda la formulazione discussa in dettaglio da (Merricks, 1994), p. 168.
[3] L'elenco è di (Hinchliff, 1996), p. 119.

Il puzzle del cambiamento sta tutto nel constatare che le precedenti intuizioni, che da qui in avanti etichetteremo come 'naturali', sono congiuntamente necessarie e inconsistenti. Naturalmente, non c'è alcuna contraddizione nel pensare che due oggetti abbiano forme, più in generale proprietà, incompatibili. Ma se uno stesso oggetto persiste attraverso il mutamento della propria forma, essendo in un primo momento diritto e poi curvo, allora abbiamo uno stesso oggetto che possiede *simpliciter* due proprietà incompatibili – il che è impossibile. Il cambiamento degli attributi sembra teoricamente impossibile; ma nella vita di tutti i giorni esperiamo sulla nostra stessa pelle, e incontriamo nelle altre persone e nelle cose, innumerevoli mutamenti di proprietà. Dunque, come è logicamente possibile che accada ciò che effettivamente accade di continuo, se nulla può possedere forme incompatibili?

Una prima risposta suona troppo banale per rappresentare la vera soluzione: basta menzionare gli istanti differenti in cui l'oggetto possiederebbe le forme incompatibili: la rosa era diritta *ieri* ed è inclinata *oggi*. Dove è la contraddizione? Da nessuna parte: questa risposta è corretta; però, non possiamo dire che sia anche completa, a meno che essa non riesca a integrare nella spiegazione del mutamento tutte e quattro le nostre intuizioni naturali. Ed è qui che i nodi vengono al pettine, in quanto le teorie che ambiscono a risolvere il puzzle da un lato sembrano tutte godere, pur in misura diversa, di una consistenza interna che ne legittima la tesi caratteristica; dall'altro, tale coerenza fa perdere ad ognuna di essa una presa salda sugli aspetti riconoscibilmente intuitivi del fenomeno del mutamento, nel senso che nessuna di esse riesce a sottrarsi a ritocchi revisionistici di una o più di una delle quattro intuizioni basilari, le quali cessano di conseguenza di essere ritenute tutte naturali[4].

2. LE TRE SOLUZIONI DI LEWIS

Le soluzioni individuate da Lewis sono tre, nell'ordine: tridimensionalismo, presentismo, quadridimensionalismo. Quest'ultimo giunge *dulcis in fundo*, come la sola soluzione corretta del problema. La disputa fra tridimensionalismo e quadridimensionalismo ha una sua storia specifica ed è conosciuta sotto diverse denominazioni: le due parti in opposizione sono chiamate anche, rispettivamente, 'permanentismo' e 'perdurantismo' o 'teoria dei continuanti' e 'teoria degli occorrenti'. Nel nostro ordine espositivo il presentismo occuperà la terza posizione.

2.1. TRIDIMENSIONALISMO

La soluzione tridimensionalista sostiene che la rosa persiste attraverso il mutamento delle sue proprietà *permanendo*[5], ossia essendo interamente presente in ciascun momento della sua storia, e avendo le varie forme incompatibili in istanti diversi.

[4] Di qui l'impressione di uno stallo, come nota (Sider, 2000), p. 86.

[5] Seguendo (Varzi, 2008), p. x, (ii), ho tradotto con 'permanere' il verbo inglese 'to endure', evitando il calco neologistico 'endurare', che a partire da Lewis indica l'interpretazione tridimensionalistica della

Gli oggetti permanenti si estendono soltanto nelle dimensioni dello spazio, e attraversano nella loro interezza quella del tempo[6]. Per comprendere meglio cosa l'espressione 'essere interamente presente' voglia dire, introduciamo la nozione di parte temporale, così definita[7]:

(TP) *x* è una *parte temporale* di *y* a *t* $=_{df}$ (i) *x* esiste solo a *t*; (ii) *x* è una parte di *y* a *t*; (iii) *x* coincide a *t* con tutto ciò che è parte di *y* a *t*.

Data (TP), definiamo il predicato 'essere interamente presente':

(IP) *x* è *interamente presente* a *t* $=_{df}$ (i) *x* è presente a *t*; (ii) non esiste un *y* che sia parte temporale di *x* in un qualche istante diverso da *t*.

Tenendo presente (IP), la tesi del tridimensionalista si riassume così: un oggetto che è presente in tempi differenti non manifesta tale presenza scandita nel tempo per mezzo di parti temporali, che l'oggetto avrebbe nei diversi istanti; al contrario, l'oggetto è presente nella sua interezza. (Lewis, 2002) afferma ironicamente che questa tesi fa pensare al miracolo della bilocazione spaziale attribuita ai santi: la rosa, in quanto oggetto permanente, è come un santo di cui si dica che appare simultaneamente – e nella sua interezza, appunto – a Roma e a Lourdes, con proprietà complementari diverse (in tal caso, avremmo un problema parallelo di intrinseci spaziali); un'analogia più profana tira in ballo gli universali, entità che risulterebbero interamente presenti in qualsiasi esemplificazione concreta che ce ne facciamo.

Riformulando la questione dal punto di vista linguistico, ogni enunciato con un parametro temporale della forma 'l'oggetto *x* ha la proprietà Q al tempo *t*' è da intendersi come equivalente alla traduzione tridimensionalista 'l'oggetto *x* ha la proprietà Q-a-*t*', dove la qualificazione temporale si combina col predicato, componendo un'unica espressione. Quando dico che la rosa ha assunto una nuova forma, nessuna contraddizione è coinvolta, in quanto non c'è nulla di contraddittorio nel sostenere che essa intrattiene relazioni incompatibili con istanti diversi: in questo caso, la difficoltà che nel puzzle è generata dalla differenza degli istanti viene neutralizzata dall'incorporazione dei momenti temporali stessi nel cuore dei concetti, da sempre pensati come astrazioni libere da ogni parametro individualizzante.

Ecco come il tridimensionalista modificherebbe l'argomento che termina con una contraddizione assumendo il principio di Leibniz (§ 1): sostituisce le premesse (2) e (3) rispettivamente con:

(2') l'oggetto *x* ha la proprietà Q-a-t_1;

durata degli oggetti nel tempo. Con 'perdurare', invece, si traduce 'to perdure' e si fa riferimento all'interpretazione quadridimensionalistica.

[6] Benché qui si presuma che un oggetto permanente sia tridimensionale, il numero effettivo delle dimensioni spaziali è inessenziale per la buona tenuta dell'ontologia permanentista: ciò che conta è che gli enti permanenti non abbiano parti temporali. Analogo discorso per il quadridimensionalismo: le entità perduranti non sono necessariamente quadridimensionali: ciò che conta è che esse abbiano una dimensione in più rispetto a quelle dello spazio.

[7] Cfr. (Sider, 1997), p. 205.

(3') l'oggetto *x* ha la proprietà non-Q-a-t_2;

La conclusione sarà:

(5') l'oggetto *x* a ha la proprietà Q-a-t_1 e ha la proprietà non-Q-a-t_2.

A quanto pare, la durata dell'oggetto è liberata dalla contraddizione. Ma questa mossa è accompagnata da un effetto collaterale tutt'altro che innocuo: il tridimensionalista, infatti, non parla più di proprietà intrinseche il cui possesso sia goduto *simpliciter*: non usa più predicati monadici, ma è costretto a ricorrere a relazioni diadiche a tempi: essere-diritto-a-*t*, essere-inclinato-a-*t*, essere-rosso-a-*t*, etc. Le proprietà, tradizionalmente ritenute vuote di riferimenti a luoghi e a istanti, si trasformano in proprietà relativizzate, ossia in relazioni. Il prezzo da pagare è una *indicizzazione dei concetti*, che comporta la recisa negazione della nostra seconda intuizione naturale.

Formalmente, il problema è stato risolto, perché non c'è alcuna contraddizione nel fatto che uno stesso oggetto possa intrattenere relazioni contrarie con due differenti *relata*. Ma il teorico tridimensionalista[8] sostiene che nessun oggetto subisce davvero un cambiamento nelle proprietà, perché queste ultime, essendo relazioni mascherate, non possono essere perse o acquisite, per via del parametro temporale che le individualizza, rendendole uniche e irripetibili: la rosa non può perdere la relazione di essere-diritta-a-t_1, perché essa può intrattenere quella relazione solo a t_1, *una tantum*. E lo stesso valga per lo (pseudo-)acquisire la (pseudo-)proprietà dell'essere-inclinata-a-t_2. Al contrario, il cambiamento consiste precisamente nel perdere e nell'acquisire delle proprietà; le proprietà genuine sono tali che un oggetto le perde e le guadagna, riperdendole e riguadagnandole – in altri termini: la soluzione tridimensionalista vieta che si possa parlare dell'esemplificazione di proprietà non temporalmente indicizzate o non-relazionali.

Le proprietà relazionali sono proprietà strutturate, con due costituenti: una relazione diadica e un tempo ('essere-diritto' + 't_n'); non sono multilocalizzabili nello spazio e nel tempo come i tradizionali universali: anche se la relazione diadica 'rosso-a' è la stessa nelle proprietà relazionali 'essere-rosso-a-t_1' e 'essere-rosso-a-t_2', queste sono proprietà distinte, non duplicati di una singola proprietà: le proprietà individualizzate in istanti diversi sono *tropi*, entità concrete e irripetibili, la cui introduzione nell'ontologia permanentista risolve il problema posto dall'identità degli indiscernibili (la perfetta uguaglianza di entità numericamente distinte non implica l'identità)[9].

Se si prescinde dalla posizione controintuitiva sulle proprietà in quanto relazioni camuffate, il tridimensionalismo rispecchia la nostra credenza di senso comune intorno all'identità degli oggetti fisici, perché asserisce che la rosa, che era interamente presente ieri in giardino con una certa proprietà Q, è letteralmente identica alla rosa che è presente adesso, con la proprietà complementare non-Q. Questa assunzione sull'identità dell'oggetto, insieme

[8] Vedi, fra gli altri, (van Inwagen, 1990), pp. 249-250.
[9] Cfr. (Runggaldier & Kanzian, 2002), p. 125.

all'assunzione sulla sua presenza intera in ogni istante della sua esistenza, costituisce l'autentico nucleo teorico del tridimensionalismo.

Tuttavia, si deve osservare in generale che i sostenitori di ognuna delle tre soluzioni al problema degli intrinseci temporanei non sempre hanno lo stesso modo di ordinare gerarchicamente i concetti portanti della loro teoria, e soprattutto non sempre hanno gli stessi concetti portanti. Nel caso particolare del tridimensionalismo, per esempio, esiste la variante detta 'avverbialismo'[10], secondo la quale il modo in cui la nostra rosa rossa *ha* la proprietà di essere diritta è modificata da un tempo. La proprietà in se stessa non è intaccata da alcun parametro temporale e non è modificata in nessun senso. Riformulando la questione dal punto di vista linguistico, ogni enunciato con un parametro temporale della forma 'l'oggetto *x* ha la proprietà Q al tempo *t*' è da intendersi come equivalente alla traduzione avverbialista 'l'oggetto *x* ha-a-*t* la proprietà Q' (o anche 'l'oggetto *x* è-a-*t* Q'), dove la qualificazione temporale si combina con il verbo 'avere' (o anche 'essere'), componendo un'unica espressione. Lo scopo è quello di sottrarsi alle critiche che fanno leva sulla seconda intuizione naturale, così come da quelle che fanno leva sulla contraddizione coinvolta dalla combinazione di tridimensionalismo e principio di Leibniz. La contraddizione, a questo punto, emergerebbe solo se le proprietà complementari fossero istanziate nello stesso modo – cosa che l'avverbialista nega recisamente.

Vediamo più da vicino il senso di questa operazione. Dovendo sintetizzarlo con uno slogan, potremmo ricorrere al titolo di (Lewis, 2002): *tensing the copula*. Istanziare una proprietà significa «istanziare a qualche tempo la proprietà»[11]: la rosa *è*-a-t_1 diritta. Se prima pensavamo l'*avere* una proprietà come una relazione diadica tra oggetti e proprietà, ora dobbiamo pensarlo come una relazione triadica che gli oggetti intrattengono con proprietà e tempi. Le proprietà incorporate nella relazione restano ontologicamente intatte e sono le monadiche vecchio stile. Lewis[12] sostiene che anche questa costruzione vieta di asserire che sono gli oggetti ad avere le proprietà (terza intuizione naturale): se una relazione si interpone fra me e la proprietà, io sono estromesso dalla proprietà stessa; le proprietà che posso avere *simpliciter* sarebbero soltanto quelle relazionali, in cui le vecchie proprietà monadiche figurano come costituenti inestrapolabili: io ho *simpliciter* l''essere-a-t_1-raffreddato'. L'avverbialismo, se recupera (ma è poi un vero recupero?) la nostra seconda intuizione naturale, distruggerebbe la terza.

Come negare che le proprietà relazionali non abbiano un aspetto esoterico o esotico? Cosa potrebbe significare 'essere-a-*t* Q'? In che rapporti starebbe con la proprietà semplice 'essere Q'? Se l'avverbialista analizza i suoi costrutti chiamando in causa, da un lato, la proprietà semplice 'essere Q' e, dall'altra, l'istante *t* in cui essa viene esemplificata, perché non si dovrebbe pensare che la rosa potrebbe essere *simpliciter* Q in un certo istante? E lo stesso dicasi per la complementare non-Q. L'avverbialista deve assumere le sue bizzarre proprietà come dei primitivi, alla stessa maniera in cui lo faceva il tridimensionalista ortodosso con le sue (pseudo-)proprietà.

[10] Sostenuta, fra gli altri, da (Haslanger, 1989) e (Johnston, 1987). Cfr. anche (Bottani, 2003).
[11] (Johnstone, 1987), p. 129.
[12] (Lewis, 2002), p. 5.

I marchingegni quasi-sintattici dell'avverbialismo, oltre ad essere piuttosto controintuitivi, hanno anche il difetto di non riconoscere che l'avere *simpliciter* non è una relazione; meglio: la copula non ha in se stessa una natura relazionale. Quando Frege pensava alle proprietà singolari (in quanto espresse dai termini predicativi monadici) come oggetti insaturi, che unicamente nel contesto di un completamento proposizionale ricavavano i loro significati, pensava qualcosa di analogo: la copula è da incorporare nei termini predicativi e questi ultimi non sono proprietà: diventano proprietà quando siano saturati dai loro portatori.

Ma una obiezione ancora più incisiva può essere formulata intorno al funzionamento della proprietà relazionale 'intrattenere la relazione di avere-Q-a-t' (*bearing-having-to*-t-*and-Q*), con la quale si pensa di ristabilire un contatto diretto, *simpliciter*, con la proprietà *avere-Q-a-t*. Lewis mostra che l'impresa cade sotto i colpi di maglio del regresso di Bradley: l'avere relazionale necessiterà a sua volta di un ulteriore avere relazionale, che necessiterà a sua volta di un ulteriore avere relazionale e così via, senza termine della spiegazione – qualcosa del genere (con omissione degli istanti): *x* ha^1 Q avendo^2 (avere^1, Q); *x* ha^1 Q avendo^3 (avere^2, avere^1, Q) etc.[13] È sempre possibile bloccare il regresso quando lo si voglia e dire che il nostro più recente avere non è relazionale, bensì *simpliciter*. Ma, in realtà, non abbiamo altro che una serie potenzialmente infinita di copule relativizzate a tempi.

Haslanger, anch'essa convinta della necessità di recuperare le proprietà monadiche rettificando il tridimensionalismo *standard*, propone di introdurre la proposizione come strumento per esprimere il possesso *simpliciter* della proprietà. Il fatto che la rosa è diritta a t_1 diventa il fatto che la proposizione che la rosa è (*simpliciter*) diritta è vera a t_1.[14] Qui la proposizione è intesa in senso temporalista: il suo valore di verità può cambiare nel tempo (non è eternamente vera, una volta che sia stata ancorata al contesto di emissione dell'enunciato che la esprime). Le critiche di Lewis a questa ulteriore soluzione ricalcano l'andamento delle precedenti: una proposizione così intesa si comporta «come una proprietà di tempi»[15]; e per tale Lewis la tratta: la proposizione vale giusto a quei tempi che ce l'hanno ed essa non è che la proprietà relazionale 'essere-a-un-tempo-*t*-tale-che-*x*-è-Q-a-*t*'. La proprietà relazionale ha come suo costituente la proprietà monadica 'essere diritto', non una relazione di 'avere-a'. Ma la Haslanger reintroduce senza spiegazione – all'interno della proposizione temporizzata – proprio la cosa che si sta tentando di spiegare: la nozione di un *x* permanente, avente una proprietà monadica ad un certo tempo.

2.2. QUADRIDIMENSIONALISMO

La soluzione quadridimensionalista sostiene che la rosa persiste attraverso il mutamento delle sue proprietà *perdurando*, ossia avendo differenti parti temporali in istanti differenti. La nozione cruciale di questa teoria è quella di *parte temporale* – o, con espressioni equivalenti, di *stadio* ('stage') o *fetta* ('slice'). Sono le parti temporali a possedere, ciascuna per conto suo, le

[13] (Lewis, 2002), p. 6.
[14] (Haslanger, 1989).
[15] (Lewis, 2002), p. 12.

proprietà incompatibili. Il possesso, inoltre, è diretto e immediato: la parte temporale ha una proprietà Q *simpliciter*. Così, la rosa era diritta ieri perché ieri aveva una parte temporale che era *simpliciter* diritta, ed è inclinata oggi perché oggi ha una parte temporale, numericamente distinta dalla precedente, che è *simpliciter* inclinata. Riformulando la questione dal punto di vista linguistico, ogni enunciato con un parametro temporale della forma 'l'oggetto *x* ha la proprietà Q al tempo *t*' è da intendersi come equivalente alla traduzione quadridimensionalista 'l'oggetto *x*-a-*t* ha la proprietà Q', dove la qualificazione temporale si combina col soggetto grammaticale, componendo un'unica espressione e denotando una fetta dell'oggetto.

Ecco come il quadridimensionalista modificherebbe l'argomento che termina con una contraddizione assumendo il principio di Leibniz (§ 1): sostituisce le premesse (2) e (3) rispettivamente con:

(2'') l'oggetto *x*-a-t_1 ha la proprietà Q;
(3'') l'oggetto *x*-a-t_2 ha la proprietà non-Q;

La conclusione sarà:

(5'') l'oggetto *x*-a-t_1 ha la proprietà Q e l'oggetto *x*-a-t_2 ha la proprietà non-Q.

Quando dico che la rosa ha assunto una nuova forma, nessuna contraddizione è coinvolta, in quanto non c'è nulla di contraddittorio nel sostenere che una sua parte temporale ha la proprietà Q e una sua diversa parte temporale ha la proprietà complementare incompatibile non-Q. Di nulla si dice che possiede allo stesso tempo la proprietà Q e non-Q. Il divieto di Eraclito – «non potresti entrare due volte nello stesso fiume» (Diels-Kranz, fr. 91) – è finalmente trasgredito; precisa Quine: «La verità è che tu *puoi* bagnarti due volte nello stesso fiume, ma non nello stesso stadio del fiume. Puoi bagnarti in due stadi di fiume, che sono stadi dello stesso fiume, e questo è ciò che costituisce il bagnarsi due volte nello stesso fiume. Un fiume è un processo temporale, e gli stadi del fiume sono le sue parti transitorie»[16]. Naturalmente, anche *io* non *mi* bagno due volte nello stesso fiume: piuttosto, avrò due parti temporali distinte nelle due parti temporali del fiume.

Ma neppure questa soluzione è esente da indesiderati effetti collaterali: essa nega la terza intuizione naturale, secondo cui è l'oggetto stesso, e non una sua fetta temporale, a dover essere il portatore delle proprietà. Il concetto stesso di cambiamento richiede in modo abbastanza ovvio che l'oggetto possieda le proprietà non derivativamente, per il tramite delle parti temporali, ma direttamente.

Gli oggetti del quadridimensionalista sono detti anche *worms*, in quanto raffigurabili come lombrichi (così viene spesso resa l'idea che essi si estendono tanto nello spazio quanto nel tempo). Un aspetto centrale dei *worms* è che la loro esistenza in ciascun istante è sempre parziale. Quella distinzione squisitamente fenomenologica, ben espressa da filosofi come Alexius Meinong, e accettata dal tridimensionalista, fra oggetti temporalmente distribuiti

[16] (Quine, 1953), p. 65.

(come i brani musicali) e indistribuiti (come gli oggetti fisici ordinari, presenti in ciascun istante senza necessitare di alcun dispiegamento diacronico), non ha più senso all'interno dello spazio-tempo fisico: la rosa avrebbe la stessa struttura di una melodia, gli oggetti diventerebbero eventi – evidentemente monotoni, come osserva Nelson Goodman, ma pur sempre eventi[17]. Secondo la similitudine di Lewis[18], l'oggetto perdurante è come un corteo: appare dapprima una parte di esso, e poi un'altra, e così via, anche se la maggior parte delle cose ha molta più continuità rispetto alle ordinarie sfilate. L'identità diacronica di un oggetto è sostituita da una relazione più debole: la continuità fra parti temporali. L'oggetto nella sua interezza è la somma mereologica delle sue fette spazio-temporali.

Nella vita quotidiana, tuttavia, nessuno si persuaderebbe facilmente del fatto che un albero in un parco sia non già un oggetto presente tutto lì di fronte a lui, bensì soltanto una somma parziale di frammenti spazio-temporali; così come nessuno che usi normalmente un nome proprio, o una descrizione definita *de re*, per riferirsi a qualcuno, si persuaderebbe facilmente del fatto che ciò che, in realtà, starebbe facendo è isolare un punto in una sequenza di altrettanti frammenti di persona.

L'oggetto quadridimensionale è stato talora paragonato a un film, in cui nessuno dei fotogrammi è mobile. Secondo Heller[19], il paragone sembra reificare le parti temporali, considerandole come interi unitari e come le uniche cose in ultima analisi reali nella prospettiva perdurantista. Per chiarire meglio il senso di tale reificazione, Heller invita a immaginare Dio, intento nel suo laboratorio a creare un essere umano, chiamiamolo Andrea. In che modo? Egli ha a disposizione su uno scaffale tutte le parti temporali di Andrea, dalla prima all'ultima: *n* Andrea. Ogni persona sullo scaffale è un sosia di quella che ha accanto; ma poiché *n* è un numero piuttosto grande, fra gli Andrea iniziali e quelli finali ci sarà quella considerevole differenza che tutti siamo abituati a registrare nel vedere una stessa persona da bambino e da vecchio. Tralasciando particolari che potrebbero minare la sensatezza di questa immagine[20], supponiamo che sulla Terra compaia Andrea in quanto Dio fa apparire la sua prima parte. Dio non ha ancora terminato il suo primo atto creativo, che deve già rimpiazzare la prima parte di Andrea con la seconda dello scaffale, la seconda con la terza etc., in un incessante processo di sostituzione. Di questo processo noi non sappiamo nulla: in quanto amici di Andrea, percepiamo solo lui nella sua interezza. Andrea passa a miglior vita nel momento in cui Dio toglie dalla Terra la sua ultima parte.

Secondo Heller, questo modo di intendere le parti temporali, come oggetti interi e completi in se stessi, che solo un potere divino potrebbe agglomerare in una collezione coerente, è

[17] Un modo alternativo di esprimere la stessa idea è: esistono solo occorrenti e non continuanti. Cfr. (Goodman, 1951), p. 286 [trad. it. 415]: «Una cosa è un evento monotono; un evento è una cosa instabile». Per disporre di un quadro contrastivo più ricco della varietà dei fenomeni in gioco è utile tener presente la classificazione percettologica degli eventi tracciata in (Vicario, 2005), p. 16.

[18] (Lewis, 2002), p. 1.

[19] (Heller, 1992), p. 699.

[20] Tali particolari sono legati a quella specifica applicazione del paradosso del sorite, che rende arduo stabilire il punto in cui sia lecito usare il nome proprio 'Andrea' come riferentesi ad un essere umano: dovremmo chiamare 'Andrea' *già* il feto, l'embrione, su su fino allo zigote? Quale sarebbe l'autentica *prima parte* di Andrea alla quale la divinità immaginata da Heller consentirebbe di manifestarsi? Analoga difficoltà affligge l'individuazione dell'*ultima parte* di Andrea.

errato. Non bisogna intendere l'intero come ontologicamente meno fondamentale delle sue parti: le parti di Andrea sono soltanto contenuti materiali che riempiono differenti regioni dello spazio-tempo; Andrea è giusto un individuo unitario, che riempie progressivamente regioni di spazio-tempo e che possiede le proprietà via via manifestate. Il fatto che egli, come intero, non sia presente in nessuna delle sue parti non ci impedisce di predicare di lui, in quanto intero, le varie proprietà. Anche un tridimensionalista è costretto ad ammettere che un oggetto permanente come una strada non occupa interamente il suo spazio nei vari punti e, tuttavia, ciò non gli impedisce di descriver*la* come asfaltata in una zona e ghiaiosa in un'altra. Come predichiamo una proprietà Q di un oggetto *x* in un luogo *s*, finché *s* si trovi nei confini spaziali di *x*, così predichiamo una proprietà Q di *x* in un istante *t*, finché *t* si trovi nei confini temporali di *x*.

Ma altre perplessità urgono: come può un oggetto avere una proprietà se non esiste? Giacché esiste solo la parte temporale di volta in volta attuale, come si può dire che sia Andrea ad avere la proprietà in quanto intero? Ad avere le proprietà sono invece le parti, istantanee e non bisognose di persistere. Il loro istanziare proprietà è atemporale: la rosa-a-t_1 *è* (atemporalmente) diritta; il cambiamento consiste nell'alternanza tra parti temporali differenti. Ma siamo sicuri che il cambiamento in gioco sia un autentico mutamento oggettuale? Chi trova convincente la metafora del *worm* o del film dà una risposta negativa e denuncia la negazione della prima intuizione naturale.

Non è solo la forte analogia fra lo spazio e il tempo a convogliare simili difficoltà; c'è anche la tesi della sopravvenienza humeana, sintetizzabile grosso modo così: tutto ciò che esiste nell'universo ammonta a una serie di configurazioni materiali di fatti particolari, in ultima istanza di punti spazio-temporali, nei quali sono localizzate qualità o proprietà intrinseche, che hanno bisogno solo di un punto a cui essere istanziate. Tutte le differenze concepibili nell'universo consistono nelle distribuzioni di queste qualità nei vari punti spazio-temporali; non c'è altro: tutto il resto *sopravviene* su questa base. La connessione col problema della persistenza è la seguente: nell'uso fattone dal quadridimensionalista, la sopravvenienza humeana nega che ci siano proprietà riferibili a oggetti persistenti, proprietà cioè intrinsecamente olistiche, in quanto tutto ciò che si può dire dell'oggetto persistente sopravviene su ciò che si può dire dei punti spazio-temporali, che non sono altro che parti istantanee dell'oggetto. Anche qui ci si chiede perplessi: in che modo ridurre fatti relativi al movimento a fatti relativi a stadi statici? Ritorna la metafora del film, appropriata nonostante le proteste di Heller. La tesi della sopravvenienza humeana è molto controversa e non tutti i quadridimensionalisti si sentono obbligati a inserirla fra i sostegni basilari della teoria[21].

Il tridimensionalismo rifiuta la sopravvenienza humeana, in quanto interessato a reidentificare nei vari istanti uno stesso oggetto olisticamente inteso; e rifiuta, naturalmente, l'analogia stretta fra lo spazio e il tempo, rendendo giustizia – almeno nelle intenzioni – a fatti concretamente sperimentati nella vita ordinaria: il tempo passa, mentre lo spazio resta dove è; noi possiamo scegliere se abitare in Italia o in un altro punto del pianeta, mentre non possiamo

[21] Il 'quadridimensionalismo minimale' di (Sider, 1997), ad esempio, è interessato primariamente a stabilire l'esistenza di parti temporali, indipendentemente da questioni di riducibilità ontologica (cfr. p. 208).

spostarci nell'Atene di Pericle o nella Londra del 2500 d.C. Il quadridimensionalista, invece, eguaglia le espressioni del cambiamento temporale alle espressioni del cambiamento spaziale. Ci capita di dire: 'in questo punto, il paesaggio da collinoso diventa pianeggiante': in se stesso, il paesaggio non cambia, è semplicemente collinoso prima di un certo confine e pianeggiante dopo di esso. Analogamente per il tempo, secondo il quadridimensionalista: nella rosa considerata come *summa* di parti spazio-temporali, ci sono parti che sono diritte e parti che sono inclinate, ma la rosa in quanto *summa* non s'è mossa, non è cambiata.

La metafora del paesaggio presuppone che ci sia un movimento di cui non si dà conto: il movimento di chi constata l'evoluzione dell'oggetto intenzionale della sua percezione. La metafora del mutamento paesaggistico presuppone quella della finestra viaggiante, in quanto contrapposta a quella della finestra ferma[22]. Ma cosa significa il viaggio della finestra? *Chi* o *cosa* si muoverebbe attraverso la statica realtà quadridimensionale? Un tale movimento è dato per presupposto e resta inspiegato. Proseguendo su questa linea di ragionamento, molti fanno notare che i nomi 'spazio' e 'tempo' hanno perso, all'interno della prospettiva quadridimensionalista, così come per altro verso nelle teorie fisico-matematiche, ogni rinvio ad esperienze vissute, soggettive e intersoggettive. Coloro che credono fermamente nella scienza sono soliti rispondere, con acre polemica, che non dobbiamo inquinare la razionalità oggettiva della fisica con l'oscurantismo delle idiosincrasie antropocentriche. Ad ogni modo, le nostre esperienze soggettive, per quanto non possano costituire la pietra di paragone di ogni conoscenza, mostrano di avere numerose peculiarità irriducibili ai parametri dell'indagine fisica e che, ciò malgrado, si prestano ad essere studiate dai percettologi e dagli psicologi del tempo[23].

È bene puntualizzare che la presente discussione delle tre dottrine menzionate da Lewis non riposa su fondamenti scientifici: ciascuna dottrina ha punti deboli logici e/o impegni

[22] (Vicario, 2005), pp. 25-26. Un sostenitore della metafora della finestra viaggiante è Agostino; Aristotele opterebbe per la finestra ferma, ma con significative oscillazioni. La metafora della finestra viaggiante è già presente in (Broad, 1923), p. 59, il quale formula – per poi criticarla e rifiutarla – l'analogia fra il presente in movimento lungo la serie degli eventi eternamente esistenti e il cerchio di luce della torcia di un poliziotto («the spot of light from a policeman's bull's-eye»), che scorre lungo le facciate delle case in una strada.

[23] Per riconoscere questo dato di fatto non è necessario essere filosofi sofisticati, impegnati a deflazionare le implicazioni ontologiche delle teorie scientifiche. Uno scienziato non certo impreparato come Einstein confidava la sua intima inquietudine per l'irriducibilità dell'esperienza dell'*adesso*, come riferisce in un passo molto noto (Carnap, 1963), pp. 37-38: «Una volta Einstein mi disse che il problema dell'*ora* lo preoccupava seriamente. Spiegò che l'esperienza dell'*ora* significa qualcosa di speciale per l'uomo, qualcosa che è essenzialmente differente dal passato e dal futuro, ma che questa importante differenza non compariva, e non poteva comparire, all'interno della fisica». Einstein era turbato dal *problema del presente* – nella formulazione di (Bourne, 2002), p. 359: «Dato il fatto che noi sappiamo di essere presenti, e che è assurdo dubitarne, qualunque teoria adeguata del tempo deve trovare un modo di garantire tale sapere». Il presentismo è l'unica teoria che prenda sul serio il problema, a costo di correre il rischio di entrare in rotta di collisione con le fondamentali teorie fisiche contemporanee. Per una discussione più approfondita del 'present problem' si veda la Prima parte di (Bourne, 2006). (Zimmerman, 1998), p. 212 esprime lo stesso problema riferendosi al «sentimento che ciò che è nel passato è finalmente concluso, e che importa soltanto ciò che è nel futuro, poiché alla fine sarà presente. Questa è l'origine dell'importanza che Prior attribuisce all'esclamazione 'Grazie al cielo è finita!'».

ontologici indesiderati, e non è certo la vicinanza a una particolare teoria scientifica (o a un teorema logico, o matematico e così via) che può risolvere difficoltà concettuali di questo tipo. Anche i presentisti ritengono di avere frecce al proprio arco per rispondere alle critiche di coloro che brandiscono la teoria della relatività speciale come un'arma decisiva contro l'esistenza di una relazione di simultaneità assoluta[24]. Il punto essenziale è che la maggior parte degli argomenti usati da tutte e tre le dottrine in gioco sono argomenti *a priori*, che non possono essere direttamente confutati da evidenze empiriche – per quanto, ovviamente, la compatibilità con le teorie scientifiche correntemente accettate sia sempre salutata con favore[25].

2.3. PRESENTISMO

Il presentismo asserisce che le uniche cose che sono diritte o inclinate, verdi o rosse o gialle etc. sono tutte e sole le cose che sono *presentemente* diritte o inclinate, verdi o rosse o gialle etc. Secondo questa soluzione, le proprietà intrinseche sono proprietà genuine che la rosa possiede *simpliciter*, ma solo al momento contestualmente presente. Riformulando la questione dal punto di vista linguistico, ogni enunciato con un parametro temporale della forma 'l'oggetto *x* ha la proprietà Q al tempo *t*' è da intendersi sempre come riferentesi al momento presente, che è il momento del proferimento dell'enunciato, in quanto *x* ha solo quelle proprietà esemplificate al presente.

Lewis[26] enuncia il presentismo come una teoria che, accanto all'unico autentico tempo, il presente, ammette anche ulteriori tempi, detti *ersatz*-tempi ('sostituti temporali'), che «sono come storie false, che rappresentano o mal rappresentano come le cose stanno». Il passato e il futuro sarebbero surrogati del presente, che restituiscono un'immagine falsa, non corrispondente al reale, dell'oggetto o dello stato di cose interessato. Se a t_2 la rosa è inclinata, c'è un surrogato temporale t_1, che rappresenta la rosa come diritta. La contraddizione è evitata in quanto l'unico tempo reale è t_2. Dal punto di vista linguistico, la qualificazione temporale del surrogato funziona come un operatore che modifica un intero enunciato: 'al tempo t_1, la rosa è diritta'. Se indichiamo con 'P' e F' gli operatori per il passato e per il futuro e con 'ϕ' un enunciato, allora P(ϕ) e F(ϕ) potranno esprimere enunciati veri a partire comunque da enunciati *falsi*[27]. Perché? Perché per il presentista l'oggetto, in quanto persistente, è localizzato interamente nel presente e di esso si possono predicare unicamente le proprietà manifestate al presente. Quando riconosce che la rosa esiste nel passato o nel futuro, egli non sta dicendo

[24] Cfr., per esempio, (Hinchliff, 2000).
[25] A conferma del fatto che le dispute metafisiche sul tempo hanno il diritto di esistere nella loro autonomia concettuale, vale la pena di sottolineare la loro intima connessione con un certo numero di problemi eminentemente filosofici, che la scienza non pare in grado di maneggiare. Basti un accenno al problema della coabitazione e della costituzione materiale e al dibattito sulle conseguenze derivanti per il quadridimensionalismo dall'assunzione del cosiddetto 'universalismo mereologico' – questioni che non è possibile trattare in questa sede per ragioni di spazio, ma per le quali si rimanda, a titolo orientativo, a (Runggaldier & Kanzian, 2002), p. 142 sgg. e (Varzi, 2005), p. 91 sgg.
[26] (Lewis, 1986), p. 204.
[27] È quanto fa rilevare (Lewis, 2002), p. 2.

affatto che la rosa, o una sua parte, è localizzata in qualche zona temporale; sta semplicemente attaccando i modificatori P e F a delle falsità per produrre verità: all'enunciato falso 'la rosa è diritta' attacca il modificatore P per ottenere l'enunciato vero 'P(la rosa è diritta)'. Per questa ragione il presentista negherebbe ciò che afferma l'uomo di senso comune, quando constata che le cose persistono attraverso il mutamento delle proprie caratteristiche.

Hinchliff[28] riconosce che questa versione del presentismo è insoddisfacente: quando diciamo che la rosa è esistita ieri ed era diritta, intendiamo catturare un tempo genuino. Inoltre, si può essere d'accordo con Lewis[29], quando sostiene che la persistenza attraverso il cambiamento si riduce – entro questa teoria – ad un nulla di fatto, in quanto c'è un solo tempo sulla scena. Hinchliff, però, ritiene di poter offrire una versione differente, di tipo avverbialista, che rifiuta l'assunzione di fondo della precedente: l'impossibilità di fare riferimento a tempi passati e futuri e a oggetti non-esistenti. Il presentismo avverbialista temporalizza le proprietà e attua riferimenti a oggetti non-presenti, ma senza impegnarsi ontologicamente sulla loro esistenza, in quanto tutti i quantificatori compaiono entro l'ambito degli operatori temporali, che funzionerebbero come modificatori *de dicto*: 'P(la rosa era diritta)'.

La linea della versione avverbialista ha avuto tra i suoi primi difensori (Prior, 1968), per il quale inserire un verbo in un enunciato al passato o al futuro è esattamente la stessa cosa dell'aggiungere un avverbio ad un enunciato. Seguendo tale approccio, gli operatori temporali si comportano come le modalità aletiche o epistemiche. Si può anche fare l'esempio della negazione verofunzionale: per render conto della verità di un enunciato come 'la rosa non è diritta', noi non poniamo un dominio di enti inesistenti, asserendo che l'enunciato è vero in quanto in siffatto dominio la rosa è diritta. Il 'non' modifica l'intero enunciato. Similmente, per render conto della verità di 'la rosa è stata diritta', il presentista non pone l'esistenza di un dominio di tempi passati, dicendo che l'enunciato è vero in quanto in siffatto dominio c'è un tempo in cui la rosa è diritta. L'enunciato 'P(ϕ)' è vero se e solo se è accaduto che l'enunciato 'ϕ' è vero.

Ecco come il presentista modificherebbe l'argomento che termina con una contraddizione assumendo il principio di Leibniz (§ 1): sostituisce le premesse (2) e (3) rispettivamente con:

(2*) a t_1 l'oggetto *x aveva* la proprietà Q (assunto che t_1 sia un tempo passato);
(3*) a t_2 l'oggetto *x ha* la proprietà non-Q (assunto che t_2 sia un tempo presente)[30].
(5*) l'oggetto *x aveva* la proprietà Q e *ha* la proprietà non-Q.

La conclusione non è contraddittoria, perché non c'è contraddizione fra le espressioni '*x* era Q' e '*x* non è Q'. Non è chiaro, ad ogni modo, come faccia il presentista a trattare l'identità

[28] (Hinchliff, 1996), p. 124 sgg.
[29] (Lewis, 1988), p. 66.
[30] (Merricks, 1994), p. 171 mette in dubbio la perspicuità di (2*) e (3*): non è affatto chiaro, a suo parere, il ruolo giocato dai tempi t_1 e t_2: in (2*), per esempio, non si dovrebbe dire che a t_1 l'oggetto *x aveva* la proprietà Q, perché si presume che l'enunciato '*x* aveva la proprietà Q' sia vero *adesso*, mentre a t_1 era vero l'enunciato '*x ha* la proprietà Q'. La traduzione dell'argomento basato sull'indiscernibilità degli identici non sembra rendere giustizia alla differenza temporale fra il passato e il presente.

oggettuale, se tutto ciò di cui egli dispone nel suo presente sono cose che esistono unicamente a quel tempo. Come facciamo a identificare il vicino di casa che ieri appariva barbuto con il vicino di casa attualmente rasato, se *tutto* l'insieme dei contenuti reali di ieri (vicino di casa incluso) è letteralmente nulla? Ci si potrebbe chiedere: dove è andato a finire il tempo t_1, in cui l'oggetto *x* aveva la proprietà Q? Non avremmo più un fondamento per la nostra prima intuizione naturale: non possiamo più dire che la rosa ha la proprietà intrinseca di essere diritta ieri, perché nella descrizione della rosa – che solo il presente rende possibile – il predicato 'essere diritto' non può occorrere. Probabilmente Lewis non considerava la variante avverbialista una novità di rilievo rispetto al presentismo ortodosso da lui contrastato: è per questa ragione, forse, che nel suo ultimo articolo[31] ribadisce le stesse critiche del suo *On the Plurality of Worlds*: i modificatori temporali 'è accaduto che' e 'accadrà che' sono trattati dal presentista come l'aggettivo 'contraffatto' in 'denaro contraffatto'. L'unica moneta sonante, potremmo dire continuando la metafora lewisiana, è l'*adesso*: tutto il resto è una falsa rappresentazione di quest'unica realtà.

I presentisti ritengono che la propria teoria esprima un nucleo concettuale abbracciato da tutti nella vita quotidiana, anche dagli anti-presentisti, e ben radicato nella grammatica di ogni lingua naturale[32]. Ma non tutti condividono tali rassicurazioni; anzi: i critici evidenziano che l'essere il discorso ordinario massicciamente carico di quantificazioni su oggetti non-presenti costringe il presentista ad escogitare ingegnose tecniche logiche per tirarsi d'impaccio[33]. Ma i motivi di perplessità diventano ancora più seri nel momento in cui si consideri che la nozione stessa di cambiamento rischia di diventare del tutto opaca; del resto, Prior stesso giunge a negarla a tutti gli effetti: «Il flusso del tempo […] è puramente metaforico, non solo perché ciò che si intende con esso non è un genuino movimento, ma anche perché ciò che si intende con esso non è un genuino cambiamento»[34]. A questo punto il limite del presentismo non è tanto quello di allontanarsi da una (o più) delle nostre intuizioni naturali, quanto piuttosto quello di prendere congedo dall'idea stessa di divenire temporale e di persistenza attraverso il cambiamento, scavalcando *eo ipso* il problema degli intrinseci temporanei.

Un argomento molto forte contro il presentismo è il cosiddetto argomento della causalità:

[i] se un evento *x* esiste ed è la causa di un altro evento *y*, allora *y* esiste;
[ii] se un evento *y* esiste, ed è causato da un altro evento *x*, allora *x* esiste;
[iii] qualche evento presente, *A*, causa qualche evento che non è ancora presente, *B*;
[iv] qualche evento presente, *B*, è causato da qualche evento che non è più presente, *A*;
[v] dunque, esistono cose che non sono presenti'[35].

[31] (Lewis 2002), p. 2.
[32] (Bigelow, 1996), p. 35, (Markosian, 2004), p. 47.
[33] Sul tema degli impegni ontologici del presentista cfr. (Sider, 1999).
[34] (Prior, 1968), pp. 10-11.
[35] (Bigelow, 1996), p. 40.

L'argomento ha spinto alcuni filosofi ad abbandonare il presentismo stretto e ad includere il dominio degli eventi passati, in modo da salvare quanto meno l'applicazione della causalità agli eventi presenti e a quelli passati ([ii], [iv])[36].

Altri filosofi propongono una via d'uscita basata sul linguaggio e ispirata agli Stoici e a Lucrezio[37]. Gli Stoici, secondo Bigelow, erano presentisti e non includevano nella propria ontologia oggetti non-presenti; piuttosto *proposizioni vere* nel presente. 'Proposizione' traduce il greco 'λεκτόν' – si tratta, in termini odierni, del pensiero espresso dall'enunciato. Riprendendo un esempio riferito da Sesto Empirico (*Contro i fisici*), l'enunciato 'se quest'uomo ha una cicatrice, allora è stato ferito' esprime una proposizione vera, non perché stabilisca un nesso causale tra un fatto presente, la cicatrice, e un fatto che non esiste più, la ferita. Il condizionale è vero perché connette due proposizioni vere *al presente*. Poiché la proposizione è intesa in senso temporalizzato, non si faticherà a trovare una forte similarità con l'approccio di Prior, ma con la seguente differenza: per gli Stoici le proposizioni vere cominciano e cessano di esistere, rimpiazzate da altre proposizioni vere: il λεκτόν 'quest'uomo ha una cicatrice' lascerà il posto al λεκτόν 'quest'uomo ha avuto una cicatrice', così come 'quest'uomo è stato ferito' ha rimpiazzato 'quest'uomo è ferito': in entrambi i casi, *salva veritate*. Il risultato è sostanzialmente lo stesso: il presentismo neutralizzerebbe l'argomento della causalità, sostenendo che causa ed effetto sono entrambi proposizioni vere.

Markosian[38] non condivide la precedente soluzione, in quanto non ritiene che il presentismo sostenuto da Bigelow sia rigoroso. Seguendo Hinchliff, si può distinguere tra 'presentismo serio' e 'presentismo non ristretto': la differenza tra i due è data dal fatto che il secondo concede che termini non più denotanti come 'Socrate' possano occorrere in proposizioni vere, come per esempio 'Socrate è stato condannato a morte', oppure 'io ammiro Socrate', nonostante il fatto che Socrate non esista più; il primo nega questa possibilità, asserendo che un oggetto non-esistente come Socrate ha ontologicamente molto più in comune con un presunto *possibile* come don Chisciotte, piuttosto che con un oggetto esistente e localizzato in un angolo remoto dello spazio, come M31, la galassia di Andromeda.

Ma, si domanderà, il fatto che Socrate sia stato reale, mentre don Chisciotte sia sempre stato fittizio, non ci impone con ogni evidenza di appaiare Socrate a oggetti reali e remoti nello spazio, come la M31? Il presentista serio risponde sfruttando:

(α) la fondamentale similarità fra tempo e modalità (nella fattispecie, la similarità fra presentismo e attualismo, cfr. *infra* § 3);
(β) la fondamentale dissimilarità fra spazio e tempo.

C'è chi – come (Markosian, 2004) – fa notare, sfruttando (α), che il fatto di essere stato reale non è diverso dal fatto di essere possibilmente reale; e, sfruttando (β), che l'essere

[36] (Broad, 1923), (Tooley, 1987). Tooley accetta [ii] e [iv], ossia l'esistenza del causante passato, ma blocca il passaggio a [v] negando l'esistenza del causato futuro, [i] e [iii]. Solo quando *B* sia effettivamente accaduto, possiamo stabilire che sia il causato presente di un causante passato; quando *A* era il causante presente, *B* non c'era affatto.
[37] Per una discussione della versione lucreziana del presentismo cfr. (Crisp, 2007), p. 92 sgg.
[38] (Markosian, 2004).

temporalmente lontano non è affatto analogo all'essere spazialmente lontano: io non posso stare in alcuna relazione con Socrate proprio come non posso stare in alcuna relazione con don Chisciotte, in quanto entrambi oggetti inesistenti.

L'ontologia del presentista serio ha *prima facie* le sembianze di un paesaggio desertico, che obbliga a ricercare elaborati costrutti parafrastici per dar conto di enunciati di uso comune. L'enunciato 'io ammiro Socrate', per esempio, dovrà essere ricostruito secondo i crismi dell'ontologia presentista grosso modo così:

(S) Ci sono varie proprietà, $Q_1,\ldots,Q_n$, tali che [1] io associo $Q_1,\ldots,Q_n$ al nome 'Socrate', e [2] pensieri relativi o alle proprietà $Q_1,\ldots,Q_n$ o al nome 'Socrate' evocano in me il sentimento caratteristico dell'ammirazione.

(S) è vera anche se non c'è nessuno a cui l'ammirazione sia diretta. Si può raffinare la (S) con una ulteriore parafrasi del fatto che Socrate sia esistito, senza far riferimento all'individuo non-presente, ma quantificando esistenzialmente su un individuo che ha la proprietà di essere il referente del nome 'Socrate', il tutto sotto il raggio d'azione dell'operatore temporale per il passato P:

(S') Ci sono varie proprietà, $Q_1,\ldots,Q_n$, tali che [1] io associo $Q_1,\ldots,Q_n$ al nome 'Socrate'; [2] pensieri relativi o alle proprietà $Q_1,\ldots,Q_n$ o al nome 'Socrate' evocano in me il sentimento caratteristico dell'ammirazione; [3] $P(\exists x)(Q_1(x) \wedge \ldots \wedge Q_n(x)$ e x è il referente di 'Socrate').

Per chi trovasse macchinosa la traduzione presentista di un enunciato banale come 'io ammiro Socrate' è pronta la risposta: non sempre, nella vita quotidiana, si fa della seria ontologia! Una filosofia severa come il presentismo obbliga il suo fautore a reinterpretare con fatica i più innocui enunciati ai tempi obliqui, esplicitando ciò che è effettivamente coinvolto nei nostri atteggiamenti proposizionali verso oggetti non-presenti. Il risultato può apparire spesso notevolmente revisionista[39].

3. QUATTRO –ISMI

Nella considerazione delle tre precedenti teorie si impone piuttosto facilmente la constatazione che la prima e la seconda hanno una stretta connessione strutturale, che le distanzia ambedue dalla problematica teorica della terza. Una formulazione semplice delle tesi tri- e quadridimensionalista, mirata a rimarcare tale connessione, è la seguente:

[39] Per quanto riguarda l'obiezione al presentismo basata sull'assenza di *truth-makers* per le verità passate e future (nota come 'the grounding objection') cfr. (Crisp, 2007).

3Da: qualsiasi oggetto che persiste è interamente presente in ogni istante della sua esistenza.

4Da: qualsiasi oggetto che persiste ha differenti parti temporali nei differenti istanti della sua esistenza.

Un fatto curioso è che entrambe queste tesi, per come sono formulate, implicano il presentismo. Questa circostanza, che illustreremo tra breve, conferma l'impressione della vicinanza fra tridimensionalismo e quadridimensionalismo, e di una loro lontananza dal presentismo. Il fatto è tanto più degno di nota in quanto c'è chi sostiene che tridimensionalismo e quadridimensionalismo condividono una metafisica del tempo che scaturisce dall'esatta negazione del presentismo: l'eternalismo[40].

La discussione presentismo/eternalismo appartiene effettivamente ad una controversia di metafisica del tempo, che andrebbe tenuta distinta da quella che vede opposti tridimensionalismo e quadridimensionalismo[41]. Da più parti si è osservato che la controversia sulla verità del presentismo ha delle interessanti analogie strutturali con la disputa tra il realismo modale e l'attualismo modale. Detto altrimenti: il realismo modale sostiene che esistono degli oggetti possibili, mentre l'attualismo modale si caratterizza per la tesi opposta: tutto ciò che esiste è attuale. Se sostituiamo alla coppia 'attuale'/'possibile' la coppia 'presente'/'non-presente', otteniamo i contendenti della seconda controversia metafisica che ci sta a cuore:

Eternalismo:possono esistere oggetti non-presenti.
Presentismo: tutto ciò che esiste è presente, non possono esistere entità non-presenti.

Non avremmo potuto usare 'assente' come equivalente di 'non-presente', in quanto l'aggettivo 'assente' può significare sia una non-presenza definitiva, sia una non-presenza provvisoria; laddove, sia l'eternalista che il presentista intendono una non-presenza definitiva, necessariamente non convertibile in una nuova presenza.

Entrambe le coppie di contendenti devono preliminarmente ammettere la disequivalenza fra, rispettivamente, le espressioni '*x* esiste' e '*x* è attuale' e le espressioni '*x* esiste' e '*x* è presente': infatti, l'assunzione di un'equivalenza fra le prime due espressioni renderebbe il realismo modale banalmente falso e l'attualismo modale banalmente vero; l'assunzione di un'equivalenza fra le ultime due espressioni renderebbe l'eternalismo banalmente falso e il presentismo banalmente vero.

Concentriamo l'attenzione sulla controversia eternalismo/presentismo. Una volta accettato che '*x* esiste' non è sinonimo di '*x* è presente', le due posizioni rivali possono concordare sul fatto che la loro disputa concerne la questione che se le due espressioni siano sempre coestensive: gli eternalisti rispondono negativamente, i presentisti affermativamente. Ora, se

[40] (Hinchliff, 1996), p. 122.
[41] (Rea, 2005) riserva il termine 'quadridimensionalismo' alla teoria che afferma la falsità del presentismo e il termine 'perdurantismo' alla teoria che afferma che gli oggetti durano nel tempo senza essere interamente presenti in ogni istante della loro esistenza.

si suppone che il presentismo sia vero, ne discende l'inesistenza di oggetti non-presenti. Nell'inventario ontologico di un presentista ateniese del V secolo a.C. ci sarebbe stato Euripide; nell'inventario ontologico di un presentista londinese del XVI secolo ci sarebbe stato Shakespeare. Al primo manca ciò che possiede l'altro, e viceversa – anche se il presentista posteriore ha sempre la possibilità (negata al primo) di esprimere un maggior numero di proposizioni vere[42]. L'eternalista è dispensato da responsabilità legate alla continua ripulitura dell'inventario, poiché i suoi impegni ontologici hanno una più vasta portata, anzi, più precisamente, hanno portata temporale massima: tutte le entità passate, presenti, e future sono sullo stesso piano, esistono tutte allo stesso titolo.

Uno sorta di posizione 'in terza persona' sembra caratterizzare la tesi eternalista, al contrario di quella presentista, caratterizzata da una posizione 'in prima persona'. Si intende con ciò affermare che la tesi dell'eternalista è svincolata da ogni prospettiva, non ha punti di riferimento temporale privilegiati: muovendo da una completa analogia fra spazio e tempo, egli sostiene che, come non c'è alcunché di metafisicamente speciale che distingua il luogo in cui è situata Piazza della Signoria dal luogo in cui è situato un qualunque cratere meteorico di Mercurio, così non c'è alcunché di metafisicamente speciale che distingua il momento in cui io sto scrivendo queste parole dal momento in cui Cesare passò il Rubicone. Tutti gli spazi e tutti i tempi sono uguali: nessuno di essi ha diritto a un privilegio metafisico. Il presentismo, invece, è intrinsecamente prospettico, essendo legato a un punto di riferimento temporale privilegiato: esso esercita un *appeal* psicologico irresistibile, in quanto è un fenomeno universalmente esperito che il presente ci colpisca nella sua vividezza come ricordi di fatti passati o aspettative di eventi futuri non potranno mai fare; questa peculiarità fenomenica è una delle ragioni più solide che inducono i filosofi a prendere sul serio i tempi verbali e a ritenerli non solo configurazioni accidentali della lingua, ma autentici strumenti di navigazione della realtà.

Come si è visto, a questa potente attrattiva del presentismo fa da *pendant* tutta una serie di complicazioni quasi proibitive sul piano della ricostruzione logica dei più elementari impegni ontologici del nostro linguaggio quotidiano. Il presentista del 2009, o quello del 2400 d.C., non può a cuor leggero formulare enunciati su Socrate, per via di quel privilegio metafisico accordato al momento di volta in volta presente, che lo costringe a quantificare solo su entità presenti[43]. Un eternalista non incontra impedimenti nel parlare di qualsivoglia entità che sia

[42] In teoria, almeno. Sia 'Euriloco' il nome del primo presentista e O^1 il suo inventario ontologico; sia 'John' il nome del secondo presentista e O^2 il suo inventario ontologico. L'asimmetria dell'accesso epistemico, che vieta ad Euriloco di dire alcunché su O^2 ('Shakespeare scriverà l'*Otello*') e consente a John di accedere parzialmente ai contenuti di O^1 ('Euripide scrisse l'*Andromaca*') è ridimensionata dal fatto che Euriloco esprimeva certamente proposizioni vere su O^1, che John (e noi con lui) non aveva più la possibilità di formulare, essendosi perdute le tracce che – *al suo presente* – avrebbero potuto giustificare proposizioni temporalizzate sui contenuti di O^1 (per esempio, proposizioni sulle 75 tragedie perdute di Euripide). Un aumento dell'informazione al presente può contribuire a divaricare l'asimmetria, ma solo un'idealizzazione sull'estensione del sapere di John (e del presentista di volta in volta successivo) ci consentirebbe di dire che il progresso conoscitivo a lui favorevole sia reale e non apparente. Può il presentista dire, in generale, che ci sia un effettivo aumento contenutistico del reale, in ragione della costante mutabilità del presente?

[43] Ma si noti quanto paradossale sia l'espressione 'il presentista del 2009': in che senso si può dire presente un intero anno? Qui l'argomento di (Agostino, 1990), p. 449 sull'estensione del presente

nel passato. E per quanto riguarda il futuro? Qui l'eternalista si rende conto di dover fare i conti con un'asimmetria fra la determinatezza del passato, al quale ha parziale accesso attraverso il sapere storico accumulato, e l'indeterminatezza del futuro. Ma contesterà che l'indeterminatezza del futuro sia ontologica: dirà che si tratta di una indeterminatezza epistemica, a cui si affianca – tra l'altro – la determinatezza parziale della sua conoscenza del passato; e, alla fine, giustificherà la propria posizione richiamandosi alla teoria della relatività speciale e alla *Block Universe View*. Tuttavia, ci possono essere avversari del presentismo che non sono eternalisti nel senso appena descritto: sostenendo una asimmetria sostanziale fra passato e futuro, essi non sono disposti ad ammettere nella propria ontologia eventi che non siano ancora presenti o passati[44].

Come si è detto, la controversia tri-/quadridimensionalismo deve essere tenuta distinta dalla controversia eternalismo/presentismo. Accade però che, se le tesi della prima controversia sono quelle espresse sopra da 3Da e 4Da, allora entrambe le posizioni implicano il presentismo, e i nostri quattro contendenti si incrociano.

Si consideri Socrate, come esempio di individuo non-presente. Naturalmente, Socrate in questo momento non è presente nella sua interezza. Ciò significa che chiunque sostenga 3Da deve anche sostenere che in questo momento Socrate non esiste e, di conseguenza, non fa parte dell'inventario ontologico effettivo. Poiché una tale osservazione si applicherebbe a tutti gli altri casi di presunti oggetti non-presenti, la 3Da implica il presentismo. Quanto a 4Da: il suo sostenitore converrà sul fatto che Socrate, non avendo *ora* alcuna parte temporale, non esiste nel presente momento e non può far parte dell'inventario ontologico. Poiché una tale osservazione si applicherebbe a tutti gli altri casi di presunti oggetti non-presenti, la 4Da implica il presentismo.

Per evitare questa duplice implicazione, entrambe le tesi devono essere riformulate. Seguendo Markosian[45], saggiamo una prima strategia.

3Db: Qualsiasi oggetto che è presente in tempi differenti è interamente presente in ogni istante in cui è presente.

4Db: Qualsiasi oggetto che è presente in tempi differenti ha differenti parti temporali nei differenti istanti in cui è presente.

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costituisce una minaccia grave per il presentista, costringendolo a fare i conti con una specificazione contestuale della posizione temporale privilegiata, col risultato – al limite dell'assurdo – per cui una stessa entità esiste o non esiste a seconda dell'ampiezza dell'unità presente considerata (un anno? un mese? un'ora? un minuto?). Sull'argomento si è soffermato (McKinnon, 2003).

[44] La posizione intermedia fra il quadro completamente eracliteo della realtà, fornito dalle filosofie presentiste, e quello completamente parmenideo, fornito dalle filosofie eternaliste, è denominabile come 'possibilismo temporale' ed è sostenuta, fra gli altri, da (Broad, 1923), (Adams, 1986), (Tooley, 1987). È radicalmente distinto dall'eternalismo, perché conferisce senso all'idea del divenire, al pari del presentismo; ma, a differenza di quest'ultimo, è più generoso dal punto di vista ontologico, poiché include nell'inventario degli oggetti esistenti anche le entità trascorse, pur continuando a sostenere che il futuro è irreale. Si è soliti usare in proposito l'immagine dello sviluppo ramificato, intendendo alludere al fatto che il binomio presente-passato costituisce metaforicamente il tronco di un albero, i cui rami rappresenterebbero le biforcazioni indeterminate del futuro.

[45] (Markosian, 1994), p. 5.

Adesso 3Db e 4Db sono compatibili con l'eternalismo, perché sono conciliabili con la possibilità che gli oggetti continuino a esistere anche quando non sono più presenti. La riformulazione, tuttavia, non cancella la compatibilità con il presentismo, in quanto entrambe le tesi riformulate sono consistenti con la possibilità che gli oggetti cessino di esistere nel momento in cui cessino di essere presenti – che equivale alla tesi centrale del presentismo.

Per eliminare questo residuo di compatibilità, avanziamo una seconda strategia. Stabiliamo una distinzione tra la locuzione '*x* esiste a *t*' e la locuzione semplice '*x* esiste'. La prima è da usare, come il suo parametro indicale suggerisce, solo per quelle entità che esistono in *t*; mentre la seconda è da usare come quantificazione atemporale su tutte le entità inserite nell'inventario ontologico corretto, indipendentemente dalla loro eventuale esistenza-a-*t*[46]. Esempi di questa distinzione: 'Giorgo Napolitano esiste-a-*t*' (*t* = 3.XI.2008), 'Socrate esiste-a-*t*' (*t* = 3.XI.408 a.C.), 'Giorgio Napolitano e Socrate esistono'. Una parafrasi di '*x* esiste a *t*' è: '*t* è (era, sarà) presente e *x* esiste (è esistito, esisterà)'. In questa prospettiva, l'eternalismo asserirebbe che esistono cose che non esistono-a-*t* (per qualunque *t*) e il presentismo sosterrebbe che qualsiasi cosa esista, è una cosa che esiste-a-*t* (*t* = il presente contestualmente attuale).

Questa seconda strategia, benché *prima facie* plausibile, non funziona, perché non rende conto dell'intenzione sostanziale del presentista di affermare la mutabilità del contenuto del proprio inventario ontologico: di conseguenza, saremmo portati a dotare di un parametro temporale anche la locuzione neutra '*x* esiste', da noi adoperata come sinonimica della locuzione '*x* appartiene all'inventario ontologico corretto'. Ma allora sorgerebbe un'ambiguità fra '*x* esiste-a-*t*' (*t* = il presente contestualmente attuale) e '*x* appartiene all'inventario ontologico corretto a *t*' (per qualunque *t*).

Una terza strategia, più fortunata, consiste nel mantenere la disequivalenza fra '*x* esiste' e '*x* esiste a *t*', ma nel rimpiazzare la prima con un'altra locuzione, come '*x* sussiste'. L'eternalista sosterrà che non sempre tutto ciò che sussiste esiste e il presentista sosterrà che tutto ciò che sussiste esiste. Sulla base della distinzione terminologica fra 'sussistere' e 'esistere', le tesi 3Da e 4Da diventano formulazioni adeguate delle posizioni tri- e quadridimensionalista. Nella letteratura critica queste sottigliezze non sono spesso tenute in considerazione, probabilmente per via del fatto che l'espressione 'esistere' è usata di solito per significare non l'esserci temporalmente presente di un oggetto, bensì la sua appartenenza al più ampio dominio possibile di individui.

Nonostante le chiarificazioni precedenti, i rapporti incrociati fra i quattro '-ismi' delle nostre dispute metafisiche restano piuttosto complicati. In particolare, si può mostrare[47] che:

(i) la verità del presentismo comporta l'inesistenza di oggetti quadridimensionali;
(ii) una combinazione di presentismo e tridimensionalismo è legittima;
(iii) l'eternalismo comporta l'inesistenza di oggetti tridimensionali.

[46] (Sider, 1997), p. 203.
[47] (Merricks, 1995).

Brevemente sul punto (i): se il presentismo fosse vero, non esisterebbero gli oggetti così come sono intesi dal quadridimensionalista, cioè come somme mereologiche di fette temporali, in quanto le fette non-presenti non esisterebbero e il lombrico si ridurrebbe giocoforza a un frammento circoscritto, quello attualmente presente[48].

Sul punto (ii): il tridimensionalista afferma che a ciascun singolo istante in cui un oggetto *x* esiste, esistono anche tutte le parti di *x* (questo è giusto il senso dell''essere interamente presente': cfr. § 2.1, (IP)). È naturale che un tridimensionalista affermi pure la possibilità che *x* cambi le proprie parti e che ciò che in un istante è stata una parte di *x* non esista più. Ebbene, il presentismo è consistente con l'asserzione che un certo oggetto permanente *x* abbia avuto una parte che non esiste più, in quanto blocca il passaggio inferenziale dal fatto che *x* abbia avuto una parte *p* ad un istante trascorso t_1 al fatto che *x* abbia ancora *p* come sua parte al momento presente t_2. La combinazione di presentismo e tridimensionalismo intende salvaguardare al contempo la seconda e la terza intuizione naturale; la prima intuizione è forse quella considerata più ovvia, mentre la quarta segue in modo banale dal fatto che al presente l'oggetto può solo possedere una proprietà e non il suo contrario: la rosa è ora inclinata, mentre la proprietà di essere stata diritta è una proprietà che la rosa *ha avuto*: 'essere stato diritto' non è affatto un modo di essere diritto, non più di quanto lo sia il non essere diritto.

Sul punto (iii): il tridimensionalista riconosce la possibilità che un oggetto permanente *x*, che abbia ora la proprietà non-Q, abbia avuto in un tempo passato anche la proprietà Q. È nelle condizioni, inoltre, di evitare la contraddizione che *x* è sia Q che non-Q, poiché il suo *x* esemplifica soltanto proprietà relazionali con tempi e al tempo attuale *x* ha solo le proprietà attualmente esemplificate. Ritorna proprio su questo punto quella combinazione fra presentismo e tridimensionalismo che abbiamo visto essere consistente. Ma supponiamo di rifiutare il presentismo per l'eternalismo, che vede nel presente unicamente il tempo in cui noi (o le nostre fette temporali, o i nostri correnti proferimenti linguistici etc.) siamo collocati, senza privilegi metafisici accordati ad altre postazioni passate o future. Sulla base di questa visione siamo portati ad asserire che se *x* ha la proprietà Q all'istante t_1 e ha la proprietà non-Q in un altro istante t_2, allora l'oggetto è simultaneamente Q e non-Q. Contraddizione: essendo i tempi come i luoghi, è come se ci venisse detto che il nostro gatto di casa è bianco in salotto e nero in cucina. La combinazione di tridimensionalismo ed eternalismo è inconsistente. Il tridimensionalista può scampare a questa contraddizione – che altro non è che la difficoltà coinvolta nell'affermazione congiunta della persistenza e del principio di Leibniz – soltanto se

[48] Questo primo punto, particolarmente controverso, è stato respinto da quei filosofi – tra cui (Brogaard, 2000) e, per puro amore di analisi, (Lombard, 1999) – che si sono cimentati nell'elaborare una versione presentista del quadridimensionalismo/perdurantismo. Il sostenitore di tale versione dirà che un oggetto attualmente esistente è presente non nella sua interezza, ma solo in quanto avente una parte temporale o stadio (*stage*) presente e farà notare come, in questo modo, sia possibile evitare l'obiezione di staticità ontologica mossa al quadridimensionalismo classico: alla nozione di cambiamento sarebbe riservato un valore autentico, in quanto la parte temporale presente avrebbe proprietà diverse da quelle possedute dalle parti temporali precedenti. Una forma di perdurantismo presentista può considerarsi la 'stage view' sviluppata da (Sider, 2000, 2001), il quale, declinando in senso temporale la teoria lewisiana delle controparti modali, sostiene che l'oggetto esistente ora, avendo una parte temporale presente, ha anche controparti temporali in altri istanti.

ricostruisce tutte le proprietà come relazioni, con il risultato controintuitivo già visto in precedenza[49]: le forme, come i colori e le estensioni, non sono relazioni mascherate, ma proprietà intrinseche. Il quadridimensionalista, invece, se la cava ricorrendo alle parti temporali, che non gli consentono di identificare la *x* tridimensionale in t_1 con la *x* tridimensionale in t_2: l'una e l'altra sono parti temporali esistenti ciascuna ad un dato istante, irripetibilmente (la fusione di tutte le *x*-a-*t* tridimensionali dà luogo a un intero quadridimensionale, di cui si dirà che è propriamente l'oggetto *x*).

Potremmo, infine, seguire Merricks[50] nel tirare le somme da questo elenco di rapporti incrociati. Dati (i) e (iii), allora, considerato che o è vero il presentismo o è vero l'eternalismo, ne segue che *o* non ci sono entità perduranti *o* non ci sono entità permanenti. I due tipi di entità sono ontologicamente incompatibili; il che, se fosse vero, spazzerebbe via almeno un paio di idee piuttosto plausibili, e cioè: primo, che possano coesistere nel nostro inventario ontologico oggetti ed eventi, ossia enti tridimensionali come tavoli, fiori e palline da tennis, ed enti quadridimensionali come le corse a ostacoli, gli sbadigli e i concerti musicali; secondo, che gli enti tridimensionali possano avere *storie* quadridimensionali (Socrate non è una sommatoria statica di fette-di-persona, ma piuttosto un corpo permanente, la cui esistenza evolve nel tempo). Una simile conclusione sarebbe accettabile soltanto ammettendo l'esaustività dell'alternativa presentismo/eternalismo; mossa che non raccoglie un consenso unanime[51].

4. A- E B-TEORIA DEL TEMPO

Passiamo, infine, al celebre l'argomento di (McTaggart, 1908) contro la realtà del tempo e vediamo in che senso esso configuri un caso speciale del problema degli intrinseci temporanei. Introduciamo in sintesi i due modi in cui, per McTaggart[52], sono esprimibili le posizioni nel tempo.

A-serie: ogni posizione nel tempo è caratterizzabile come *presente*, *passata* o *futura*;
B-serie: ogni posizione nel tempo è caratterizzata dall'essere *prima di* o *dopo di* qualche altra posizione nel tempo, senza alcun riferimento (diretto o indiretto) al presente.

Le tre distinzioni della A-serie sono impermanenti, poiché un evento che è ora presente, sarà passato essendo stato futuro. Le due distinzioni della B-serie sono permanenti, poiché un evento *x* che sia prima/dopo di un evento *y*, sarà per sempre, definitivamente, prima/dopo di *y*.

Dall'assunzione della A-serie deriva una contraddizione, per due ragioni:

[49] Contestato da (Lewis, 1986), p. 204 e da (Merricks, 1994).
[50] (Merricks, 1994), p. 530.
[51] Cfr. nota 44.
[52] (McTaggart, 1908), pp. 9-10.

(α) in primo luogo, gli A-predicati esprimono proprietà mutuamente esclusive: un evento che è presente ('N' da 'now') non è *ipso facto* passato ('P') né futuro ('F'): Np → ¬(Pp ∨ Fp);

(β) in secondo luogo, per McTaggart il cambiamento consiste precisamente nel fatto che eventi futuri diventano presenti ed eventi presenti diventano passati; ne segue che ogni evento deve essere futuro *e* presente *e* passato, deve cioè godere prima o poi di tutte e tre le A-proprietà incompatibili (Pp ∧ Np ∧ Fp). Se anche si dovesse ammettere un evento assolutamente iniziale e uno assolutamente finale del tempo, questi finirebbero per avere comunque *due*, se non tutte e tre, delle A-proprietà.

Di qui la contraddizione e di qui, secondo McTaggart, la conclusione che il tempo è irreale: poiché, infatti, la A-serie è decisiva per rendere conto del cambiamento (la B-serie, da sola, non è sufficiente), e poiché il cambiamento è un tratto essenziale del tempo, il tempo è irreale in quanto richiede la realtà della A-serie.

Ma il ragionamento di McTaggart non finisce qui, perché prevede anche una consistente replica al paradosso, e tenta di neutralizzarla. Il sostenitore della A-serie potrebbe replicare di non aver bisogno di dire che un evento è *simultaneamente* passato, presente e futuro: ciò che dirà, senza tema di contraddizione, è che un evento che *è* presente, *sarà* passato ed *era* futuro. Ebbene, McTaggart farebbe notare a tale obiettore che la minaccia della contraddizione salta fuori anche a questo ulteriore livello dei tempi di secondo ordine[53]: affermare, infatti, che un evento *era futuro*, significa affermare che è (atemporalmente) *futuro nel passato*; ma lo stesso identico evento è (atemporalmente) anche *passato nel passato*, e siamo di nuovo punto e daccapo. Se qui l'unica arma rimasta a disposizione dell'A-teorico consistesse nel duplicare la precedente mossa, sostenendo che un evento non è simultaneamente futuro nel passato e passato nel passato, ma è stato futuro nel passato e sarà passato nel passato, allora McTaggart concluderebbe vittoriosamente il suo argomento, additando l'insorgere di un maligno regresso all'infinito.

Tuttavia, a McTaggart è stato contestato un banale errore di logica[54]: McTaggart non avrebbe capito la *token*-riflessività, o indicalità, delle espressioni della A-serie: '*x* è presente' vuol dire '*x* accade *ora*'. Le condizioni di verità di enunciati contenenti 'ora' sono dipendenti dal contesto (il proferimento di un *token* enunciativo '*x* accade ora' è vero se e solo se il *token* dell'enunciato è proferito al tempo *t* tale che *x* accade a *t*). Le cose non cambiano con l'indicale 'qui'; anzi, è proprio prendendo il caso analogo dello spazio che la fallacia indicale di McTaggart risalta in tutta pienezza: è semplicemente sbagliato dire che *x*, che non accade *qui*, ma che accade *lì*, sta accadendo *qui lì*. Ciò che si può dire è che un proferimento *lì* del *token* enunciativo '*x* accade qui' è vero. Parimenti, quando dico che *x* accadrà, non sto introducendo un tempo iterato 'presente nel futuro', non sto cioè coimplicando – in questo mio dire – che *x*

[53] I tempi di secondo ordine sono nove, rappresentabili grosso modo così: {passato, presente, futuro} *nel* {passato, presente, futuro). (Dummett, 1960), p. 498 osserva, però, che tre di essi sono equivalenti ai tre tempi del prim'ordine, e precisamente: {passato, presente, futuro} *nel* presente. Sicché, se la contraddizione tocca il primo livello, non la si può sfuggire salendo al secondo.
[54] (Lowe, 1987), p. 66.

sta accadendo ora nel futuro, sebbene io stia invece coimplicando che nel futuro sarà possibile esprimere un asserto vero dicendo '*x* accade ora'.

A McTaggart, quindi, sarebbe sfuggita la natura ineliminabilmente indicale degli A-predicati; egli non può affermare che ciò che è futuro diventerà presente e quindi passato. Piuttosto: se *x* è un evento futuro, cioè se *x* accadrà, allora *sarà* possibile esprimere un asserto vero per mezzo dell'enunciato '*x* accade ora'. Più in generale, si può impiegare la A-terminologia e asserire senza contraddizioni che: per ogni evento *Y*, (i) è stato, è o sarà vero dire '*Y* è accaduto', e (ii) è stato, è o sarà vero dire '*Y* accade ora', e (iii) è stato, è o sarà vero dire '*Y* accadrà'[55]. Così, il fatto che io sia attualmente seduto al tavolo in compagnia del mio gatto *era* veridicamente descrivibile come 'futuro', è veridicamente descrivibile come 'presente', e sarà veridicamente descrivibile come 'passato'. McTaggart avrebbe operato un ingiustificato passaggio dalla prospettiva in prima persona a quella in terza (cfr. § 3): egli pensa le cose *sub specie aeternitatis*, come presenti per certi individui, passati per altri, e futuri per altri ancora, sottraendosi indebitamente alla sua peculiare prospettiva temporale, che lo costringerebbe a usare l'A-predicato 'essere presente' in riferimento al contesto del *suo* presente.

Senza invocare evidenze scientifiche per prendere posizione sulla disputa fra i temporizzatori (sostenitori della primarietà della A-serie) e detemporizzatori (sostenitori della primarietà della B-serie), procediamo a mostrare – con (Craig, 1998) – che il paradosso di McTaggart è un caso speciale del problema degli intrinseci temporanei. Le proprietà della A-serie, infatti, sono intrinseche e temporanee, e la contraddizione derivante dall'assunzione del principio di Leibniz si ripresenta tale e quale, in quanto le proprietà complementari in questione sono quelle dell'essere presente e dell'essere passato (o dell'essere presente e dell'essere futuro).

Integriamo il paradosso di McTaggart nel corpo delle tre teorie individuate da Lewis, a cominciare dal tridimensionalismo. Il tridimensionalista sosterrebbe che le A-proprietà sono relazioni camuffate, che l'oggetto intrattiene con istanti: la rosa può essere presente in relazione a certi istanti e passata in relazione a certi altri istanti. La relativizzazione delle A-proprietà si può realizzare in due modi, a seconda che gli istanti siano quelli della A-serie o quelli della B-serie. Nel primo caso, un oggetto *x* sarebbe futuro relativamente ad alcuni istanti di ieri (3.XI.2008) o a qualunque altra posizione nella A-serie. Nel secondo caso, *x* sarebbe futuro relativamente al 3.XI.2008 o a qualunque altra posizione nella B-serie. Nel secondo caso le A-proprietà sono state tradotte in B-proprietà: dire di *x* che è futuro relativamente a una certa data equivale a dire che *x* è (eternamente) *prima* di quella data.

Ma, in questo modo, sfuggiamo alla sfida posta dal problema degli intrinseci temporanei. Nel caso in cui la relativizzazione delle A-proprietà è realizzata mediante la A-serie stessa, non si risolve ugualmente nulla, in quanto si cade in un regresso all'infinito, paventato dallo stesso McTaggart: le A-proprietà sarebbero relative ad un presente che, in quanto determinazione temporale relazionale, deve esso stesso essere relativo a un presente, e così via.

[55] Cfr. (Lowe, 1992), p. 325 e (Lowe, 2001), p. 90 sgg. Lo scopo della costruzione metalinguistica di Lowe, nella quale le condizioni di verità degli enunciati temporizzati sono *token*-riflessive, è quello di evitare di porre presente, passato e futuro come proprietà sostanziali degli eventi.

Con il quadridimensionalismo il discorso procede più speditamente: il paradosso di McTaggart non si pone: le parti temporali postulate dalla teoria, infatti, non persistono, ma sono identiche a se stesse nell'istante in cui sono presenti, nonostante il fatto che siano presenti e passate. Non ha senso dire di una parte temporale di *x* che essa ha, a sua volta, parti temporali aventi A-proprietà intrinseche.

Il problema degli intrinseci temporanei non si pone nemmeno nel caso del presentismo: poiché un oggetto *x* esiste solo al presente, *x* non possiede proprietà incompatibili a diversi istanti. Non viene fuori nessuna contraddizione, dal momento che si temporizzano tutti gli enunciati: la rosa *esisteva* a t_1 ed *esiste* a t_2; la rosa *era* diritta a t_1 e non *è* diritta a t_2. Solo le ascrizioni a *x* del presente possono essere prese in senso letterale come il possesso da parte di *x* di una A-determinazione: le uniche proprietà intrinseche di *x* sono quelle che esso ha al presente, e queste proprietà sono tutte compatibili fra di loro (come l'essere ora rossa della rosa è compatibile con il suo essere ora inclinata). C'è chi ha sostenuto che soltanto il presentismo potrebbe esorcizzare in modo soddisfacente la prova di McTaggart, proponendo un *ora* che è in se stesso non-relazionale[56].

Il risultato di questa interazione fra il paradosso di McTaggart e le tre teorie di Lewis è abbastanza sorprendente: il paradosso, infatti, colpisce soltanto la posizione ibrida di quei filosofi che rapportano un'ontologia basata sulla B-serie con A-proprietà intrinseche, non-relazionali: questi filosofi (tri- e quadridimensionalisti) non riescono a spiegare come un oggetto *x*-a-*t* possa avere avuto al tempo *t* la proprietà intrinseca dell'essere presente e possa avere ora a *t'* la proprietà intrinseca dell'essere passato, e tuttavia rimanere lo stesso *x* nel passaggio da *t* a *t'*. Di solito, coloro che ricorrono al paradosso di McTaggart lo fanno per confutare i sostenitori della A-teoria *tout court*, mentre il paradosso non toccherebbe giustappunto gli A-teorici puri, ossia i presentisti.

Come che stiano le cose, la contrapposizione fra A-teorici e B-teorici non deve far supporre che, mentre i secondi siano fautori dell'eternalismo, i primi siano tutti infallibilmente presentisti. Si tratta di due questioni separate[57]: posso dichiararmi a favore di un resoconto temporizzato o detemporizzato degli enunciati, e tuttavia, se sono un presentista, avrò le medesima difficoltà a difendere la mia posizione, specie in riferimento agli enunciati in cui compaiono termini singolari non più denotanti. Il fatto che la A-teoria riservi un posto privilegiato al presente, in un modo che non è dato riscontrare nella B-teoria, non significa che la A-teoria offra simultaneamente una visione metafisica sostantiva del tempo presente, come invece il presentista intende fare: essa non incide minimamente sullo *status* filosofico del presentismo, né ha bisogno di farlo.

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[56] Cfr. (Le Poidevin, 1991), p. 36 (pur da una posizione non presentista).
[57] Su questa separazione teorica si sofferma (Williams, 1996).

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Change, Contradiction and Possibility. Outline for Leibniz's Metaphysics of Time

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ABSTRACT

In this paper I consider some aspects of Leibniz's theory of time. On the whole, I point out how Leibniz relies in this, on one hand, on the inner experience of the mind; on the other, he works out a logico-ontological structure which underlies the temporal features of world.
In particular, then, I focus on the relationship between change and time. In the first part of my paper I take into account the thesis that time cannot be conceived without change, an important piece of a reductionist approach to the ontological status of time. It is endorsed by Leibniz, who in general professes the ontological priority of the 'history system' (the series of things and changes in time) with respect to the 'time system' (the system of properly temporal items). It does not fail to create some tension, however, with his characterization of time as an order of *possible* things – which seems to allow for the possibility of temporal vacua. In any event, the relation of time with possibility turns out to be a central one.
In the second part, I consider the fact that time, in its turn, seems to be required in order to conceive of change, insofar as it is taken by Leibniz as the way to neutralize the contradiction which would be implied by change itself.

INTRODUCTION

The relation with change has played a central role in the philosophical theory of time since its very origins. Already in Aristotle, change enters into the very definition of time. Change, in its turn, exhibits an intuitive link with contradiction. As is often the case in philosophy, we are faced here with a family of closely interrelated notions.

In his paper *Time, change and contradiction*,[1] G.H. von Wright put forward a clear articulation of this network of conceptual relations. According to von Wright, on the one hand, change is the condition of time from the epistemic point of view, while on the other, time is the condition of change from the logico - ontological point of view.

The first part of this statement points to the fact that change is required as a condition for the application of our temporal concepts; the intuition underlying the last part is that time allows us to conceive of change without falling into contradiction.

Now, Leibniz would subscribe to both lines of thought sketchily developed by von Wright on behalf of his double thesis. For his own part, however, he endorses a univocal conceptual and ontological chain of dependence, going from logical contradiction, to change, to time, in this order. I wish to try to explore here the Leibnizian articulation of these notions, and to show

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[1] (Von Wright, 1969).

how this matter is closely bound to the position he takes up in the great debate of his age about the ontological status of time.

1. NO TIME WITHOUT CHANGE. TIME, CHANGE AND THE REDUCIBILITY THESIS

"Aristotle's Principle"

As I have hinted above, the idea that time is somehow inseparable from change is an ancient one, having got its standard formulation already in Aristotle's theory of time, according to which time is nothing but the measure of change: "Time is the number of change according to the before and after"[2]. In the contemporary debate, indeed, the thesis according to which time depends – ontologically and conceptually – on change has been sometimes labelled 'Aristotle's Principle' (AP). More precisely, the principle states that there is no time without change[3].

Needless to say, this principle works as a necessary (if not sufficient) condition for those who want to defend a reductionist view, according to which talk about temporal items (instants, intervals and so on) is parasitic on talk about what is, or happens, in time (things, events, processes). In Leibniz's age, however, challenging the old Aristotelian framework goes hand in hand with the rise of a view of time (and space) as fundamentally independent of things in time[4]. In this context, the discussion on AP – hence, on the alleged dependence of time on change – becomes a crucial test in the debate between two main ontological approaches to time itself. In order to better consider this background, let me start from Leibniz's commentary to Locke's ideas about time, in NE II, ch. 14.

Time of the Mind and Time of the World: Time without Physical Change

On the whole, Locke's exposition reflects two leading threads in seventeenth century reflection on time: on one hand, the weakening of the conceptual link between time and physical (especially heavenly) motion; on the other, and more generally, the breaking of the dependence of time on things and their changes, and the rise of an idea of time as a kind of pre-existing container. Let me briefly consider the first one.

Traditionally, the change to which time was normally associated was – first and foremost – the physical, or better the cosmological one, such as heavenly motion: due to the fact that time had been defined as the measure, or number of change, and the motion of celestial bodies provided the means to measure all other changes.

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[2] Physics IV, 220 a 24-25.

[3] For the label of AP in contemporary debate, see Newton-Smith1980, ch.2. For Aristotle's arguments on behalf of AP, see Physics IV 218 b 21-30. For a well-known argument on behalf of the possibility of time without change, see (Shoemaker, 1969).

[4] For a standard statement of the two rival ontological views on time (labeled, respectively, reductionist and Platonist, see (Newton-Smith, 1980), ch. 1.

In the seventeenth century – together with the destruction of the ancient *kosmos* and the rise of a new philosophy of mind and subjectivity – there was a tendency to cut that privileged link with motion, and instead give a mental foundation to time: although, of course, the new notion of time worked out was bound to become one of the basic ones for the new physics. Thus, in Descartes' *Third Meditation*, the meditator discovers within himself the ideas of duration and succession, while still doubting the existence of the external world.

Half a century later, John Locke in his *Essay* also emphasized the foundation of the idea of time in the inner experience of the life of the mind: the idea of duration is drawn from the constant change of perceptions in our mind[5].

Consider now Leibniz's reaction to Locke' stance. In NE II, 14, he seems to accept the privileged role of inner experience. As a matter of fact, the temporal experience of the mind turns out to be one of the primitive sources of some of his fundamental ideas. Think, e.g., of the significance of memory for the mind/body distinction and its constitutive role for the temporal sameness of substance – an idea which is well documented in Leibniz's writings, from the early *Hypothesis physica nova* until the *New Essays*.

At the same time, Leibniz is working out, during his philosophical development, a more abstract model of the '*series rerum*', which has a wholly general import, embracing both the fields of the philosophy of mind and of physical science. This duality of approaches, as we shall see, is a constant in his handling of time, which is rooted, on the one hand, within the inner experience of mind, and aiming, on the other, at clarifying an underlying logico-ontological structure.

Temporal Vacua. Time without Actual Change?

Besides breaking with physical changes, there was – in seventeenth century thought about time – the more radical tendency to cut the link with actual change in general, and to unfold in different ways the idea of imaginary times, outside the temporal boundaries of our world. For his own part Locke – still in order to detach the idea of time from actual physical motion - insisted on showing how a measure of time, drawn by some physical motions, can then be applied to periods where there is no such motion.

Interestingly enough, it is Leibniz who reinforces the import of Locke's remark. Where the English philosopher had simply spoken about a period without the sun's revolutions, he seems to take the situation in a more radical way as that of a period 'void' of any event: "Such a vacuum which can be conceived of in time, like that in space, shows that time and space extend to possible things, and not only to actual ones." (GP V 140). And when Locke positively hints at the infinity of space and time, by observing that we can well conceive of a finite world with a beginning, preceded by an eternal duration, Leibniz comments: "This is due to the fact that, as I have said above, time and space refer to possibilities, without presupposing

[5] 'Duration' was commonly distinguished from time – both in Scholastic and post-Cartesian philosophical terminology – as a real attribute of thing, while time was acknowledged as an abstract device. Leibniz also follows this view, while not being always coherent in his terminological usage.

existences. Time and space share in the nature of eternal truths, which bear in the same way on the possible and the existent." (Ibidem).

On the whole, these remarks on time in the NE seem to consider both intra-world and extramundane temporal vacua as a wholly legitimate possibility, made conceivable, and even necessarily implied, by the extension of the scope of time to possible things.

The Platonic Background and Modal Reductionism

The reference to 'eternal truths' urges us to clarify the ontological background of Leibniz's remark. While accepting the 'mentalizing' of change, Leibniz challenges the genetic role Locke attributes to it. He points out that "the succession of perceptions evokes in us the idea of duration, but it does not constitute it. Our perceptions do not have a succession regular and constant enough to correspond to that of time, which is a uniform and simple continuum like a straight line. The change in perception gives us the occasion to think of time and we measure it through uniform changes…" (GP V 139).

Leibniz's qualification is in tune with his general concern, in the NE, to preserve the objective value and the meta-empirical import of our knowledge against Locke's empiristic-subjectivist drift. In so doing, however, he seems to encourage a Platonist interpretation of the 'idea of duration'. Time, Leibniz insists, by flowing in a perfectly uniform manner is the true measure of all other processes. It is grasped by our mind, but is wholly independent of it.

In the following chapter (15) Leibniz does confirm this status of time, by emphasizing its foundation in God: "He [sc. God] is the source of possibilities as well as of existences; of the former through His essence, of the latter through His will. Thus, space and time derive their reality from Him, and He can fill the Vacuum as He likes." (GP V 141). The last sentence goes as far as to suggest the idea of a kind of eternal container, waiting to be filled according to the divine creative will.

This, however, is not the case with Leibniz, who never embraces the absolutist view[6]. More than ten years later, as is well known, in his discussion with Samuel Clarke, the attitude – still nuanced in the NE - towards the time of the 'English philosophers' will make room for an open fight.

In the course of this dispute, the status of Leibniz's space and time is unequivocally clarified: they are mathematical beings, i.e. abstract (or better ideal) structures. As such, notice, they share most of the features of Newton's space and time, exactly as it was shown by the remarks in NE. But the decisive divide lies in the way of conceiving the ontological status of mathematical objects in general. Whereas in the Newtonian perspective, space and time are somehow hypostatized, Leibniz is eager to stress their conceptual/abstract character, in contrast with concrete real beings. Admittedly, this radical ontological weakening coexists with a robust defence of their epistemical value, going far beyond the status of empirical devices.

[6] Even when the neo-Platonic roots of this view are more evident, notice, Leibniz is eager to distinguish Immensity and eternity as Attributes of God from their mundane counterparts Space and Time – the latter finding their basis in the former, while being quite different. See e.g. A VI.3, 519-520. I owe this remark to an anonymous referee of this review.

This was the sense of the criticism against Locke, and it is also the reason why it is far more correct to speak about an 'ideal' than about an 'abstract' character of space and time.

Epistemological Platonism, therefore, together with an anti-**Platonistic** approach, on the ontological side: we are faced here with a typical Leibnizian strategy to get the pay-offs of both Platonism and Aristotelianism (or better, of a frankly nominalist view), without the respective drawbacks. It remains to be seen whether the resulting whole is coherent, or it is open to tension which cannot be actually disposed of. In the following, I shall try to collect the materials of the theory, leaving the question open.

In that strategy, a decisive role is played by the anchoring of ideas and truths in the divine intellect. Whereas this guarantees their peculiar 'reality' (in the sense of mind-independence, with respect to the human mind) and objectivity, their categorial qualification plays the decisive role, as far as their proper ontological evaluation is concerned. Space and time are not things nor attributes, indeed, but they belong, instead, to the category of Relation. More precisely, they are *orders* of relations. Accordingly, one can immediately see a quite natural sense in which they cannot but be something dependent on the existence of things located within them.

Anyway, they extend - as orders – to *possible* as well as to actual things. Leibniz's emphasis on this fact is important for the possibility of detaching time from every *actual* change, even while keeping firm with a reductionist approach, as Leibniz actually did. Thus, as we have seen, in NE II.14 he seems to suggest a way of accounting for temporal vacua through the relation of time to possible things and events. In contemporary debate, some authors have attempted in a similar vein to reconcile the giving up of strong AP – hence, the admitted possibility of time without change - with a broader reductionist approach. According to Newton-Smith's definition: "There is a period of time between the events E1 and E2 if and only if relative to these events it is possible for some event or events to occur between them."[7] Now, Leibniz might well appear as the ancestor of a kindred modal reductionism.

Modal Reductionism and the Problem of Temporal Vacua

Things are more complicated, however. As a matter of fact Leibniz, when considering closer the issue of temporal vacua, clearly denies their very possibility, or conceivability. It remains to be seen, how this denial can be reconciled with the modal reductionism he seems to profess.

Thus, at the end of the selfsame chapter 15 of NE, Leibniz introduces a warning concerning exactly the alleged possibility of (intramundane) temporal vacua. Before considering it, however, we should observe that, as a matter of fact, the rejection of temporal vacua had already been attested some decades before in his writings.

The denial is already stated in the Paris Notes of 1676, where it is drawn from a version of the Plenitude Principle: "After due consideration I take as a principle the harmony of things; that is, that the greatest amount of essence that can exist, does exist… It follows from this principle that there is no vacuum among forms; also that there is no vacuum in place and time, as far as it is possible. From which it follows that there is no assignable time in which

[7] (Newton-Smith, 1980), p. 44

something did not exist." (A VI.3, 473, P 21-23). Still, the denial has here a rather uncertain status, insofar as it relies on a notion of plenitude which depends, in its turn, on a kind of (presumably contingent) principle of perfection, ruling our actual world. Most of all, it might figure as a rule designed to fill up some temporal container which is 'already there'.

In the later passage from the NE, instead, the conceivability of temporal vacua is challenged more radically: "Before leaving this topic, I would like to add a new comparison between time and place, beside those you have drawn yourself. If there were a vacuum in space (e.g. a void sphere), we could determine its magnitude; if there were a temporal vacuum, however – that is to say, a duration without changes – it would be impossible to determine its length. Hence, we can refute those who claim that two bodies, between which there is a vacuum, touch … But we could not refute those who claimed that two worlds, one after the other in time, touch as far as their duration is concerned, so that the one necessarily does begin when the other ceases to be, without any possible interval. I say that we could not confute them, because this interval could not be determined." (GP V 142).

This argument has an unmistakable verificationist flavour, which should not surprise us. A verificationist bent, indeed, is far from absent in Leibniz's epistemological and metaphysical reflection. By the way: this is a case where the alleged space-time parallelism – which Leibniz himself seems usually to subscribe to – fails to obtain.

No Time Before the World

But the main Leibnizian discussion on temporal vacua will concern the other case adumbrated in Locke's treatment – i.e., extramundane time, or time before the world's creation - and it will unfold in the context of that debate with Clarke, where Leibniz launches his most vigorous attack against temporal absolutism.

A good deal of the discussion bears, indeed, on the hypothetical situation of a time without change. The anti-absolutist arguments Leibniz advances in this scenario are an exemplary case for his claim that his prinicples of *Sufficient Reason* (PR) and of the *Identity of Indiscernibles* (IdInd) are able to give metaphysics the status of a demonstrative science.

Clarke had used the homogeneity of space and time as a premise to show that, in some circumstances, the mere will works perfectly as a sufficient reason: only God's will can explain His decision to move a system of matter from one position into another in space or time. In his reply, Leibniz promptly seizes the opportunity to overturn the significance of Clarke's example into a refutation of the absolutist view of space and time: "[Clarke] makes use of an example which falls exactly under one of my arguments against absolute space, which is the idol of some modern English thinkers." (GP VII 363)

Among Clarke's premises, Leibniz subscribes, notice, to the homogeneity requirement. As I have said, the structure of Leibnizian time, as such – i.e. as a mathematical object – **basically** shares the **topological** features of the time of the 'Englishmen'. **In particular**, time is a perfectly homogeneous quantity. That is to say, there is no difference – except in order – among the instants or intervals of time as such.

On the basis of homogeneity, however, taken together with the principle of sufficient reason (in his Leibnizian understanding[8]), Leibniz can overturn the sense of his interlocutor's conclusion: to change the location of some material object in space or time, without any other change, would amount for God to a violation of PR. Let me schematize:

(1) Time is homogeneous (premise P1: homogeneity)
(2) Time is a pre-existing absolute container (premise P2: absoluteness)
(3) God creates the world in time at the instant t_1 (Hyp)
(4) There is no reason for this action of God (why not having created it at t_2, with $t_2 < t_1$?)

But

(5) God cannot act without a reason (premise P3: Principle of reason – PR)

Therefore, conclusion (4) is unacceptable, and as a consequence hypothesis (3) is falsified.

Later on, Leibniz will present this *reductio* explicitly in the form of the old 'why not sooner?' argument, put forward by the adversaries of the doctrine of creation in time: if it is not possible to mark a privileged instant for creation, one should give up creation itself and be finally committed to the eternity of the world.

In order to block this outcome, according to Leibniz, one should give up, instead, the absoluteness clause (2). Thus, Clarke's argument has been overturned into a true *reductio ad absurdum* of the absolutist view: "his conclusion would be true, if time were something outside things in time, because it would be impossible to give any reason why things should have been associated with these instants rather than those. But this proves that instants are nothing outside things…" (GP VII 364).

Leibniz wants to substitute his view of space and time as 'orders'for the conception of a self-subsistent independent container 'being there' to be filled**;** he continues, indeed, with the positive statement: "they [sc. the instants] are, instead, nothing but the order of succession of things themselves…" (ibidem). Then, in the second part of his strategy, he can show that, on this new basis, the puzzling situation can (should) be simply dismissed as incoherent: "…and if it [sc. the order] remains the same, one of the two states – as is the case in the imagined anticipation – would not be different in any way, and could not be distinguished from the actual state." (ibidem).

The appeal to PR could work as an argument *ad hominem* against the hypothesis of creating something in a perfectly homogeneous time; but taking into account IdInd shows that the hypothesis is one we simply cannot make any sense of. As Leibniz explains in his following letter: "To pose two indiscernible things amounts to posing the same thing under two names. Thus, the hypothesis according to which the universe would have had at its beginning a different position in space and time as the one it actually received, and all its parts would have

[8] That is to say, a way of intending it, according to which mere will cannot figure as a good candidate to satisfy the claim for sufficient reason.

maintained, instead, the same position among themselves: all this is *an impossible fiction*." (GP VII 372).

The nature strictly *ad hominem* of the first battery of arguments is clearly acknowledged by Leibniz, who assimilates the arguments moving from hypothetical situations of purely numerical difference to the technical case of the mathematical proofs *per absurdum*, where a state of affairs is assumed, whose impossibility is finally demonstrated.

Thus, Leibniz's move works as a radical restatement of Augustine's solution to the why-not-sooner problem. The classic answer – according to which the beginning of the world does actually coincide with the beginning of time - turns out being now a matter of conceptual necessity.

A further, brief remark on homogeneity is in order. As purely abstract objects, space and time are not subjected to IdInd. Their falling outside the scope of this principle, however, is the mark of their being not real. Saying that they constitute a homogeneous plurality (something 'different without difference', as Hegel will say) only insofar as they are taken in abstraction, indicates that also their conceivability ultimately depends on their being grounded in some concrete discernible 'contents'. Far from being sufficient to ground the numerical difference of things, spaces and times themselves require these discernible things in order to be distinguished. The underlying intuition is that we cannot refer to and individuate spaces and times without relying on things and events located in them – the indistinguishability of the latter being, in its turn, excluded by IdInd. Hence the inconceivability of the 'fictions' at stake is easily concluded.

Anticipating Creation, again: Time and Possibility

So far so good. But what about the seeming justification of vacua in the NE with regard to space and time as orders of the possible? Leibniz's statement can be interpreted in a 'weak' sense: insofar as the order of places and times is independent of this or that thing – in this sense, it is not bound to the actual – the thought of a 'void' place or time can be explained, but not justified. In his last writing against Clarke, however, Leibniz feels the need of further clarification, taking into account the modal dimension of his definition of time. Thus, the problem re-opens: does this dimension – that is to say, the fact that *possibles* are taken into account – not go unavoidably beyond the boundaries of our actual world and its changes? Let us consider Leibniz's words in his Fifth Letter to Clarke: "As far as the issue is concerned, whether God could have created the world before He did, we should be clear: having shown that time, without things, is a simple ideal possibility, it is clear that, if someone said that the same world which has been actually created could have, without any change, been created before, then he/she will not be saying anything sensible." (GP VII 404-405). And this is the point we are already familiar with: taken in this way, the hypothesis of anticipated creation simply makes no sense, being equivalent to the incoherent idea of a 'change without change'.

But there is a second way of understanding the possibility of anticipated creation, which cannot be dismissed as easily: "Absolutely speaking, however, one can well conceive that a universe began earlier than it actually did." (GP VII 405) This is the case, when one imagines

that other events, or things, have been created: "This is because, the things being increased, time will be increased in its turn." (Ibidem).

Ultimately, however, also this hypothesis turns out to be untenable – though for a different kind of impossibility: "Whether such an increase, however, is reasonable and matches with divine wisdom – this is quite another issue; and we should answer negatively, otherwise God would have made it." (Ibidem)

We should carefully evaluate the full import of this apparently hasty Leibnizian clause. First of all, it is clear that the extending of the time system outside the boundaries of our actual world depends entirely on the corresponding extending of the history system. But the further point is that the last operation is – within the framework of Leibniz's metaphysics of possible worlds – not possible, as a matter of fact and in principle. We know, indeed, that a possible world (*each* possible world, the actual one included, of course) is, by definition, a *maximal* set of compossible substances with their respective and interrelated states. And no further addition can be made to a maximal set, on pain of contradiction. Accordingly, a (relativized) principle of plenitude holds within each possible world: all which is possible relatively to its inhabitants is included in the world itself.

A similar point is made in the correspondence with Bourguet of the same years[9]. Here also, notice, this topological property of time – having or not having a beginning, i.e. a first instant – is not discussed by considering the time system in itself. Thus, time before the world is not considered, properly. What is at stake, instead, is the infinite or finite extension of the 'history system', in our jargon; or of the *series rerum*, in Leibniz's. This goes as far as to make metaphysical considerations concerning the content in perfection of our world decisive, in order to take either one or the other side of the alternative: if the perfection of our world is steadily increasing, then, at least according to a certain increase scheme, it is likely that there is a first stage, hence also a first instant in the temporal series. To see this type of argument in detail would require taking into account the other great aspect of the concept of time – I mean, order – and thus I stop here. For now, it suffices to confirm that the property of the temporal series at stake depends, in Leibniz's view, on the related property of the history series.

Anyway, faced with this conclusion, one might reply: well, possible times cannot be conceived of through the (possible) implementation of the actual world, but they can, by considering a quite different alternative possible world. This is true, but it shows exactly that the idea of an earlier beginning of the actual world, making sense of time outside the created world (but the point holds also for each possible world - would be an inappropriate one, and should be spelt out, instead, in terms of the possibility of another world.

Moreover, there is no comparison to be made among the times of different possible worlds. That is to say, it makes no sense to talk about possible events happening before, or after, events in our world. It is interesting to dwell a bit on this aspect, which has important connections both with Leibniz's mature theory of time and the working out of his view of possible worlds. Moreover, it can introduce us to the other aspect of the relationship of time to contradiction

[9] See GP III 581-582.

Interlude: *Unconnected times?*

In the *Initia rerum mathematicarum metaphysica*, contemporaneous with the Clarke correspondence, we can find the sketch of a theory of time in a quasi-axiomatic form. Leibniz makes explicit here a postulate of connectedness. According to this, every state of a world must be either simultaneous with, or before, or after each other state of the same world.

This systematization – which is already documented in several drafts from the Eighties on – formally expresses, of course, our fundamental intuition concerning the temporal unity of a world. But the negative side of this intuition is also bound with an idea lying at the origins of Leibniz's conception of possible worlds. In the intensive experimental working out of a metaphysical view during the Seventies – as is reflected especially in the so-called *Paris Notes* – Leibniz is concerned, among other things, with the principle of plenitude. As I have shown above, a version of it is occasionally even invoked by him, in this context, to deny temporal vacua. But on the whole, he looks for a way out of the undesired modal consequences of it – when the scope of the possible is narrowed to what happens or exists before or after in time. As is well known, indeed, to maintain the possibility of things and events which have no place in the history of our world is taken by Leibniz as a decisive step toward breaking with bad plenitude and the related fatalism, to rescue contingency. A kind of plenitude remains within the actual world, still excluding any temporal vacua. Other things are possible, however, and their extrusion from the sphere of the actual is the seed for the constitution of Leibniz's possible worlds. A crucial step in this move – what distinguishes them from the plurality of the Epicurean or Stoic worlds[10] - is the breaking of every spatio-temporal (and causal) connection with the actual world itself.

Interestingly enough, this move is sometimes seen from the point of view of a phenomenistic approach, where the notion of reality is tentatively reconstructed in terms of the coherence of our perceptions. Thus, in some suggestive 1676 drafts, the real world and the dreamt-of ones are distinguished as different coherent sets of perceptions, each having its own space – and the remark can well be extended to time.

At this point, it is tempting to think of Leibniz's possible worlds as each having its own spatial and temporal structure, unconnected with the others. I think, however, that this suggestion should be taken with care, and ultimately resisted. First of all, we should take care to avoid a Lewisian-style reading, which would directly contrast with Leibniz's intention in introducing his possible worlds. They are not only spatio-temporally (and causally) unconnected; or better, they are such because, first and foremost, all possible worlds on the one hand, and the actual one on the other, do not share the same ontological status. Leibniz, indeed, takes care to exclude the possibility of attributing any form of existence to the worlds different from the actual one. In a draft of December, 1676 we read: "There is no need for the multitude of things to be increased by a plurality of worlds; for there is no number of things

[10] The worlds of the Stoics follow one another in time, in tune with their well-known view of cyclical time. Leibniz is also concerned with this view. See (Fichant, 1991).

which is not in this world… To introduce another genus of existing things, and as it were another world which is also infinite, is to abuse the name of existence; for it cannot be said whether those things exist now or not. But existence, as it is conceived by us, involves a certain determinate time; or, we say that that thing exists of which it can be said at some certain moment of time, 'That thing now exists.'" (A VI.3, 581, P 103-105). Thus, a thing having no common temporal measure with actual things simply does not exist. Nor is there any common 'super-space' or 'super-time', ideally embracing the special spaces and times.

Moreover, I have already stressed Leibniz's attribution to the spatial and temporal structure of the status of eternal truths. And this certainly means that it holds in all possible worlds[11]. Accordingly, the attempt at distinguishing the ***concept*** of time (one and the same across different possible worlds) on the one hand, and the different possible spaces and times on the other[12], is doomed to failure, if it is meant to suggest that every concrete time is different from the others.

Time, on the contrary, as a wholly abstract structure, is simply the same for all worlds. In one sense, we might say that the times of different worlds are unconnected not because these worlds are located in different times, but just because they are supposed to occupy the same time[13]. And this is why Leibniz sometimes goes as far as to speak as if space and time were containers of a given capacity, which different sets of compossibles fight to occupy – which might give the wrong impression that he is assuming an absolutist view.

Anyway, space and time are deeply bound to the central notion of compossibility, and to its puzzling constitution. To better see this, we should now turn to the relationship between time and contradiction.

2. NO CHANGE WITHOUT TIME. TIME, CHANGE AND CONTRADICTION

An abstract model for Change

Change is something basic for time; it is required in order to have time, as we have seen. Change in its turn implies contradiction. This fundamental aspect emerges when Leibniz applies himself to a philosophical analysis of this pervasive phenomenon. An important stage in this reflection is the dialogue *Pacidius Philalethi*, written by Leibniz in 1676 in a ship, crossing from England to Holland. It is devoted to the problems of motion, starting from Zeno's aporias; it represents, indeed, a milestone in Leibniz's handling of the continuum issue. Leibniz finds here a way out of this intractable problem, by attributing a discrete character to motion. According to Pacidius – his counterpart in the dialogue – a moving body is destroyed and recreated at every instant of its motion.

Now, this odd solution is confined to this stage of the development of Leibniz's physics, and it will be presumably abandoned not much later. Pacidius' analysis, however, goes beyond

[11] Thus, geometry, hence the properties of space holds for Leibniz in all possible worlds.
[12] See on this (Rescher, 1981).
[13] There is however, I think, some objective tension between this intuition on one hand, and the idea of defining simultaneity,as a basic temporal notion, through compossibility on the other.

physical motion, to provide a definition of change in general. Ultimately, change is conceived of as the passage from a state A to its contradictory not-A. Therefore, by applying the principles of Non-Contradiction and of the Excluded Middle, Leibniz simply excludes the possibility of the instant of change. As a consequence, change turns out to be not a state, but the aggregate of two immediately close contradictory states – a situation that can be captured by the Aristotelian model of the 'contiguous'[14].

It is worth noting that the general definition of change worked out in the *Pacidius* will survive its specific application to spatial motion and the related idiosyncratic thesis of 'transcreation'. We find it anew at the beginning of the suggestive psychological study *De affectibus*, of 1679, where 'change' is taken as the genus to which both action and passion – the two fundamental notions in ethico-psychological inquiry – belong: "Change is the aggregate of two contradictory states." (A VI.4, 1411). And in a draft dated to the same year – hence, when Leibniz has abandoned the physics of the *Pacidius* – we read: "An attribute is either a state or a change. Although, to be true, a change is the aggregate of two opposite states at the same time [*in uno temporis tractu*], without any moment where change occurs, as I have shown in a dialogue." (*Definitiones*, A VI.4, 307). Moreover, this appears again and again as the standard definition in several later drafts, devoted to a kind of categorial inquiry: "*Mutatio est aggregatum duorum statuum contradictoriorum*".

The discrete character of this model is likely to appear difficult to reconcile with the emphasis constantly put by Leibniz on continuity in nature, and with the continuous character he is normally eager to acknowledge to time itself. Here, I do not want to enter into the intricacies of the continuum problem, with respect to the different layers of reality. Two general remarks are in order, however. Firstly, time, indeed, as a theoretical construction – as a mathematical object – does possess a certain topological micro-structure: beyond any doubt, at least for the 'mature' Leibniz, time is a continuum. This matches well exactly with its ontological status of 'ideal thing'. Hence, we should accurately distinguish this structure of time *qua* abstract tool from the possibly or supposedly discrete character of things in time.

Interestingly enough, von Wright himself – when construing a 'Tractarian' model of the world, very close to Leibniz's series rerum – is not far from a kindred view. Thus, he writes, concerning the continuity we attribute to physical processes, in contrast to the discrete model of the series-of-states: "This highly sophisticated and complex conception and its relation to reality is not easy to determine. The idea of continuity can perhaps be called an 'idealization' smoothing the rough surface of reality"[15].

Secondly, we should realize, I think, that also this representation of changing things is to a large extent still an abstract one. In this type of categorial inquiry, in fact, Leibniz is moving at the level of an abstract model of '*series rerum*': a quite general logico-ontological framework – exactly, a *model* - which can be applied, in principle, to both the phenomenal and the properly metaphysical level, leaving unexplored the differences between them. In any case, it is within

[14] See *Pacidius Philalethi*, A VI.3, 534-537.
[15] (Von Wright, 1971), p. 46-47.

this abstract model of the discrete succession of states that Leibniz goes on to think of the relationship between contradiction and time.

Time as the Way Out of Contradiction

One of the most relevant categorial drafts of the Eighties – the *Divisio terminorum* - presents an interesting approach to the problem of change. On the whole, this text is an outstanding example of Leibniz's double approach to categorial analysis, to which I hinted above: moving from a kind of phenomenological inquiry, rooted in the life of the mind, on the one hand, and from a more abstract logico-linguistic analysis on the other.

Here, indeed, the model of the series-of-states, and change itself, are introduced in a sort of phenomenological style: "Then, we observe Novelty and Change, that is to say [we observe] contradictory attributes of the selfsame thing. E. g., things which are contiguous come to be separated one from another, while all their remaining properties remain, contact being excepted. And this is why we are more inclined to think that the same things become separate from being contiguous, and others separated are substituted for them." (A VI.4, 561-562).

Change does imply sameness – and contradiction also. Observation, by itself, exhibits, however, only a series of states. Acknowledging sameness is presented as a further interpretative option – and not one going without saying. In the following, indeed, Leibniz goes on to discuss, whether it makes more sense to conceive of the permanence of the same thing, or of admitting, rather, a succession of different things, according to the old *transproductio* model. And the solution, notice, is to be found on the terrain of the life of mind: it is the experience of self-awareness, in fact, which guarantees sameness. But I cannot dwell here on this highly interesting issue. I shall instead focus my attention on what immediately follows.

Contradiction, I have said, properly arises only if there is a true identity of a subject, and not a series of *entia successiva*. Thus, if we are ready, as Leibniz is, to assert true sameness, we are faced with an apparent violation of the IndId, hence with contradiction. Here, temporal difference comes to play its decisive role: "Now, given that it is impossible that two quite contradictory predicates are said of the same thing, that difference which alone holds, all the rest being unchanged, and thus makes true that there is not a plain contradiction, when the same thing is said to be contiguous and separate from another: this is the temporal difference." (A VI.4, 562).

In a probably close draft, the *Enumeratio terminorum simpliciorum* – an exemplary one for categorial inquiry – we read: "If two propositions are true, and they seem to be contradictory, except for one difference alone, which can be recognized with respect to something external: then, these propositions do differ as for time" (A VI.4, 390). Here, *propositions* are explicitly in view. Notice Leibniz's precision: they are not contradictory, but only *appear* to be so. Or better, they would appear as such, unless for the temporal difference they embody. In order to neutralize, *caeteris paribus*, the contradiction implied by predication (A and not-A), temporal difference should be clearly located on another level with respect to the other predicates, or differences. The precision that this difference can be known only with respect to some external

thing is an unmistakable clue that we have to do with a predicate in the category of Position. I shall return below to this nature of temporal difference and its role in blocking contradiction.

Simultaneity and Compossibility

Certainly, the dimension of time turns out to be a powerful factor for the increase of the logical space of compossibility, hence for the structuring of a world. Already at the beginning of the Seventies we find this remark: "*Compatible* are those which can exist at the same time in some common place. *Compossible* are those which, once one of them is given, it does not follow that the other is destroyed, that is to say, those of which one is possible, the other being assumed. E,g. it is possible that an Eclypse happened nineteen years ago, and a similar one happens now. But it is not possible that one happened nine years ago, and a similar one happens now. Those two Eclypses, however, though being compossible, are not compatible, because they cannot happen at the same time. Compatibility, therefore, is among things, compossibility among propositions." (*Vorarbeiten zur Characteristica universalis*, A II,2, 498)

Compatible things are defined here as those which exist (can exist) in the same time. When Leibniz later on defines simultaneity, however, no mention is usually made of time. Simultaneity, instead, is simply defined through compatibility, i.e. the logical possibility of being-together; sometimes also, and more strongly, through reciprocal implication. In this way, Leibniz gets, through purely logical means, the characterization of a single time-slice, so that simultaneity appears as the fundamental temporal notion[16]: although, as a matter of fact, in the categorial tables Leibniz prefers to speak of time only when succession is involved. All this is in tune with his prevailing attitude to reducing somehow temporal concepts to some more basic relationships.

Here, however, I wish to call attention to the distinction traced between compatibility and compossibility, Admittedly, this terminological distinction will be left aside later. Anyway, it shows the emergence of an important conceptual shift. Temporal difference – insofar as it creates a logical space where it is possible to distribute contradiction - allows for arriving at the wider notion of compossibility.

The operation is complementary (or better preliminary) to the one which I have taken account of in the previous section, concerning the structuring of the model of possible worlds. Temporal difference allows for expanding a compatibility slice to a whole series of states, according to a maximization rule. What lies outside the resulting series – hence, outside this extended compatibility set (or more exactly, if one should insist on the terminological distinction above, compossibility) – cannot find its place in any time, and goes to constitute the alternative possible worlds. In the example, notice, the two compossible eclypses – i.e. two phenomena which are part of the same world, while occurring at different times – might not occur at different times, because they belong to a certain law-like order.

[16] See for this point, and for Leibniz's sketched quasi-axiomatic theory of time, (Arthur, 1985), one of the best available accounts on Leibniz's theory of time, in general.

Our text from the Seventies also reserved the terminology of 'compossibility' to propositions. Maybe, we could talk of states-of-affairs, to translate Leibniz's intuition into our jargon. Thus, a Leibnizian possible world necessarily presents itself as a series of states: that is to say, it possesses a temporal structure. At the level of his categorial analysis, a kind of formal ontological inquiry, Leibniz uses these building blocks to construct a model of a world which is, in itself, still neutral with respect to the more specific interpretations it can receive. Thus, the relationships of compatibility/simultaneity and causality/succession which structure it can be read differently: either according to a phenomenal interpretation, where real inter-substantial causality is admitted, or to a rigorous metaphysical one, having no room for it. In the second **reading**, the postulate of connectedness suffices to have a coherent image of a world according to Leibniz's 'metaphysical strength', i.e. assuming only intra-monadic causality, and the different simultaneity slices corresponding to inter-monadic simultaneity relations.
Finally, the temporal character of each possible world in no way contrasts with Leibniz's emphasis on the link of time (and space) with existence. As we shall see immediately, a world is a set of (possible) interrelated individuals, and having spatio-temporal positions is an important feature for individuals, in order to distinguish them from (possible) abstract or general essences.

Time, Substance and Concept

Later on, also the terminology of compossibility will be commonly used in a looser way by Leibniz, to refer both to things (individuals) and to propositions. The opposition is not so dramatic for Leibniz, however. As a matter of fact, indeed, Leibniz's 'states' should always be taken as states-of-a-substance. Remember that, without assuming the sameness of a subject, we would not even have any contradiction, nor any true change, but only a succession of more or less similar states.

Now, the idea of substance as a continuant underlying change was also a venerable one, going back to Aristotle's legacy. In *Categories* 5, substance was presented as a 'power of contraries', i.e. as something of which contradictory statements can be true. In Aristotle's model, the sameness of substance is thought of as the permanence of a substratum, on the model of the role played in change by matter.

Leibniz, on the contrary, tries to give a new reading of the transtemporal sameness of substance, by grounding it on the unity of a concept which dominates and rules the whole temporal unfolding of an individual. This transtemporal dimension turns out to be one of the central intuitions that gave rise to his theory of the individual concept. In the *Notationes Generales* - a draft very close to the 1686 *Discourse* - we read: "The same thing can subsist, even if changed, if from its very nature it follows that the same should have different states successively. I am said to be the same, insofar as my substance involves all my states, be they past or present or future. And it does not matter that thus contradictory predicates are referred to me; this is, indeed, the very nature of time, that contradictory predicates can be true of the same thing according to different times." (A VI.4, 556)

Leibniz's line of thought seems to be this: the nature of an individual thing, expressed by its concept, implies change, that is to say the successive unfolding of predicates which cannot coexist. But change does not violate IndId, insofar as predicates are relativized to times, and time is, by definition, what allows **contradiction to be neutralized.** This is the idea we are already familiar with, and which is now put at the core of the logico-ontological structure of the individual substance.

Concluding Remarks. Contradiction and the Priority of Change

We should consider a bit closer the way in which temporal difference neutralizes contradiction – an assumption we have so far taken for granted, to a large extent. In order to do this, a closer look into the nature of temporal determinations would be required. I have said that they belong to the category of Position. The existence of the whole thing, or its properties, are located at different times. But what is modified, exactly, by those determinations? If one tries to give them a place in Leibniz's analysis of proposition, one might be uncertain between the adverbial reading and the adjectival one. I suspect that the first corresponds more to Leibniz's intention. Only, if we combine this analysis with the properly categorial one, the adverbial modification turns out not to refer to some 'quality' of existence, but rather to some location it receives – analogously to the adverbs of place.

Remember, however, that in Leibniz's reductionist view, positions are not a system independent of their 'contents'. This means that temporal difference presupposes, and is based on, the discernibility among the states of substance and their order.

This is why, considering temporal difference as what allows us to think of change does not imply, in Leibniz's view, any ontological priority of time over change, as is the case in von Wright, or in Kant. On the contrary, time appears as the phenomenon of the underlying logico-ontological structure of change. The sameness of the subject is presupposed by contradiction; taken together, they give rise to change, which in turn produces temporal difference. At least, this is, the picture we can draw from Leibniz's categorial schemes. I say 'phenomenon' because sometimes Leibniz exploits the connection of time and perception and seems actually to think of temporal order as the phenomenal expression of the logico-ontological underlying structure: "[Of two things] Prior is what is conceived of in a simpler way than the other. If, then, we add the relation to existence, or perception, it becomes prior by time." (AVI.4, 873)

From the point of view of a theory of time, this is a highly controversial view, of course. One might ask whether change can be actually conceived of, unless we previously assume the concept of time taken in the sense of the A-series. As I have hinted above, Leibniz himself seems to presuppose, in his inquiry about those logico-ontological structures, some primitive experience of the temporal life of the mind. In his final categorial scheme, however, the *explanans* of the temporal dimension turns out to be entirely articulated in terms of the B-series, implemented with causal relation. This can be palatable for present-day tenseless theories, but it does not cease to be a highly controversial issue. Anyway, all this should be the theme of another wider study.

ABBREVIATIONS

A = G. W. Leibniz, *Sämtliche Werke*, Ajademie-Ausgabe, Berlin 1923-; series, volume and page.

GP = G. W. Leibniz, *Die philosophischen Schriften*, ed, by C. I. Gerhardt, Berlin, 1875-1890. Repr. Hildesheim – New York, OLMS, 2008; volume and page.

NE = G. W. Leibniz, *Nouveaux Essais sur l'entendement humain* (ed. in GP V and A VI.6).

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Dust and Time:
On Relativity Theory and the Reality of Time

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The only reason for time
is so that everything does not happen at once
(A.Einstein)

ABSTRACT

In this paper Godel's argument for the unreality of time is reconstructedusing the modern language of four dimensional spacetime geometry. It is argued that, as it stands, the argument cries for an interpretation. Three tentative ones are proposed, based on different modal or epistemic considerations. None of them is found entirely satisfactory, but each of them has its own strenghts. The natural conclusion is that even if the original thesis of the unreality of time is far too strong to be supported by Godel's argument, it enlighens deep and important features of time in relativistic spacetimes.

It is often claimed that Relativity theory, both the special and the general[1], have refuted Kant's trascendental idealism. (Gödel, 1949a) is a notable exception. In this short, beautiful and rather mysterious work Gödel in fact argues that relativity theory support the kantian thesis[2] of the ideality of time, i.e *the ontological thesis that time in itself is unreal.* In what follows I will address exactly this question: the relation between relativity theory and the reality of time as understood by Gödel. The structure of the paper is rather simple. In section 1 I will reconstruct[3] Gödel's original argument. From this reconstruction it will be clear that the argument cries for an interpretation. The following sections will be devoted then to such tentative interpretations[4]. I will group them under two headings, the *modal interpretation* and

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[1] STR and GTR respectively from now on.

[2] We need to be more precise. In the first critique Kant argues for the empirical reality and trascendental ideality of space and time. The trascendental ideality of time is purported to show that time is just a form of our intuition, i.e time in itself is not real. This is what is meant by Gödel when he talks about the ideality of time. However unreality and ideality are two ontological distinct thesis in the original kantian framework. It is not possible to spend too much time on these niceties here. Since the paper will deal with Gödel's understanding of this question they will be leaved aside, and we will think about ideality as *just* an unreality thesis.

[3] My analysis will be a reconstruction rather than a simple presentation. I will, for example, recast the original argument in more modern terms.

[4] I will try to construct the more robust interpretations I can think of. For this reason they will be close but different from the ones found in literature.

the *epistemic interpretation* that will be addressed in section 2 and 3 respectively[5]. Finally in section 4 I will give some conclusive remarks.

1. GÖDEL'S ARGUMENT FOR THE UNREALITY OF TIME

Gödel's argument has an elegant structure. It can be reconstructed along the following lines.

1.1 Preliminary. A necessary condition that has to be met in order to conclude that time is real is singled out.

1.2 Argument from STR. Time as described by STR can not meet the requirement in i), therefore time in STR is not real.

1.3 Argument from general solutions to Einstein's field equations[6] *in GTR*. The argument from STR in ii) can be overcome passing to cosmological models that represent general solutions to EFE.

1.4 Argument from new solutions to EFE. There exist different cosmological solutions to EFE where the necessary requirement singled out in i) can not be met. Therefore, as in ii), time in these models is not real.

1.5 The step. Different cosmological models in iii) and iv) differ only for contingent non lawlike features. Since these new models represent physical possibilities time is not real in all of the possible models allowed by the theory.

I now turn to give a detailed analysis step by step.

1.1 PRELIMINARY. A NECESSARY CONDITION FOR THE REALITY OF TIME

If Time is real change is real[7]. And change becomes possible only trough an *objective lapse of time*. The existence of an objective lapse of time is equivalent to the fact that *reality consists of an infinity of layers of now which comes into existence successively*[8]. Here Gödel singles out an informal criterion[9] time has to meet in order to be real. The task is to formulate such a

[5] I will leave aside another tentative interpretation, namely the symmetry interpretation, due to Gordon Belot. This is a very fascinating suggestion indeed, but as Belot himself points out, read in this way Gödel's argument does not cut really deep. I think that this is not what Gödel's himself had in mind but I personally consider it a very interesting starting point for a new argument altogether. See (Belot, 2005).

[6] EFE from now on.

[7] This premise is not explicit in (Gödel, 1949a) but it is in the preliminary drafts, namely ((Gödel, 1946-49), b2-c1). As far as I know Gödel has never questioned its validity.

[8] Note that this picture is almost verbatim the picture of a growing block derived from Broadian notion of Becoming, i.e it is not an A-theoretic notion as described by McTaggart's A series. The identification of lapse of time with the image of a growing block is again never questioned by Gödel.

[9] Naturally this criterion can be questioned. However it is not completely arbitrary. There are good reasons to adopt it, derived in particular from McTaggart's argument and from the arguments in the

criterion in the formal language of relativity theory. It is this task that I take up now. A brief construction of a hierarchy of topological, metrical, and temporal[10] conditions is needed.

A *relativistic spacetime is a pair* <M, g_{ab}> where M is a *n-dimensional differentiable manifold* and g_{ab} is *a Lorentz signature metric*, i.e a signature (1,n-1)[11], defined on all of M. This is the most general geometric structure GTR assigns to the world. In the limiting case of vanishing gravitational fields we have Minkowski spacetime <M, η_{ab}> where η_{ab} is the so called Minkowski tensor that assigns a flat non euclidean geometry to M. Minkowski spacetime is the geometric structure STR assigns to the world instead[12].

<M,g_{ab}> is said to be *temporally orientable* iff it admits a global time sense, i.e a possible way to distinguish locally between a future and a past direction at every point p $\in$ M. A sufficient condition for temporal orientability is the existence of a non vanishing timelike vector field on M, i.e an assignment of a vector μ to each point in M such that $\mu^a\mu_a > 0$[13]. It is a basic lemma that for any <M, g_{ab}> where M is simply connected than <M,g_{ab}> is temporally orientable.

Let <M,g_{ab}> be a temporally orientable spacetime. Choose one of the two possible orientation as giving the future direction of time[14]. Then for every p, q $\in$ M , *p chronologically precedes q,* written formally as p << q, iff there is a future directed timelike curve from p to q. The chronological past of p is I^- (p) : ={q $\in$ M : q << p}[15]. Again it is a basic lemma that << is a *transitive* relation. We require that << is also *irreflexive*, i.e for every p $\in$ M $\neg$ (p<<p), then <M,$g_{ab,}$ $\uparrow$> is said to have a *time order*[16]. Now everything is in place to recast Gödel's informal criterion into the formal language of relativity theory[17].

Let $\lambda : I \rightarrow M$, where I is an arbitrary interval, be a smooth timelike curve and consider the tangent space T_p at a point p $\in \lambda$. Let H_p be the three dimensional spacelike submanifold

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metaphysical exposition of the concept of time in Kant's first critique. It is not possible to deal with these niceties here.

[10] This hierarchy of conditions can be pushed further adding *causal* conditions.

[11] I adopt the sign convention (+, -,-,-). The Lorentzian metric induces the famous classification of vectors into timelike, spacelike and null.

[12] The problem of conventionality of metrical geometry is neglected. A necessary and sufficient condition for M to admit a Lorentzian metric is the existence of a non vanishing line element field on M. There are certain topological properties M have to satisfy in order to define such line element field. Any non-compact M will do but not every compact M will do. For example in the case of dim (M) =2 and signature (1,1) a sphere will not do.

[13] Here $\mu^a\mu_a = \mu^1\mu^1 - \mu^2\mu^2 - \mu^3\mu^3 - \mu^4\mu^4$ and naturally dim (M) = 4. The so called Einstein's summation convention is used.

[14] At this level this is a pure conventional choice. The argument developed later in the section depends crucially on time orientability, i.e on the possibility of distinguishing past and future directions but it does not hinge upon the choice of such a distinction as the one corresponding to the one that obtains, if at all, in the world. I will write a temporally oriented spacetime as <M, g_{ab}, $\uparrow$>.

[15] The chronological future is defined analogously.

[16] If << is *reflexive* then <M,g_{ab}> is said to be *chronologically vicious*.

[17] Note that it has been talked only of a time order and not of time coordinates. It will not be difficult however to do so.

orthogonal to T_p[18]. H_p is the M-submanifold that contains simultaneous events. It is then natural to identify the "layers of now" of Gödel's informal criterion with the different spacelike hypersurfaces orthogonal to the tangent space at a point. Consider now two different hypersurfaces at two different points p_1 and p_2. According to Gödel's informal criterion they have to "come into existence successively". It is easy to recast this requirement using the formal language developed above. H_{p2} comes into existence successively to H_{p1} iff $p_1 << p_2$ for every p_1 and p_2 belonging respectively to H_{p1} and H_{p2}. Moreover this coming successively into existence has to represent the *objective lapse of time*.

Let then t: M → R be a differentiable map assigning time coordinates to events in M in such a way that $t_{(p1)} < t_{(p2)}$ iff H_{p2} comes into existence successively to H_{p1}. The differentiable map just defined is called a *global time function*. To represent an objective lapse of time we impose two different requirements, i) that it has to be invariant under the symmetries of the $<M, g_{ab}>$ considered and ii) that if two different global time function are defined they agree on the relations of temporal succession assigned. We can make these assertion precise: Here's a formulation for both:

i) Let $\varphi : M \rightarrow M$ be an isometry[19] of $<M,g_{ab}>$. We require that if $t_{(p1)} < t_{(p2)}$, then $t_{\varphi(p1)} < t_{\varphi(p2)}$.
ii) Let t and t' be two different maps t,t': M → R defined using different hypersurfaces. Then for every p_1 and p_2 such that $t_{(p1)} < t_{(p2)}$ we have $t'_{(p1)} < t'_{(p2)}$.

The construction of this global time function seems to capture Gödel's informal criterion for the reality of time. In fact it can be used to represent an objective lapse of time and it encodes the fact that reality consists of layers of now that come into existence successively. Thus the result of the argument above can be stated easily. The *possibility of defining a global time function on* $<M,g_{ab},\uparrow>$ that is invariant under the symmetries of the cosmological model into consideration *is a necessary condition for the reality of time.*

1.2 THE ARGUMENT FROM STR

Framed this way the question becomes quite straightforward. Is it possible to define a global time function on Minkowski spacetime that is invariant under its symmetries? The answer is no. Let me give first an informal argument following Gödel's own[20]. The well known result of relativity of simultaneity imply that a foliation of Minkowski spacetime into spacelike hypersurfaces of simultaneity is observer dependent, i.e different hypersurfaces are singled

[18] It is easy to prove that it has to be spacelike, i.e for every $\mu \in H_p$, $\mu^a\mu_a < 0$.
[19] An isometry is a symmetry that preserves the metric structure.
[20] In (Gödel, 1949a) the argument from STR is just three lines: "But if simultaneity is something relative (...) reality can not be split up into such layers in an objectively determined way. Each observer has his own set of "nows", and none of these various systems of layers can claim the prerogative of representing the objective lapse of Time".

out by different non parallel timelike lines[21]. Since we have identified these hypersurfaces of simultaneity with the layers of now this result amounts to say that every observer has her own set of "now". Moreover, due to the relativity principle that establishes the equivalence of every observer, there is no way to regard some of the hypersurfaces of simultaneity as representing the objective lapse of time over some others.

Let me give a more formal argument.

Let L, L' be two frames, i.e some collection of maximal timelike parallel lines[22] in Minkowski time oriented spacetime $<M,\eta_{ab,}\uparrow>$[23] and let L_1 and $L_{1'}$ be two timelike lines belonging to L and L' respectively that intersect at p. It is a basic fact of Minkowski spacetime that the hypersurfaces of simultaneity at p relative to L_1 and $L_{1'}$, call them H_{p1} and $H_{p1'}$, will be different. Use the different hypersurfaces to construct two different differentiable maps t and t' respectively according to the procedure described in 1.1.

Now the problem is to see whether t and t' meet i) and ii). Temporal orientability becomes crucial in Minkowski spacetime at this stage of the argument. It in fact guarantees that both t and t' meet 1)[24]. Thus they are serious candidate to represent the objective lapse of time. The serious problem arise with ii). It is in fact always possible to find a point $q \in M$[25] such that $t_{(p)} < t_{(q)}$ but $t'_{(q)} < t'_{(p)}$. This does not settle the question by itself. It can be in fact argued that even if both t and t' meet requirement i) it is possible to single out one of them as the one representing the true objective lapse of time in terms of the geometric structure of Minkowski spacetime. And here's the last step. There is always an isometry $\varphi : M \rightarrow M$ that maps L_1 into L_1'.[26] This means that it is not possible to single out a timelike line as a privileged one in geometric terms. Thus it is not possible to define an *invariant global*[27] *time function* over $<M,\eta_{ab,}\uparrow>$. According to the argument in 1.1 then *Time, as described by STR, is not real*.[28]

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[21] These curves model the worldlines of possible observers.

[22] I'm using lines instead of curves for sake of simplicity. The argument will go trough anyway dealing with timelike curves but we will have to take into consideration the tangent space at every point and the spacelike submanifold orthogonal to that space.

[23] The arrow stands for a timelike vector field defined over M in order to distinguish past and future direction. Minkowski spacetime is always time orientable, i.e such a vector field is always definable. This will play a crucial role at a certain stage of my argument. Time orientability will fail in several general relativistic spacetimes but not in the ones I will deal with in the paper.

[24] Temporal orientability becomes crucial here because otherwise a map φ: M → M that is a reflection about an orthogonal subspace of an arbitrary timelike line will be an isometry of the not time oriented Minkowski spacetime. Then let p and q be two points such that p<<q. By our construction it has to be the case that $t_{(p)} < t_{(q)}$. But it is always possible to find an isometry of the type described above such that it leaves p fixed and maps q to q', i.e $\varphi(p) = p$ and $\varphi(q) = q'$, such that $t_{(q')} < t_{(p)}$. Hence the global time function t will not be invariant under the symmetries of the spacetime considered.

[25] It has to be spacelike separated from p.

[26] This is a way to capture nicely in terms of the four dimensional minkowskian geometry the *relativity principle*.

[27] In fact only a partial time ordering that is invariant under the symmetries of Minkowski spacetime can be defined, namely for timelike separated points.

[28] Note that this is due to the very geometric structure of Minkowski spacetime. According to the argument in 1.1) if the world would have been newtonian then Time would have been real. The reader is urged to find an argument herself. As an hint consider the fact that simultaneity hypersurfaces are not

1.3 THE ARGUMENT FROM GENERAL SOLUTIONS TO EFE IN GTR.

Suppose we define a new structure over $<M,\eta_{ab,}\uparrow>$, namely a congruence C of inertial timelike curves[29]. This structure would define over Minkowski spacetime a privileged inertial worldline through each spacetime point. We call $<M,\eta_{ab},\uparrow,C>$ augmented Minkowski spacetime. It would be possible to take the family of spacelike hypersurfaces everywhere orthogonal to C which is transverse, i.e every hypersurface intersects each inertial worldline exactly once. We could use this family of hypersurfaces to define a global time function t as described in 1.1. It can be proved that this function is the only one that is invariant under the symmetries of the augmented Minkowski spacetime. According to the argument in 1.1 Time in $<M,\eta_{ab},\uparrow,C>$ would then be real.[30] Gödel himself hinted at this possibility in a footnote. The problem is the definition of C is contrary to the spirit itself of STR since it amounts to reintroduce a privileged reference frame[31].

But consider now a general solutions to EFE in GTR. Or better, consider the so called dust[32] solutions in which spacetime is filled with dust motes representing galaxies in free fall motion, i.e the only force acting on dust motes is given by the gravitational field. A solution to dust cosmologies is given by a spacetime manifold M, a spacetime geometry encoded by the metric tensor g_{ab}, and a function describing the dust density at each point and a congruence C' of timelike geodesics representing the dust motes of the galaxies. It is possible to prove that the last two structures can be reconstructed in terms of the components of the metric tensor g_{ab} alone. It seems then that the geometry of some general relativistic spacetimes itself provides the additional structure[33] needed to run the argument given for the augment Minkowski spacetime. It will be only necessary to replace the congruence C of inertial timelike lines with the congruence C' of dust worldlines and then proceed geometrically to construct the family of spacelike hypersurfaces orthogonal to the tangent vector field of the dust worldlines at every point and then define an invariant global time function over $<M, g_{ab}>$. We just need to check if the global time function defined geometrically is furthermore invariant under the symmetries of the cosmological model considered, since these symmetries usually differ from the symmetries of the augmented Minkowski spacetime. But a general solution to EFE *usually*

singled out by the orthogonality criterion. An interesting objection to this line of thought is considered by Gödel himself in a footnote. I will deal with it section 2.2).

[29] We use curves instead of lines since it will be easier to generalize the result to general relativistic spacetimes. Strictly speaking there are no inertial timelike curves in Minkowski spacetimes that are not timelike lines.

[30] Actually this conclusion will not follow that easily. Remember in fact that the condition singled out in 1.1) is a just a *necessary condition and not a sufficient one too*. However the map t will be a natural candidate to represent the objective lapse of time in augmented Minkowski spacetime.

[31] In terms of four dimensional geometry this will mean that there is no isometry mapping the set of timelike curves defined by C into another arbitrary set of timelike curves.

[32] These solutions are the ones Gödel deals with.

[33] In Gödel's own words "the existence of matter, however, as well as the particular kind of curvature of spacetime produced by it, largely destroy the equivalence of different observers and distinguish them conspicuously from the rest, namely those which follow the mean motion of matter".

admits no non trivial spacetime symmetries, hence the global time function is trivially invariant. Then, according to the argument in 1.1 *time in general dust solutions to EFE is real.*[34] The reality of time seems thus regained, even if only at a cosmological level, passing to GTR.

1.4 THE ARGUMENT FROM NEW SOLUTIONS TO EFE IN GTR

Note that the argument in 1.3 is a two step argument.

i) Firstly the spacelike submanifold, i.e the set of spacelike hypersurfaces everywhere orthogonal to the tangent space of the congruence of timelike curves is constructed.
ii) Then the set of spacelike hypersurfaces singled out in i) is used to construct an invariant global time function t: M → R on the basis of the relation of chronological precedence << that capture the requirement of coming into existence successively of that very family of hypersurfaces.

Gödel was able to find new solutions to EFE that render *both the steps impossible*. Here's a brief formal representation of Gödel's cosmological model. I will call it the *R-Universe for rotating universe*[35]. $\langle M, g_{ab}, T^{ab} \rangle$ is a solution to EFE with positive cosmological constant.

iii) R-Universe is dust filled[36] and the dust is everywhere rotating, i.e $\nabla[_a V_{b]} \neq 0$.
iv) M = R[37]. Thus M is simply connected and it is a basic lemma that any simply connected M is time orientable.
v) There does not exist a single global time slice, i.e spacelike hypersurfaces without edges.
vi) The spacetime is chronologically vicious.[38] Thus for every point p ϵ M there is a closed timelike curve, i.e a timelike curve whose tangent vectors at every point are always timelike and future directed which comes back to p.

It is now easy to prove that the argument in 1.3 and summarized in i) and ii) above, fails in the R-universe. It turns out that *it is possible to take orthogonal subspaces to the worldlines of matter iff the matter is everywhere non rotating*, i.e $\nabla[_a V_{b]} = 0$[39]. But naturally, *this is not possible in R-Universe, given iii)*. It is even possible to prove a stronger result. In fact orthogonality is not the only candidate to define a 3 dimensional spacelike submanifold that intersect a given a timelike curve exactly once. It is possible to consider for example

[34] Again, see footnote 30.
[35] The reason is quite obvious.
[36] Formally this means that the stress energy tensor T^{ab} is given by $T^{ab} = \rho V^a V^b$ where ρ is the density of the dust and V^a is the four velocity field of the dust.
[37] Gödel's cosmological model is topologically very simple. R^4 is in fact the simplest topology for M.
[38] See footnote 16.
[39] This is a special case of the so called Frobenius' theorem. It has been argued that Gödel was pushed towards the discovery of his solutions exactly by this technical point. Only in a second time he realized the presence of the closed timelike curves that strengthen the argument. See (Malament, 1995).

homogeneity, i.e to consider an hypersurface where the distribution of matter has the same value for density and pressure, or hypersurfaces with *minimal possible curvature.* The problem in the R-Universe is that, given v) *there are simply no spacelike hyprsurfaces whatsoever that are transeverse*. This argument shows that i) fails. Another simple argument establishes that even ii) fails. It in fact follows from vi) that for every p $\in$ M, p << p holds. This *contradicts the requirement of being irreflexive imposed* in 1.1 *on the relation of chronological precedence.* And it is this very relation that is used to define a possible candidate for a global time function. These arguments taken together imply that is not possible to define an invariant global time function in the R-Universe. Thus, according again to the argument in 1.1 *time in the R-Universe is not real*.

1.5 THE STEP

Call the cosmological model described by the general solutions to EFE of section 1.3 G-Universe, for general universe. The arguments in the last two sections seem to establish that time is real in the G-Universe but unreal in the R-Universe. But R-Universe is just a physically possible universe. Moreover our actual universe is similar to the G-Universe[40]. We have all kind of empirical evidence that the actual universe is not a R-Universe. Now, the unreality thesis is an ontological thesis of certain importance if it is referred to our actual universe and not to just a possible one. In the very last part of the paper Gödel tackles exactly this point in a rather mysterious way. Here's a possible reconstruction of his last argument.

i) R-Universe is a physically possible universe since it is a solution to EFE and it satisfy other additional requirements.[41]
ii) R-Universe can not be ruled out a priori because of its causal structure.[42]
iii) Time is unreal in the R-Universe, by the argument in 1.4.
iv) The main difference between G-Universe, i.e. our actual universe and the R-Universe is the non lawlike contingent difference in the distribution of matter and its motion.
v) It is *unsatisfactory* to maintain that an ontological difference of such importance, namely the existence of time, depends solely upon the contingent features in iv).[43]
vi) ∴ *Time is unreal also in the actual universe, a G-Universe*.

[40] For the purpose of the paper I will assume that our universe, described by the so called Robertson Friedman Walker solutions, or RFW, is a G-Universe.
[41] For example the so called energy condition.
[42] I will take for granted its validity for sake of the argument.
[43] In Gödel's own words "The mere compatibility with the laws of nature of worlds in which there is no distinguished absolute time [...] throws some light on the meaning of time also in those worlds in which an absolute time *can* be defined. For, if someone asserts that this absolute time is lapsing, he accepts as a consequence that, whether or not an objective lapse of time exists depends on the particular way in which matter and its motion are arranged in the world. *This is not a straightforward contradiction; nevertheless a philosophical view leading to such consequences can hardly be considered as satisfactory*" (First italic original, second italic mine).

This concludes, almost with Gödel's own words, the reconstruction of the argument presented in (Gödel, 1949a). It is not difficult to see from this reconstruction that the argument cries for an interpretation. Naturally the argument in 1.5 seems to carry the heavier burden of every interpretation, especially the rather mysterious premise v). At first sight we usually do make such "unsatisfactory" claims and consider them quite natural. For example we normally find claims like "Space in our Universe is open but have the mass distribution been different it would have been closed" unproblematic. What then assign a special status to the claim assessing that the lapse of time, and consequently its existence, according to Gödel, depends on the mass distribution?[44] I will now turn to the task of providing tentative interpretations to account for the strong thesis in vi).

2. GÖDEL'S ARGUMENT REVISITED: THE MODAL INTERPRETATION

As I have already pointed out most of the burden for every tentative interpretation seems to be the argument presented in section 1.5. The starting point for a modal interpretation of the argument is the recognition of its *modal nature:* a conclusion, namely the unreality of time, that is established for a *possible* world, is extended to the *actual* one. Hence it is an argument that deals with the classical *modal gap between possibility and actuality*. I can think of three different versions for a modal reading. I will call them the kripkean version, the broadian version and the kantian version for reasons that will be obvious.

2.1 A KRIPKEAN[45] VERSION

Suppose we endorse an essentialist view of this form: for every entity there is a set of properties P_i all of which any entity of that kind must have in order to be real. Call it the *essentialist assumption*. And suppose furthermore that we accept Kripke's famous argument for the necessity of identity statements. Then a claim like "E = the entity which has the set of properties P_i" is a necessary truth, i.e it has to hold in all possible worlds. Call it the *kripkean assumption*. With this background in hand is possible to run an interesting version of Gödel's modal argument. Here's a possible construction:

i) Time = that entity that lapses[46].

[44] This is the central point of what can be called, following Belot, Earman's challenge.

[45] This is to be taken as a suggestion. It has no intention to be an adequate reading of Kripke's main argument in *Naming and Necessity*. See Kripke, S. (1972), *Naming and Necessity*, Harvard University press.

[46] Or better "Time = that entity which has this essential set of properties: P_1,P_2,..P_l = it lapses, ...P_n". I think there are good reasons to hold i) even if personally I would be inclined not to endorse it. Gödel surely held it. I think that it is possible to argue for i) if two sorts of considerations are taken into account, namely kantian arguments from the metaphysical exposition of the concept of time and Mc Taggart's argument. Note that both are explicitly mentioned by Gödel himself. It is not possible to enter in those details here.

ii) Since the statement in i) is an identity statement it has to hold in all possible worlds.(from kripkean assumption)
iii) In all possible worlds Time has to lapse in order to be real (from i), ii) and the essentialist assumption).
iv) There is a physically possible universe in which time does not lapse, namely the R-Universe. (by the argument in 1.4)
v) Time does not exist in all possible worlds. (from i), iii) and iv)).
vi) ∴ *Time is unreal in the actual world* (a fortiori).

Put more informally if lapsing is an essential property of time, a property time must have in all possible worlds in order to be real according to the modal variant of the essentialist assumption, then if it is possible to find a world in which time does not lapse, for example the R-Universe, you have shown that time is not real. This argument uses an essentialist strategy to fulfill the modal gap that was problematic in the original formulation of section 1.5). The price to pay for such an argument is however quite high. Firstly it has to be argued for premise i). Even if an essentialist position is endorsed an argument for i) is still needed. As I have noted in footnote 46 there are reasons to hold i) but the question of whether lapsing is an essential property of time is far from settled[47]. But apart from that it is the modal variant of the essentialist assumption itself that seems an heavy metaphysical load.

2.2 A BROADIAN[48] VERSION

Recall the argument in 1.1 and the one from STR in 1.2. It could be argued that the second invariant condition in 1.1 on the different global time functions, the one telling that two different maps have to agree on the assignments of time coordinates, is too strong a requirement. Following this lead the argument from STR does not establish that time is not real *but only that the objective lapse of time has to be relativized to a particular timelike line*. In fact given an arbitrary timelike line and a point on that line there is just one spacelike submanifold orthogonal to the line that contains such a point. Taking the family of the spacelike hypersurfaces at different points on the line it is possible to define a global time function that is invariant under the symmetries of time oriented Minkowski spacetime. Gödel himself imagined this possible line of thought and in a footnote he gave a response. Briefly the response goes along these lines. The notion of time's lapse, as it is constructed in section 1.1, is closely related to the one proposed by Broad in response to McTaggart's argument[49], and *is equivalent to a change in existing*. Thus a relativization of the notion of lapsing of time means in the end a relativization of the notion of existence. But the *concept of existence can not be relativized without destroying its meaning completely*, using Gödel's words almost verbatim. I

[47] It is actually denied in all of the so called B- theories of time.
[48] See Broad, C.H. (1923), *Scientific thought*, Cambridge University press.
[49] See Mc Taggart, J.E. (1908), *The Unreality of time*, Mind, 18. It is not possible to deal with their positions here. A contemporary advocate of a broadian notion of becoming is Michael Tooley. See Tooley, M. (1997), *Time, Tense, Causation*, Clarendon press.

think that this discussion for the argument in STR can be developed in an argument to fill the modal gap in 1.5. I now turn to give such an argument.

i) Lapse of time means a change in existing (by the construction in 1.1))
ii) Reality of time means a change in existing (by the argument in 1.1) reality of time is linked to its lapse)
iii) A relativization of the notion of time's lapse means a relativization of the concept of existence (by i)).
iv) A relativization of the reality of time means a relativization of the concept of existence (by ii) and iii)).
v) Reality of time has to be relativized to a certain mass distribution (by the arguments in 1.3 and 1.4).
vi) The concept of existence has to be relativized to a certain mass distribution (by iv) and v)).
vii) The concept of existence can not be relativized without destroying its meaning completely (by Gödel's *assumption*).
viii) Reality of time destroys the meaning of the concept of existence completely (by v) and vii)).
ix) ∴ *Time is unreal*.

This argument uses the concept of relativization to overcome the modal gap in 1.5. The first thing to note is a weakness of the argument as it stands. The original gödelian remark from STR was intended to refer to a certain notion of relativization, relativization to different observers. Premise v) uses the notion of relativization to a certain mass distribution instead. At first sight it seems difficult to argue that these two notions are the same or even that they entail the same consequences, at leats it seems to me. But apart from that most of the burden of the argument is Gödel's assumption vii). It is probably rooted in the platonic-leibnizean metaphysics Gödel endorses also in his mathematical work. But the same remark of the last section applies here: the endorsement of this metaphysical background seems a high price to pay.

2.3 A KANTIAN[50] VERSION

As I have briefly pointed out in footnote 2 Gödel's original argument was intended to show that relativity theory provides support for the *ideality of time, not only its unreality*. The ontological thesis of the ideality of time Gödel had in mind was originally defended by Kant in the Trascendental Aesthetic. Thus it seems not completely inadequate to look back at Kant in order to find a possible interpretation for the argument in 1.5. A few words are needed. In the metaphysical exposition of the concept of time Kant argues for two different thesis, the first being the a priority thesis, i.e a thesis according to which the representation of time is given a

[50] For Kant I have used Kant, I. Translation by N.K.Smith. (1929), *Critique of pure reason*, St.Martin's press.

priori, and the second being the intuition thesis, i.e. the thesis according to which the representation of time is not a concept but an intuition[51]. Each of these thesis is supported with two different arguments[52]. For the purpose of the paper the important one is the second argument for the a priority thesis[53]. Kant argues that it is not possible, in respect to appearances, remove the representation of time itself though it is quite possible to have a representation of time that is void of appearances. Let's try to construct an argument using these remarks.

i) Existence of time has to be relativized to a certain mass distribution (from the arguments in 1.3 and 1.4).
ii) This means that if there would be no matter there would be no lapse of time, and hence time would not be real (from i) and the link between reality of time and its lapse in 1.1).
iii) But according to the second argument from the metaphysical exposition of the concept of time we would have the representation of time even without appearances, i.e even without masses (from Kant's Trascendental Aesthetic).
iv) Hence, existence of time can not be relativized to a certain mass distribution (from iii).
v) Reality of time is then an absolute matter, independent from the contingent presence of masses, i.e if it is real is then real in all possible worlds that differ only for mass distribution (from iv).
vi) There is a world, namely the R-Universe, in which Time is not real (by the argument in 1.4).
vii) Time is not real in all possible worlds that differ from R-Universe only for the contingent feature of mass distribution (from v) and vi)).
viii) Our Universe, G-Universe, differ from the R-Universe, just for the mass distribution (from the argument in 1.4).
ix) ∴ *Time is unreal also in our Universe* (from vii) and viii)).

I have to admit that I do not find the argument convincing in this form although it seems at least persuasive. But, differently from the argument for the kripkean version this is not only due to the fact that you have to buy a controversial assumption, namely the result from the second argument for the a priority thesis in iii). It is the passage from i) to ii) that seems problematic. The fact that existence of time has to be relativized to a certain mass distribution does not imply by itself that without any masses there would not be lapse of time.

[51] Kant's terminological choices can sometimes cause confusion to the reader. For example the section's title is Metaphysical Exposition of the *concept* of time but one of its fundamental thesis is that *time is not a concept*.
[52] Kant's scholars are divided on this point. Some of them read the arguments as two different logically independent arguments, some other as a single two step argument. I will not deal with these exegetical points here.
[53] Precisely the argument is found in B46.2

Take a possible cosmological model, i.e a possible solution to EFE. It could be the case that there were no masses and yet the solution attributes to the world a geometric structure that allows defining a global time function to describe the objective lapsing of time. There are in fact solutions to EFE, namely De Sitter solutions, where $T^{ab}= 0$ and yet given a point on a timelike curve it is possible to define the spacelike submanifold orthogonal to the tangent vector at that point. However, before concluding the section, I want to point out three considerations in order to render the argument more plausible.

Firstly, consider for example De Sitter solutions. It is true that the *components of the stress energy tensor vanish but the components of the metric tensor g_{ab} do not*. And it is still an open question whether we should consider the metric itself in GTR as carrying energy. If so, since energy and mass are intimately related in relativity theory, it would be difficult to sustain that De Sitter solutions represent a world that is void of appearances, if we are to use Kant's notion of appearance. Secondly, it could be argued that generally speaking the dynamical laws of GTR are formulated in such a way in which space, time and spacetime crucially depend on the existence of matter distribution. *It is just in some solutions, and not in the dynamical equations themselves, that the components of the stress energy tensor could vanish*. And, at last, and probably more importantly, in such cosmological models there are symmetries mapping timelike curves into one another. [54] There is no way to single out a privileged congruence of timelike curves and then use the spacelike submanifold orthogonal at every point of the curves to define an invariant global time function. Recall in fact that in the argument in 1.3) a privileged congruence was singled out as being the one representing those observers that were comoving with the cosmic matter. *But here we are working under the hypothesis in which there is no matter at all*. Naturally if there is no cosmic matter no observers can be singled out as comoving with it.

These are the stronger modal variants of the argument in 1.5 I can think of. This exposition is in no way intended to be exhaustive. Something somehow striking has to be underlined though. Every version presented here seems to *depend crucially on the assumption of some very controversial claims*, namely the kripkean modal variant of the essentialist assumption[55] in 2.1, the platonic-leibnizean assumption of the impossibility of relativizing the notion of existence in 2.2, and the kantian assumption derived from the metaphysical exposition of the concept of time in 2.3. It is for this reason that it could seem promising to adopt a different strategy altogether that does away with all of them. The epistemic interpretation of the next section can be considered an example of such a strategy.

[54] Actually just timelike geodesics, but this difference is playing no role here.
[55] I have called them assumptions because I have accepted them without any arguments. But naturally in their original framework they are theoretical conclusions rather than assumptions. They remain however very controversial conclusions.

3. GÖDEL'S ARGUMENT REVISITED: THE EPISTEMIC INTERPRETATION

The overall strategy of the previous section was to find some ontological assumption that could be used to fill the modal gap between the conclusions obtained for a physically possible world and the actual one. The strategy of this section hinges upon some epistemic claims about the experiences of observers in the different worlds. It draws mainly from this passage of Gödel:

> For, in whatever way one may assume time to be lapsing, there will always exist, possible observers to whose experienced lapse of time no objective lapse corresponds. But, if the experience of lapse of time can exist without an objective lapse of time, no reason can be given why an objective lapse of time should be assumed at all.

The passage deals with the experience of lapse of time. Consider this experience in the G-Universe. I will call it G-experience of time. As time lapses in the G-Universe different layers of now comes into existence successively, by the argument in 1.1. Hence experiencing time lapsing is equivalent to *experiencing a change in existing*, *namely a change that is consistent with the relation of chronological precedence* since it is this very relation that is used to formalized the notion of coming into existence successively in the informal argument of section 1.1.

Take now a step back to the mathematical representation of the R-Universe. Gödel himself introduces a global spacetime coordinate system with a global time coordinate[56], global time that orders the events on each worldline of matter consistently with the relation of chronological precedence, due to the technical fact that Gödel's spacetime is time orientable. Consider now the experience of an observer in the R-Universe that is comoving with a worldline of cosmic matter. The mathematical representation above is supposed to model such an experience, and it is exactly the same representation given in the G-Universe. This imply that any observer that is comoving with a worldline of matter will experience a change in existing, and furthermore a change that is consistent with the relation of chronological precedence as defined for points on that worldline itself. R-Experience of time is *thus indistinguishable from G-experience of time if we are restricted to non closed timelike curves*[57]. Call this argument the *Indistinguishibility argument*. Within this framework is possible to run an interesting epistemic argument, at least in a weak version.[58] It follows roughly these lines.

i) G-Universe and R-Universe are physically possible universes according to GTR because they both represent solutions to the dynamical equations of the theory.
ii) *It is possible to have the same experience of lapse of time in both the universes in i)*

[56] This renders possible the definition of a global time function.
[57] That means not only for worldlines for observers that are comoving with the cosmic matter. It is then possible to calculate the difference in the assignment of time coordinates for every non closed timelike curves and regard the needed corrections as deviation due to the mass distribution.
[58] It will be clear later the reason why I have called this variant, a weak version of an epistemic argument.

(by the indistinguishibility argument above).

iii) Time does not lapse in R-Universe (by the argument in 1.4).

iv) *It is possible to have the phenomenological experience of lapse of time* even if nothing corresponds to it in reality (by ii) and iii)).

v) There are two reasons to endorse the thesis that time is really lapsing, the ones derived from our best spacetime theories, namely GTR, and the ones derived from the phenomenology of our experience.

vi) GTR provides no ground to endorse that time is lapsing (by i) and iii)).

vii) The phenomenology of our experience provides no ground to endorse that time is lapsing (by iv)).

viii) We have no reason to believe that time is lapsing (by v), vi), vii)).

ix) ∴ *We have no reason to believe that time is real* (by viii) and the link between reality of time and its lapse in 1.1)).

I think this is a very interesting argument. There are immediately some important remarks to make. The conclusion of this epistemic interpretation is far weaker that the one reached at the end of the modal interpretation. In fact, if one of the modal variants presented in the previous section were successful it would establish that *time is unreal*. The epistemic argument, even if successful would just establish that we *have no reasons to believe that time is real*. The overall strategy of the epistemic interpretation could be adequately described as *shifting the burden of the proof* to the realist[59]. Before concluding the section I want to hint at a possible way to strengthen the argument. In this weak version the indistinguishibility argument is the basis to establish premise ii), i.e that *it is possible to have the same phenomenological experience* in both universes. It is however not enough to establish that the experience *is* the same. So, in iv) I have concluded that *it is possible to have the experience of lapse of time even if nothing corresponds to it* but I was *not* able to argue that *this is in fact the case*.

A first step towards such an argument would have to show that we would experience that time is lapsing even if we were to be confined to a closed timelike curve in the R-Universe. I think that in this case there are considerations that point to different directions. Gödel's spacetime is time orientable. This means that locally it is possible to distinguish at every point between the future direction and the past direction, even on a closed timelike curve. Then there is a sense in which locally we would experience a change in existing that is consistent with the relation of chronological precedence even on a closed timelike curve. This brief argument, if correct, would establish that *we do have an experience of lapse of time*, according to the construction in this section, *at least locally at every spacetime point in the manifold*. But the problem is when we consider the closed timelike curve as a whole.

Let's consider what the experience of lapse of time is supposed to be more carefully. According to the construction in 1.1 as time lapses new layers of now comes into existence. As I have already pointed out this means that the experience of time lapsing is an experience of

[59] Both these two consequences are clearly stated in (Savitt, 1994). His reconstruction of the argument is however different in significant points.

change in existing. But we can go further. It is a very particular kind of change in existing, it is a *growth* in existence[60]. Consider now this thought experiment. Take a timelike curve λ: I → M and two points p and q on λ such that p<<q. Suppose an observer were to follow that curve and count the sum of what's existing at p, call it S_p and at q, call it S_q. Then, for every arbitrary timelike curve in the G-Universe the observer will find that $S_p < S_q$. Hence an observer in the G-Universe will *always experience lapse of time as a growth in existence*. Take a closed timelike curve in R-Universe instead. The observer will find out that, at a critical radius, there will be two points p and q such that p<<q but $S_q < S_p$. Moreover consider the situation at a single spacetime point p. Since in R-Universe there is always a closed timelike curve passing through p, and since for a closed timelike curve p<<p holds, the observer, to experience lapse of time as a growth in existence, should find out that $S_p < S_p$. But this is clearly impossible.

In the R-Universe, in the unlucky circumstance of being confined to a closed timelike curve, the observer 's experience of lapse of time will not always be that of a growth in existence. Thus it seems to follow from this argument that *even if it is possible* to have a G-experience of time, i.e an experience of time an inhabitant of a G-universe would have, in the R-Universe, *this is not always the case*. There are several ways to reply to such an argument. First, it could be argued that probably the inhabitants of the R-Universe are short living creatures like us so that they will probably never spend their entire life on a closed timelike curve. Second, it could be argued that my thought experiment does not go through since it implies the possibility of actually counting the sum of what's existing at every single spacetime point. But technically speaking relativity theory implies that there is no such notion of a spatially extended present. All these suggestions do not sum up to an argument but I think they are interesting as a possible starting point. The weak version of the epistemic argument presented above is however not touched by these considerations.

4. CONCLUSION: REMARKS ON GÖDEL'S REMARK.

I'd like to conclude with some final brief remarks. It is clear that the original version of Gödel's argument is as beautiful as mysterious. Gödel himself acknowledges that his own argument does not refute the thesis of the reality of time showing that it is contradictory but it rather makes it unsatisfactory. Naturally it all hinges upon the question of why it is unsatisfactory and to what extent it is so. In sections 2 and 3 I have tried to construct interpretations of the original argument that, if successful would at least clarify why and how the reality thesis is unsatisfactory. The modal interpretation implies that it is simply false, the epistemic interpretation suggests that arguments that are independent from GTR or the phenomenology of experience are needed.

But let's for a moment take for granted that some of the arguments in sections 2 and 3 are indeed successful and ask if they are enough to establish what they are supposed to. Strictly speaking they establish that a certain conception of time and becoming, namely the one that is

[60] This analysis is consistent with the picture of a growing block derived from the notion of broadian becoming.

captured by Gödel's informal criterion, is not compatible with relativity theory. If furthermore it is assumed that relativity theory provides the best description of reality we have, it can be concluded that this very concept of time *does not refer to anything real,* i.e *time as intended in 1.1 is not real*. But the fact that time has that very particular structure is still a very controversial question. Many of the philosophers of time and probably most of the physicists would argue that lapsing is an unnecessary feature of time drawn from the mistaken perspective of common sense. And even among the ones defending the necessity of lapse there would be disagreement on how to describe that lapse itself. That said if successful, Gödel's argument would at least establish that, using Weyl's[61] marvelous words "the objective world is, it does not happen".

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[61] See (Weyl. 1949). This passage has been called to my attention by John Earman.

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The Phenomenology of Time and the Retreat of Reason

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ABSTRACT

The controversy between the *A*- and the *B*-theoretical understandings of the nature of time remains open as a matter of metaphysics, and supporters of either theory can recognise supporters of the other as worthwhile interlocutors in discussions of the philosophy of time. The present article does not seek to present a decisive argument to break this deadlock. Rather, the aim is to contrast the cast of thought expressed in the *B* theory with what appear to be humans' most spontaneous evaluative and emotional engagements with temporal phenomena. In particular, the *B*-theoretic denial that there are any genuine tensed facts calls forth complications to explain motivation in the present, the widespread asymmetries in our attitudes to the past and the future, and the differences that longer or shorter passages of time can make. If (some version of) the *B* theory is true, then many of the biases to which we are given are irrational.

1. SPECIALIST KNOWLEDGE

Over the last century or so, the philosophy of time has taken on some of the characteristics of a specialist discipline. Prominent among these are a certain consensus regarding the canonical texts relative to which new work should be located, as well as the development of vocabularies and formalisms that have taken on technical meanings which are likely to be obscure or misleading to those new to the subject. Naturally, these two characteristics are interrelated. The terminology and symbolisms used in some of the classic texts have continued to exercise a hold over adepts in the philosophy of time and provide useful common ground for carrying forward debates that would be hard to express at all in the absence of some shorthand with agreed – or nearly-agreed – connotations or, in the more fortunate cases, definitions. In this paper, we shall avail ourselves of no more than an indispensable minimum of these technicalities.

We may briskly list the three prime sources to which modern philosophers of time turn for the expressive resources that have been developed since their initial appearance in the first decade of the twentieth century. In the first place, there is the physical theory of spacetime that has grown out of the proposals of Albert Einstein and others to conceive of time as a dimension orthogonal to three spatial dimensions, and as distinguishable from them only relative to an inertial frame of reference. To this, the present notes will make hardly any reference, although the idea of spacetime as a four-dimensional manifold has been snugly incorporated into a theory on which we shall try to throw some fresh doubts. Second, developments in formal logic in the twentieth century have had an enormous impact on how

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constructive metaphysics has been – and indeed should be – conducted. Two lines of investigation may be singled out as particularly fruitful for the philosophy of time (as for much else in philosophy). On the one hand, the formalisations of quantification, especially in variants of the notation proposed in Whitehead and Russell's *Principia Mathematica*, have allowed perspicuous and concise expression of existence claims. On the other, the systematisations of intensional logics in the wake of C.I. Lewis' work (itself set on foot in reaction to Whitehead and Russell's pioneering publication) have permitted the symbolic representation of temporal logics of varying topology. Finally, and closest to our present concerns, it is widely agreed that the arguments proposed by John McTaggart Ellis McTaggart to prove the unreality of time are classics that cannot be ignored. More in particular, McTaggart's distinctions among the ways that temporal or apparently temporal series can be conceived have been accepted to such an extent that a reference to, for instance, an '*A* series' is instantly recognisable, even if a given philosopher's understanding of what should be meant by it may turn on his or her evaluation of the rest of McTaggart's argumentation. While some other terminological conventions and neologisms may be regarded as more advanced keys in the philosophy of time, someone who is completely in the dark about even one of the foregoing specimens of required background knowledge will have little title to special acquaintance with the subject[1].

One further characteristic of many specialist disciplines that is, however, lacking from the philosophy of time is an underlying agreement not so much about what it is worth debating, as about the basic structure of the object of debate. That this characteristic is lacking in the philosophy of time can be seen by considering the way that there is no consensus, for instance, about the moral (or morals) to be drawn from (or about) McTaggart's arguments against the reality of time. As this is one of the matters on which we shall have more to say, all I intend for the time being is to note *that* the debate on the question goes to the very heart of the philosophy of time and *that* it has not been resolved to general satisfaction among the specialists in the field. Although some jaded commentators on the scene might infer that there is something deeply misguided about a discipline that cannot identify its own object's basic traits and hence that perhaps all the technicalities that have been developed are premature and even a cause of the *impasse*, we shall proceed on the assumption that the philosophy of time is properly philosophical in pretty much the following sense: a person's adoption of one or other of the positions expressible with the linguistic and logical machinery that has been made available over the last century or so may genuinely be setting out a view of the nature of reality that is not wholly amenable to technical determination. To put the point more crudely: intuitions about what, after all, time *is* may not lend themselves to knock-down proof or disproof by means of even the most sophisticated of specialist tools.

[1] If this is fair, then so is the claim that, among others, Henri Bergson and Martin Heidegger did not contribute to the philosophy of time. If the contributions of relativity theory, formal logic and McTaggart's distinctions are allowed to be optional to the philosophy of time in and after the twentieth century, then we may reserve the right to designate a field of study, say, the 'philosophy of schmime', that does operate a basic competence bar of the sort envisaged and say that the philosophy of schmime is the object of present comment.

Yet another characteristic often found in the possessors of specialist knowledge is the ability to do things that non-specialists do not think of doing or are unable to do. By contrast, impressionistic encounters with a fair number of professional philosophers of time yield two observations that may seem a first glance merely silly. One is that these experts are not noticeably better or worse than other people at dealing with what happens in time: they are not noticeably more or less punctual, or more or less accurate in estimating the passage of ten minutes, for instance. The other is that, in similar practical affairs, the supporters of one theory in the philosophy of time have no perceptible advantage over the supporters of another; indeed, they all seem to act and, more important for present purposes, react to what happens in the course of their lives in much the same way as the rest of us do.

While the former of these impressions may not be particularly surprising, I shall try to make a case for thinking that the latter should cause a little bit more perplexity than it actually does. In particular, I shall propose that the theorists who take time to be constituted fundamentally of a *B* series *should* cultivate a set of attitudes to and evaluations of temporal phenomena rather different from the sort of emotional architecture that at once is probably the most widespread in humans and also more naturally explained – but perhaps not justified – on an *A*-series view. This is not quite the claim that those *B*-theorists who remain indifferent to the pastness or futurity and to the recentness and imminence of events that affect them are the only ones who are honest about the theory that they espouse[2]. Rather, the thought to be investigated is that a wholehearted endorsement of a *B*-series view sits ill with – even if it is not strictly inconsistent with – a set of propensities that come unbidden to most human beings.

In particular, the propensities we shall be most concerned with may be called 'biases' and, in the next section, (2), we shall review some of the ways that biases of partiality or perspective may lead to irrationality in contexts that are not specifically temporal. In section (3) we shall offer some thoughts about the overall cast of mind involved in acceptance of a *B* theory and the priority it attributes to the characteristics of spatial dimensions in modelling the basic traits of time. We shall then, in sections (4), (5) and (6) consider various temporal biases to which a *B*-theorist should be immune, but that seem to be at least as widespread among these experts as they are among not only their more or less expert interlocutors who conceive time in *A*-series terms, but also in the population at large.

Although I hope that some of the instances to be considered provide some relatively unexamined material for assessing widespread positions among experts in the philosophy of time, I should stress at the outset two disavowals relative to the proposal made here. On the one hand, I do not hope to give anything like a direct proof that an *A*-series conception of time is the ultimate truth of the core dispute in the philosophy of time. Even though I believe that it is and fear that some of my comments may seem simply to assume that it is, I allow that the question is still a bone of legitimate philosophical contention. The present aim is rather to alert *B*-theorists to some tensions that their position in the philosophy of time sets up against the background of what it is reasonable to expect are their ethical and emotional orientations. The

[2] This I take to be a pretty direct corollary of the thesis espoused by David Cockburn in (Cockburn, 1997) and (Cockburn, 1998).

other disavowal regards originality: beginning with my title, I signal the inspiration I have derived from Ingmar Persson's important book *The Retreat of Reason*[3]. Because Persson is inclined to think that a *B*-conception is the ultimate truth of the matter in the philosophy of time[4], it is entirely to his credit that he struggles with such perspicacity and honesty against the threat that many of our temporal biases lead us into irrationality. The interested reader is strongly recommended to read or re-read this gripping book for a more systematic and far-reaching account of the problem than the coming few pages can hope to offer.

2. BIASES: KLUGES, HOBBY-HORSES AND STANDPOINTS

In order to have some points of reference for establishing various types of propensity that can affect the arising of moral and emotional attitudes, it is worth making some effort to distinguish, at least in a rough-and-ready way, the sources and effects of at least three types of bias. Though they are surely not exhaustive nor clearly exclusive, it may be helpful to outline the categories indicated in the present section heading.

The word '*kluge*' (pronounced to rhyme with 'huge') has been adopted in some areas of computing science and of evolutionary theory to indicate an imperfect, clumsy or inelegant design feature[5]. In a variety of environments, a kluge may be acceptable so long as the resultant product – whether it be hardware, software or an organism – enjoys some overall advantage relative to its competitors. But, as a sort of unhappy exaptation[6], a kluge carries with it a cost. Thus, for instance, the fact that human beings stand on two feet offers the advantage of allowing us to use our forepaws to manipulate tools more effectively, but there is a cost to be paid in the form of back pain (lumbago, sciatica, slipped discs and the rest), given that the single undulating spine we are stuck with is structurally unfit to the bear the loads put on it. Because no one designed the human body, no one is to blame; but the kluge is there for all to see or undergo.

Though we shall return to some specifically temporal kluges in subsequent sections, it is worth illustrating what we may call 'cognitive kluges' by considering an asymmetry that is deeply rooted in our judgments of behaviour according to whether we are agents or observers. It is a fact about the way we are made up that, when we explain our own actions, we tend to appeal to the situation in which we find ourselves, whereas when we account for what others do, we tend to refer to their character traits or dispositions[7]. The divergent evaluations that follow from the different causal categories invoked in the two cases make it easier for us to forgive ourselves an error, because we see our own behaviour as a rational response to circumstance, while it is less pressing for us to do the same for others.

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[3] (Persson, 2005).
[4] (Persson, 2005), pp. 201-4
[5] For pronunciation and history of the word, as well as application of the concept to human cognitive resources, see (Marcus, 2008).
[6] See (Gould, 2002), pp. 1229-49.
[7] A classic experiment to bring out this discrepancy is described in (Nisbett, 1973).

It is not to our present purpose to speculate on the adaptive value of such an asymmetry; yet one might easily and perhaps plausibly think that a feature of this sort helps us to preserve at least a modicum of self-esteem in the face of our miserable fallibility. But it looks like a cognitive kluge because, in many social situations, it can easily lead us not to understand how other agents thought they were acting; more especially, in more casual encounters, such as those among motorists, self-justification is rife and road rage not unknown ('I had an urgent appointment, but the other driver was just being a selfish road-hog'). What is more to our point is that the agent/observer distortion is utterly general and thoroughly ingrained: it takes at least a moment's reflection on each occasion not to fall into the trap or even to notice when we have fallen into it.

While the first-/third-person asymmetry in the attribution process represents an unwilled egoism, some of the biases that we may call '*hobby-horses*' can be forms of more-or-less chosen, but often partial, altruism. For instance, on a sketchy account of love that defines that disposition as a readiness to place the loved one's interests on a par with one's own, we might say that, instead of situating oneself as the sole centre of the lived universe, there are two major foci of one's concern. In the most cheering cases of this phenomenon, we can even detect some overcoming of the kluge just outlined: one takes the loved one's behaviour at their own estimate, rather than at that of an observer. In more aberrant cases, which nevertheless share the same structure and thus justify the choice of the label 'hobby-horse' for the whole class, the object of altruistic concern may even be unknown to the carer, as we see with Mrs Jellyby's dedication to the natives of Borrioboola-Gha at the expense of her family. But, whether cheering or aberrant, these hobby-horses still fall far short of taking the whole range of sentient creatures into account as utilitarians require, or even of extending our attention to all (but also only) members of the species *homo sapiens sapiens* as Kantians think fit. According to those two popular doctrines, any preferential treatment should be regarded as a bias that prevents us from making sound ethical judgments.

In their turn, both utilitarianism, understood as the promotion of some good in certain distributions but regardless of the identities of the beneficiaries, and Kantianism, understood as impartiality in the application of the moral law, can be regarded as hobby-horses. For both can be regarded not merely as willed but even as wilful efforts to correct each human's strong propensity to favour themselves over others. That is, while the altruisms of love and of charity are obviously arbitrary, it is not obvious that the stipulation of universalisability is not also arbitrary in its own way, given that no human being has ever been able to adopt such a posture for more than a few minutes, and then only in the tranquillity of the philosophy room. That is to say, to *say* that one should, in Hutcheson's formula, promote the greatest happiness of the greatest number or, in one of Kant's versions, act as if the maxim of one's action were to become through one's will a universal law, is one thing; actually to try to carry it out would be a sign of severe mental disorder, given what human beings are like, and specifically how little information they can process about the interests of others.

Let us grant the incoherence of ethical egoism in the following adequately precise sense. No one can justify, either to themselves or to others, that they should be the sole object of concern for themselves and for others merely in virtue of being who they are: the mere fact of

being who they are is insufficient to establish what we might call their moral priority. That I am who I am and that you are who you are, are pretty clearly facts of some sort, but neither gives either me or you grounds for giving moral priority to one or to the other. Nevertheless, I have a certain *standpoint* on my own affairs that you do not have and you have a certain standpoint on yours that I do not have.[8] In this sense, I care about what I want, what I want promoted, and how it seems best to promote it in a way that you, as a matter of fact, do not; and I am sure that you have similar cares for yourself. Moreover, I have information about my cares that you do not have. For this reason, I can give an instrumental account of why sometimes it is better that I should put through my projects than have them carried out by others on my behalf. For instance, I do not want others to do my shopping for me and I would be uncertain in doing the shopping for others, at least in the absence of a pretty detailed shopping list they had made up for me.

If it is the case, as is most likely, that neither any form of utilitarianism nor any form of Kantianism is the whole story to be told about the conditions for acceptably motivated action, then it may be that there is some fact about my being me that makes it acceptable for me to promote my interests, and sometimes to do so at the expense of others. But such a fact will pretty certainly not be particularly persuasive to others; my own priority *for me* is not generalisable because it is rooted in my standpoint. And if there is some such fact about another person that makes it acceptable for them to pursue their goals to my detriment, it is not likely to have much motivational force for me.

Standpoints, such mine on my being myself, are pretty close to ineradicable from human beings. Indeed, one might say that an individual who sought to eliminate their own interests from their reckoning about how to act in favour of a total submission to the preferences of another would be, at the very least, incapable of flourishing, if for no other reason than their ignorance of the other's desires and hence perpetual uncertainty about what to do. The early phases of childcare have this feature, but they are thankfully temporary. On the other hand, if someone else took my agenda as determinative of what they should do, I would very quickly find such slavishness an intolerable burden on me, and I certainly would not want the company of such a person: I could hardly treat them as a human being.

In the following sections, we shall use this rough-and-ready taxonomy of kluges, hobby-horses and standpoints to see which of the cognitive and emotional biases that humans most commonly display are most likely to generate tensions for specialists in the philosophy of time, and especially for those of a *B*-theoretic bent.

3. HAD I WORLD ENOUGH AND TIME

The underlying thrust of a *B*-theoretic conception of time encourages us to think of various times as capable of being laid out in front of us in such a way that, just as we can see various

[8] Although the word 'standpoint' carries some moribund metaphorical freight from the idea of the occupation of a location in space, it is at least less weighed down than the alternative 'perspective', which smuggles also the idea of perceptual access to other locations.

places as equally real though each of us occupies just one of them, we can grasp that times other than the present are equally real. This tendency – not unlike that of the ethical theories of Kant and Mill – is towards abstraction. Like those ethical theories, it is a tendency that should help to promote or at least to identify rationality in the long run (when we have a long run), because even the fairly distant future is seen to count as much as the present. Conceived in this way, the temptation is overwhelming to represent temporality by means of a spatial axis, even if it is one with an arrow attached to it. Yet the presence of an arrow does not stop one looking at a page on which a timeline is drawn and thinking that right-to-left is as good as left-to-right. Even those philosophers, of whatever persuasion relative to McTaggart's basic distinction, who deny the possibility of (especially backward) time travel, find themselves virtually forced to speak of 'locations' and 'positions' in time to and from which one may or may not 'move', as one moves from one place to another in space. This manner of speaking may in its turn have encouraged, and have been encouraged by, the idea that spatial and temporal dimensions should be treated as ultimately isomorphic, at least in the sense that the separation between two events in spacetime can be assigned a constant physical quantity under transformations of frame of reference.

Though it may be that no philosopher has enunciated an *ensemble* of opinions with exactly the emphasis just indicated[9], it is nevertheless impressive how the various elements hang together and form a coherent view of things. This coherence may of itself speak in favour of the underlying ideology. Thus, it may be impossible to tell whether a given philosopher who embraces the *B* series does so because of a preference for the abstract, because of the ease of representation on a piece of paper or because of its apparently more intuitive coherence with our best physical theory, or whether, vice-versa, his refusal to privilege the present, his readiness to draw an axis – with or without arrows – to represent time, and his willingness to think of before-and-after as a variant (relative to some frame of reference) on up-and-down, back-and-forth and left-and-right derive from his acceptance of a *B*-series view. And so on with the other permutations. Although there may be, with regard to any particular philosopher a psychological or biographical order in which such commitments grow, it is not clear that any one of the elements has clear conceptual priority relative to the others.

There are at least three important disanalogies between our notions of space and of time that nevertheless speak in favour of the tendency to deploy spatial vocabulary for the description of time. They speak in favour of that assimilation because they concern ways in which space presents itself as less problematic or mysterious than time, and thus can be mobilised to help us understand time by taming it. After all, St Augustine did not say '*si non rogas, intelligo*' about space.

One disanalogy, to which we have already alluded, is that we can take in places other than the one we occupy by means of perception and are thus disinclined to make ontological discriminations among them in the way that our access by means of only non-perceptual cognition (memory and imagination) to the past and the future encourages us to think of them

[9] A cursory reading of (Le Poidevin, 2003), gives the impression that its author may be such a philosopher, though he says virtually nothing about relativity physics. I do not know what impression a properly attentive reading would give.

as having a different status from what we are currently experiencing. The *B*-theoretic response to this is to say that the partiality that *A*-theorists sometimes show in admitting the reality of the distant in space while at least hedging the reality of the distant in time (especially the future) is unwarranted. Unless we are to apply double standards on the basis of the nature of our experience, we should treat times much as we do places.

A second difference between our theorisations of space and of time arises from the fact that while much of the best geometry can be done without making measurements, e.g. in inches with a ruler, but rather by mobilizing variables, chronometry can hardly get started without the establishment of some unit of time-lapse, whether it be the movement of the celestial bodies or the cooking of rice. This difference might suggest that our perception of duration is somehow derivative from the notion of repetition, whereas that of extension is, so to say, purer and more exact. The moral might thus be drawn that we should abstract the passage of time from its measurement and that this can be done by thinking of it as a fourth dimension is many ways similar to the three spatial ones.

Perhaps the most important apparent disanalogy between 'here' and 'now' arises from the way that the place I happen to occupy at any given moment, and hence the view I have on my environment, is pretty radically contingent: I could have been somewhere else and seen things from another angle. Even though the vocabulary of 'standpoints' used in the last section to express my unsheddable me-ness bears the imprint of a spatial metaphor, we should bear in mind that human beings have some control over their position in space in a way that they do not over who they are or what the time is. It may be that, if human beings had not been mobile, they could not have grasped the basic conception of space that seems to be common in all known cultures, on which change of place is in one way or another taken for granted. If, for instance, we had been as stationary as plants are, we might have found ourselves with a notion of our spatial standpoint more similar to that of our self. Where *B*-theorists want to assimilate 'now' to 'here', some *A*-theorists might think of 'now' as functioning more like 'I': it imposes a standpoint, albeit one that, unlike 'I', is always changing. For an *A*-theorist, the now I am in at any given time is given to me in much the same way that my being me is not a matter I can do anything about. But for the *B*-theorist the idea that one can have a standpoint that is both permanent, because we always experience only the present, and yet transitory, because the present does not last, constitutes a mystery that needs to be resolved. And the apparently easiest resolution is to deny that what is fleeting is really real. This is a point to which we shall return, but we may note that this aspect of the *B*-theoretical spatialising of time may account for a greater receptiveness – or a lesser impatience – among some (but by no means all) of its proponents towards the notion of time travel.

Even supposing that treating time as in some respects on a par with the spatial dimensions were as straightforward as it appears to many *B*-theorists, we are not out of the woods. For, even if we do not suppose ourselves to have, properly speaking, any standpoints as regards space, there remains a range of kluges and hobby-horses that invest our interactions with the dispositions of objects in space. If the tendency to represent the lapse of time as a linear distance is meant to make time more amenable to representation and measurement, we may be overestimating how even-handed we are about places and the sizes of things in them.

Consider, for instance, the temporal kluge well represented by the saying that time flies when you're having fun (i.e. and doesn't when you're waiting for the number 53 bus in the rain). This is a matter of subjective measurement, in which time apparently elapses at different rates according to what you're up to: a clocked hour of fun *seems* to last as long as ten minutes at the bus stop. Though we can correct our estimates by looking at our watches, we may remain slightly incredulous that we have made such a mistake, and may even be inclined to suspect that some trick has been pulled on us. It might be suggested that there is a pretty good spatial analogue to this kluge in the effect of the Müller-Lyer illusion: a person challenged to see the two lines that are of equal length *as* of equal length will fail just as predictably as one challenged to compare lapses of fun and soggy bus-awaiting. If what holds of the Müller-Lyer, and of innumerable other perceptologists' inventions, should be expressed by saying that, in such cases, we cannot believe our eyes, then it is not obvious that estimates of spatial length should be taken as regulative of how we judge the passage of time. In both cases, we are subject to systematic and predictable error.

Again, consider the naturalness of saying that I met the same person in the same place when I ran into her in the corner shop yesterday morning and this morning. While it is true that I met her at the same part of the surface of the Earth, this part of the surface of the Earth was not at all in the same place, what with all the spinning around that astronomers have been telling us about over the last few hundred years. Though this kluge can be circumvented on certain occasions, perhaps for the purposes of making a joke or confusing one's interlocutor, the apparent fixity of the surface of the Earth is hard to give up. Short of taking to a spaceship, the Earth always figures in our spatial reference frame. Likewise, it is very hard for human beings to account spans of interstellar space as made up of lengths that are simple multiples of my present distance from the corner shop. Perhaps some astrophysicists are able, so to speak, to think in light-years or in parsecs, but it is more common to find enormous distances represented as proportions among small objects ('if the Sun were the size of a pumpkin …')[10]. And it is a point of common observation that it is almost impossible to see a sunset as a rotation of the Earth (but that is a kluge to do rather with relative motion than with relative size).

In addition to the kluges that feed visual illusions and to the partiality that keeps human beings particularly attached to the surface to the Earth, there are indefinitely many spatial hobby-horses that different people nourish regarding particular parts of that surface, often starting with the claim that there's no place like home – wherever that may be. Some of these investments of emotional, religious or economic value may be more or less readily admitted to

[10] The sort of view that I take to be the default position from which one may begin philosophising is eloquently expressed in a well-known passage by F.P. Ramsey:

> My picture of the world is drawn in perspective, and not like a model to scale. The foreground is occupied by human beings and the stars are all as small a threepenny bits. I don't really believe in astronomy, except as a complicated description of part of the course of human and possibly animal sensation. I apply my perspective not merely to space but also to time. In time the world will cool and everything will die; but that is a long time off still, and its present value at compound discount is almost nothing.
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> 'Epilogue' in (Ramsey, 1990), p. 249.

be artificial, conventional or arbitrary, but they none the less make up part of our geography and affect our judgments of size; particularly to be prized by non-New Yorkers is the world viewed in self-conscious perspective on a famous cover of *The New Yorker*, in which Central Park dwarfs Europe.

The point of citing this sprinkling of instances is this: while we have fair confidence that a minimum of geometry or of the wielding of measuring rods will suffice to correct distortions in the perception of space, the feeling is abroad that a rather more energetic and elaborate intervention is called for to bring impartiality to our apprehensions about time. Moreover, if we are to discipline our temporal biases, the most effective way to do it may be by thinking of series of instants in the same manner in which we distribute points on a line. Whether or not, as a point of psychology, this is the best way to promote inter-temporal rationality I do not profess to know; but what does seem to be the case, as a point of philosophy, is that the representation of time as just another axis in a coordinate system carries with it a series of puzzles about how to explain the ways that human beings, as a matter of fact, face up to what happens as time passes.

4. PUNCTUALITY IS THE POLITENESS OF PRINCES

Though it has been expressed in a variety of more technical ways, the key negative claim of the *B*-series theory can be put as follows: there are no tensed facts. To this claim and to its negation (namely the claim that there are tensed facts) almost all the rest of the elaborations, problems, solutions, proposals and counterproposals in the philosophy of time are related with a certain rigour.

When a *B*-theorist elaborates his basic thesis that there are no tensed facts, he generally means that sentences such as 'it is raining', 'we had fun', and 'it'll be dark before morning' stand in need of two sorts of treatment before they can be regarded as expressing facts. The first level of treatment requires an application of some distinction between types and tokens. Considered as a sentence-type, 'it is raining' certainly does not express a fact in quite the way that some sentence-types, such as those expressing logical and mathematical truths, may. This is because it is only on those occasions that a token of the type is uttered that we can begin to assess it for truth on those occasions. In particular, a token of the type 'it is raining', if uttered when it is raining in the vicinity of the utterance (i.e. at the 53 stop), will express a fact and, if uttered when it is not raining, will not. So the second level of treatment called for aims to elucidate what is meant by 'if uttered when'. Roughly speaking, two lines have been taken by various *B*-theorists (and, in at least one case, by the same theorist at different times[11]) to explain what this means. According to one view – the 'token-reflexive' view – a token of the type 'it is raining' expresses a fact if that token is simultaneous with an occasion on which it is

[11] I have in mind the views expressed in the two versions of Hugh Mellor's admirable summations of *B*-theories in his (Mellor, 1981) and (Mellor, 1998). I remain indebted to Prof. Mellor, whose Cambridge lectures on time, delivered in academic year 1981-2 and based on the former book, first pricked my interest in the topic.

raining. Likewise with 'we had fun', if uttered after an occasion on which we have fun, and with 'it'll be dark before morning' if uttered before an occasion on which it is dark before morning. On the other view – the 'date analysis' –, a token of the type 'it is raining' expresses a fact if, for some time *t*, the token is uttered at *t* and it is raining at *t*.

Whether a *B*-theorist inclines towards the token-reflexive view or the date analysis, it is clear that he sees some sort of problem to be solved regarding tokens of sentences whose ruling verb ('is raining', 'had fun', ''ll be dark'[12]) is tensed. The solutions are proposed to respond, that is, to some sense in which a token of 'it is raining' is incomplete when it is uttered. The aim therefore is to find some conditions whereby the fact expressed by 'it is raining' when it is raining can be pinned down once and for all. Such conditions will individuate what some people like to call the truthmaker for a given token of the type. That is to say, the *B*-theorist has a propensity towards the idea that a fact is only really a fact if it is eternally a fact. If this is what lies behind the elaborations such as the token-reflexive view and the date analysis, then we might think that what we have here is a hobby-horse – a prejudice, so to say, in favour of what holds for all times.

A tenseless view of time tends to be the sort of philosophical theory that one can only hold for brief periods and only when one has no business to dispatch. For the dispatch of business requires us to privilege whatever time is the time at which we have to dispatch it, that is to say in the now of its dispatch. Yet, the *B*-theorist's denial that there are tensed facts will lead him to say that there is no tenseless fact about when now is. While the *B*-theorist will tend to say that the lack of any time that is always the present means that there is no fact about nowness, the *A*-theorist will want to say that, at any given time, there is a time that it is (and, if you want to know which it is, look at your watch or ask a policeman).

This is not to say that *B*-theorists have *no* way of explaining how a person can be punctual or act in a timely manner, coordinating the sequence of events in his environment with the sequence of the actions that he performs. For instance, they can deploy the token-reflexive analysis and observe that, if a certain token of 'it is time for the television news' is simultaneous with its being time for the television news, then the belief that that is so, when it is so, can help explain why a person puts the television on at the right time to see the news, rather than too soon or too late. Similarly, on the date analysis, the temporal coincidence between a token of 'it is time for the television news' and its being nine o'clock can likewise be called in aid of action explanation. An *A*-theorist is inclined to suspect that such explanations invert the conceptual order, treating more or less technical notions of simultaneity and potentially complex systems of time measurement as more primitive than the fact of time's being experienced in a series of nows. But the point is that a *B*-theorist is stuck with having to conceive of her relation with the present as somehow mediated, and as involving at least one belief (namely 'it is time for the television news') that does not a have a genuine – tenseless – truthmaker. The *B*-theorist has to allow that he has and acts on a belief that is not fully true,

[12] We may leave to one side the fact that, in English, futurity is expressed with two (differently differentiated – hence the ''ll' formulation, to avoid making invidious distinctions among English English, American English, Australian English and Scottish-or-Canadian English) modal verbs plus infinitive, and therefore does not constitute a tense properly so-called.

because there is no fact for it to latch onto. For, the 'is' in 'it is time for the television news' is clearly present-tensed insofar as it is almost redundant to add a 'now'.

No-one really wants to deny the motivational difference between saying 'if I want to see the news, I should put the television on at nine o'clock' and saying 'if I want to see the news, I should put the television on now'[13]. Yet, for the former to get him to put the television on, the *B*-theorist must somehow acknowledge a feature of his predicament that does not seems to register anywhere among the truthmakers he recognises, namely, that, albeit fleetingly, it is now nine o'clock. Furthermore, given the way that the *B*-theory accentuates and formalises the tendency to think of the history of the universe as a sort of four-dimensional block within which spatial and temporal relations among events are fixed, it also seems that 'if I want to see the news, I should put the television on' carries with it the menace that, unless I do something about the television's coming on, I shall miss the news: my putting it on will make it the case – which it might not have been otherwise – that I see the news. Of the two basic options open to me now (seeing the news or not), I do something that realises one rather than the other. In thus acknowledging the causal efficacy of my manipulation of the 'on' button, I have to allow that something that was not previously a fact (the television's being on when the news is) is now a fact. Yet, I cannot be said to have caused to be the case something that was already going to be the case, which seems to be a direct consequence of the tenselessness of the genuine truthmakers acknowledged on the *B*-theory.

Human beings are, on the whole, most interested in what is happening to them and in what they are doing in the present. Other sentient creatures with which we are acquainted are considerably more now-centred than we are, having little thought for the past and perhaps just a little more for the future. Our capacity, up to a certain point and with a certain degree of abstractness, to think of what happens to us and of what we do in a longer temporal perspective is a peculiarity that allows us to go in for forms of learning and planning that have few parallels in the biosystem of which we are part. But it also leads to a temptation – which arises precisely out of a propensity to favour abstractions when we are in the philosophy room – to try to extend our interest from the near past and the near future to ever-longer lapses of time. Once we begin succumb to this temptation, it is hard to draw a line and say that, beyond a certain point, the far past and the far future are of no account.

Having started the process of expanding our temporal horizons, it becomes easier to suppose that there is such as thing as a 'complete description of reality'[14], possession of which would, in one way or another, answer all our questions. In this direction, there arise a set of fantasies, some of which have been with us for a good while and are held in good repute, according to which there is a point of view on the temporal series that is not itself temporal, and that can grasp the whole history of the universe in all its detail from beginning to end in a

[13] On the token-reflexive account, the *B*-theoretic formulation would have to be 'if I want to see the news, I should put the television on simultaneous with this token of "if I want to see the news, I should put the television on"', where that token is uttered (spoken, thought) at the same time as the start of the television news.

[14] The phrase is Dummett's: (Dummett, 1960), pp. 356-7.

single instant[15], or that such a complete description is somehow already in place, conceived perhaps as a book or (more recently) as a film or computer programme, whose conclusion is already fixed though we have not yet got to it[16]. Though the fatalist implications of such fantasies are sometimes recognised and resisted by conscientious *B*-theorists[17], it is hard to see how someone who does not think that they can make any difference to the complete description can regard their own actions as their own or as making a difference to what will come about next.

A person who was really committed to treating all times as equally important in determining how things stand and how to act would also find it hard to avoid a pretty overwhelming sense of his own insignificance in the grand scheme of things. There is an interesting instability about how one might express this. On the one hand, the *B*-theorist might say that the standpoint of the present gives too much weight to what happens, from time to time, to be our perspective on what is going on. On the other, there is the sense that if we try to 'put things in perspective', we get swallowed up by the big picture[18].

The hobby-horse of trying to be even-handed with respect to the various times that may ultimately (i.e. at the end of time, if there will be one) figure in a complete description of reality may be no more and no less arbitrary than utilitarian or Kantian claims about what rationality demands in ethics. We may allow that it is rather less arbitrary than a range of more partial hobby-horses, such as a fixation with a certain past time, as may happen with some extreme forms of nostalgia or with the misfortune of Alzheimer's, or with a certain future time, whether this be the reaching of pensionable age or the Second Coming. Moreover, it is considerably easier to understand than a sort of partiality that Parfit mentions, according to which a person may be indifferent to what happens to them on future Tuesdays[19]. Nevertheless, it is a hard theory to maintain in the face of the way in which, one after another, our experiences come to us as irreducibly present at the time they come to us.

Just as my being me is inescapable for me, so its now being the time it is does not leave me much choice about which time to give most of my attention to. I privilege what I am now doing (writing some notes on the philosophy of time) because this is my present task.

Before proceeding to consider two other areas in which a *B*-theoretic understanding of the basic structure of time can generate tensions with some of our most deep-seated mental habits and emotional attachments, we may as well admit that, insofar as the denial that there

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[15] Boethius, *Consolatio Philosophiæ*, V; St Thomas Aquinas, *De Veritate*, II, xii.

[16] As an expression of the former genre, Voltaire's *Zadig* provides an example of the idea of a 'book of destiny'; of the latter, in the Wachowski brothers' *Matrix*, the inexorable running of the computer's programme makes the world within the Matrix fatalist. It is an interesting feature of the non-representability of the fatalist thesis that films, such as *Sliding Doors* or *Final Destination*, in which alternative stories are presented and that therefore negate the thesis, are thought to thematise it. *Casablanca*, by contrast, which has only one way out for Rick and Ilsa, is a meditation on contingency and human choice.

[17] E.g. (Oaklander, 1998).

[18] This is the point of the Total Perspective Vortex in *The Hitchhiker's Guide to the Galaxy*: no-one – apart from the intolerably arrogant Zephod Beeblebrox – can contemplate their own insignificance with equanimity. On related phenomena, see (Persson, 2005), pp. 224-31.

[19] (Parfit, 1984), pp. 123-6, elaborated by Persson in (Persson, 2005), pp. 197-200.

are any tensed facts is an effort to overcome partiality towards the present, it should tend to counteract some cognitive kluges, such as those that trap us into overestimating the importance of what happens to be going on at the present or of what we are planning to do in the near future. Let us give an instance of such a trap.

There is at least one fairly easily recognised kluge that a *B*-series stance should help to overcome. This is the tendency to misreckon how much time it will take us to perform a given task, such as writing a paper on the philosophy of time. In accordance with the attribution kluge, if I fail to meet the deadline, then I attribute my failure to force of circumstance (diligent lecture preparation, meetings and other commitments), whereas if I observe someone else's failure, then it is that person being their usual, boringly disorganised, self. In what has come to be known as 'the planning fallacy', humans tend to underestimate the likelihood of unexpected obstacles to their putting through their business. Hence, if one thinks of what lies ahead as no different from what is present, this propensity should be, as we have said, put in perspective. That is, we should think that things will always take longer than we expect, because we are not very adept at expecting the unexpected[20]. An epicycle to this kluge is 'Hofstadter's Law', which states that it always takes longer than you expect, even when you take account of Hofstadter's Law[21]. As already indicated, however, impressionistic encounters with experts in the philosophy of time do not furnish strong empirical grounds for thinking that those who embrace the *B*-series are more immune to this kluge than anyone else is, even though, by rights, they should be.

5. FRAMING A FEARFUL ASYMMETRY

McTaggart first published his argument against the reality of time in *Mind* for 1908 and he proposed a version of it in Book V, chapter xxxiii of the *Nature of Existence*, the second volume of which appeared posthumous in 1927 under the editorship of C.D. Broad[22].

Most *B*-theorists adopt the position that they do because they take it (a^B) that McTaggart did show that there arises on an *A* series a regress that is both infinite and vicious; and (b^B) that McTaggart's strictures on the inadequacy of the *B* series to account for genuine change are inconclusive to show that time cannot be real if there is only a *B* series. Conversely, most *A*-theorists adopt the position they do because they take it (a^A) that McTaggart did show how a regress can be generated from an *A* series, but that, even if it is infinite, it is not vicious; and (b^A) that McTaggart's strictures on the inadequacy of the *B* series to account for genuine change do show that time cannot be real if there is only a *B* series. McTaggart believed his arguments sufficient to persuade us of (a^B) and (b^A), but he has not had many takers over the last century or so[23]; and few, if any, have been interested in exploring the combination of (a^A)

[20] These are the future-tense expressions of Secretary Rumsfeld's 'unknown unknowns'.
[21] (Hofstadter, 1979), p. 152.
[22] (McTaggart, 1908) and (McTaggart, 1921/7).
[23] McTaggart himself repeatedly refers to the number of philosophers who have rejected the reality of time as a consideration in favour of taking the possibility seriously. He cites Spinoza, Kant, Hegel and Bradley ((McTaggart, 1921/7), §304) and 'many philosophers, from Descartes to the present day'

with (b^B), probably because it is common ground that, if time is real, one or other of the series that McTaggart distinguished must be more fundamental than the other[24].

Though V, xxxiii is the doubtless the best-known chapter of the *Nature of Existence*, we wish to draw attention to an argument that McTaggart presents near the beginning of Book VII ('Practical Consequences'), in chapter lix. Holding firm to (a^B), McTaggart nevertheless thinks it worthwhile to investigate the characteristics of ostensible or merely apparent temporality, and invokes what he calls a *C* series, 'which is not a time series, but under certain conditions appears to us to be one'.[25] What McTaggart thinks are the basic characteristics of a *C* series are pretty much what most *A*-theorists think are the basic characteristics of an *A* series. The two most basic characteristics that McTaggart attributes to a *C* series and that *A*-theorists attribute to an *A* series are (i) that it appears to have a 'fundamental sense'; and (ii) that it does not have more than one 'fundamental sense'; where a 'fundamental sense' is understood to be an ordering relation of the members of the series that 'expresses the nature of the series more adequately' than its converse does.[26] Since the 'earlier than' relation more adequately expresses the direction of (apparent) change than the 'later than' relation does, McTaggart proposes that the fundamental sense of a *C* series is from what (apparently) causes to what is (apparently) caused[27]. That is, a *C* series can appear to be a time series because it is asymmetric.

One asymmetry of an apparently temporal *C* series that McTaggart draws our attention to is the 'undisputed fact that anticipation of future good or evil affects our happiness or unhappiness in the present far more than the memory of past good or evil'.[28] To bring out this undisputed fact, he compares the cases of two persons *G* and *H*, where *G* is looking back on ten years of intense misery and looking forward to ten years of happiness, while *H* anticipates ten years of intense misery and remembers ten years of happiness.[29] Though *G* and *H* are contemplating the same amounts of misery and happiness over the full twenty-year period, 'it is obvious', says McTaggart[30], that, at the moment of contemplating them, *G* will be happier than *H*. The indisputability and obviousness of this difference has to do with the indisputability and obviousness of the difference between, on a *C* series, the appearances of the future and the appearances of the past or, on an *A* series (i.e. granting the reality of time), between the future and the past. A *B*-theorist seems to be put in the position of having to say either that

(McTaggart (1921/7), §692), among whom he further specifies Schopenhauer ((McTaggart, 1908), p. 457). I take it that the reference to Descartes should be read as 'from the time of Descartes' because, even if McTaggart believed that Descartes denied the reality of time, Descartes' position on the question of whether there is real temporal becoming seems to have been that there is (though it is at every instant dependent on divine re-creation).

[24] Cf. (McTaggart, 1921/7), §306

[25] (McTaggart, 1921/7), §347.

[26] (McTaggart, 1921/7), §698.

[27] Cf. (McTaggart, 1921/7), §218.

[28] (McTaggart, 1921/7), §701.

[29] It is worth stressing, what McTaggart does not, that this thought-experiment depends on each of *G* and *H* having what each considers for himself experiences that cause happiness and misery: the contents of the experiences may differ according to *G*'s and *H*'s own preferences, tastes, projects &c..

[30] (McTaggart, 1921/7), §701.

what is an indisputable and obvious fact is a mere appearance or that there is something deeply irrational in the differences of attitude between *G* and *H*. Or, of course, both. Let us look at these options.

The *B*-theoretic denial that there are any tensed facts leads not only to the denial that, at any given time, there is a (genuine) fact about what time it is, but also to the denial that the monadic determinations 'past' and 'future' can appear without temporal indexing in the expression of any (genuine) fact. Even if a *C* series has a fundamental sense of the sort McTaggart proposes, a *B*-theorist should regard that sense as a matter of mere appearance: insofar as there are no real causal relations among the fixed facts of the *B* series, the appearance of a fundamental sense set up in a *C* series is ultimately illusory. As a consequence, the difference that everyone else makes between remembering and anticipating is also an artefact of some sort, one that is not to be trusted as a guide to what is past and what is future at any given time.

If this is what the *B*-theorist has in mind, we may allow that, given that he is impressed by arguments in favour of (a^B), then some sort of scepticism about temporal appearances may be his best line. That is, if the *A*-series does generate a vicious infinite regress, then our confidence about distinguishing between memory and expectation may be undermined. But, as so often in philosophy, one man's *modus ponendo ponens* is another man's *modus tollendo tollens*. For some *A*-theorists, it may be enough to say that we can know that the regress that can arise from an *A* series is not vicious because we can, at least often enough and in a general sort of way, know that we are recalling something that happened in the past rather than imagining something that has yet to happen, and vice-versa. Of course, there are occasions on which we are mistaken about such things; but most *A*-theorists would want to say that such errors are about how to classify particular beliefs within a classification that is solid enough (from one moment to the next).

If the *B*-theorist persists with his scepticism, we may either ignore him or use the usual tools that we use on first-year undergraduates who get excited about the madmen, dreamers and the Demon in Descartes' *Meditations* I. One of these rather blunt instruments is to make an appointment with him yesterday – or indeed the day before – to talk about the problem in more depth, which also leaves us the option of ignoring him. The well-known fact that, with most interesting forms of scepticism, the sceptic cannot live in strict accordance with his professed doctrine, may have a sobering effect as a reminder that, once outside the philosophy room, we do set considerable store by the difference between past and future, thinking of the former as an object of memory and of the latter as an object of expectation.

On the other hand, a *B*-theorist may admit the difference between the positions of *G* and *H*, and try to cast it in *B*-theoretic terms, using for instance the token-reflexivity of the monadic temporal determinations. Even so, he might insist that the difference between what is earlier and what is later *should* not make the difference it makes to the degrees of happiness of *G* and *H* as they contemplate their respective conditions. In making this move, he may be motivated by what we have already called his even-handedness about times. Let us suppose this *B*-theorist also to be some sort of utilitarian. Let us then ask him whether it would be indifferent for him to be *G* or *H*. The only consistent response he should give is that, indeed, at least as

regards the twenty years around the moment that is the object of choice, there are equal amounts of happiness and misery for each. Hence, he would have to say that it would not be particularly rational to prefer the position of *G*, who has just exited from misery and faces happiness, to that of *H*, who will have no more happiness but only misery from now on.

I have tried, in various encounters with experts in the philosophy of time, to elicit a response to what I have come to think of as 'the indifference question'. It seems, however, that I have been unable to formulate the question with sufficient clarity to follow the answers I have received. So I am not in a position to be sure whether the answer I have suggested as the only one that is consistent with the theory of a *B*-inclined utilitarian is the one that many or most *B*-theorists (utilitarian or other) would actually subscribe to. But, as already indicated, Ingmar Persson is one philosopher who has thought bravely about the matter, and, although he does not quote the McTaggart case, his view seems tantamount to an admission that it is a 'cognitively irrational'[31] bias in favour of the future that would make us prefer the position of *G* to that of *H*. If what a utilitarian is interested in is maximising benefit and there is no difference in the total benefits accruing to *G* and *H*, then it is not rational to prefer the position of one to that of the other. On that ground, Persson thinks that we would be more rational if we could divest ourselves of the bias that distorts our judgment in favour of this preference. He does not infer directly that it would be *better* for us to be without this bias[32], but only that, *if* rationality were our best strategy for living satisfactorily – a hypothesis on which Persson's work as a whole throws serious doubt –, then extirpating the bias might help us to make better choices.

One sort of consideration that Persson and McTaggart converge on as possibly relevant to the most widespread bias or preference in such cases has to do with the vividness of our cognitions in the two directions along the ostensible temporal sequence. Despite the greater importance we attribute to the future, they are open to the thought that we nevertheless find it harder to envisage it with full determinacy or liveliness. As a result, they conclude, rightly I think, that cognitive vividness can hardly be the deciding factor determining our preference for *G*'s condition. In particular, because McTaggart does not acknowledge the reality of the becoming of which the ostensibly temporal *C* series is an appearance, he doubts that any reason can be assigned for preferring the position of *G* to that of *H*, but he thinks that this is the preference that all of us do, as a matter of fact, harbour, and that in doing so we are not being unreasonable or going contrary to reason.[33] If they adopted our terminology, Persson and McTaggart would nevertheless say that the differences in importance we give to the future and to the past are kluges or hobby-horses.

For anyone who does not deny the reality of *A* series, this is all distinctly odd. My standpoint on what is going to happen to me for the next ten years is different from that on what has happened to me in the last ten years *because* the former is now future and the latter is now past. As a creature in time, it is an abstraction for me to try to view my present position in the sequence of the events that, once I am dead, will have made up my life as if what comes

[31] (Persson, 2005), p. 216.
[32] (Persson, 2005), pp. 217-9.
[33] (McTaggart, 1921/7), §702.

next makes no difference. I want my next experience to be a happy one because this is the point I am now at. And the one after likewise, because that will be next. This has to do with the nature of wanting. Though more or less revealing cases of wanting directed at the past can no doubt be constructed, most of what they reveal is this: that the object of wanting is centrally in or for the present or the future. In many instances, my wanting something to be the case can move me to (try to) bring it about that it is so. As I cannot bring it about that the past be different from what it was, it is vain (because too late) for me to want to.

Whereas McTaggart's case of *G* and *H* concerns, so to speak, the thinly rational motivation of what may boil down to a preference, it is intimately hooked into a wide range of thicker attitudes, emotions and reactions that make essential reference to the difference between past and future. If there really is no choosing between the positions of *G* and *H*, then we would have to give up, for instance, the differences between, on the one hand, fear and apprehension, which are directed at the present and for the future, and, on the other, remorse and regret, which cannot but have past acts and omissions as their objects. These states might be regarded as tense-sensitive species of some genus like dread, and a convinced *B*-theorist might say that it is misleading to distinguish them. But what would it be to 'give up' such distinctions? And how are we 'misled' by them? And if we are misled in the case of *G* and *H*, are we not also subject to some sort of irrationality in all those attitudinal and emotive states that demand some inherently tense-relative orientation? Wouldn't these include at least boredom, agitation, disillusion, hope, relief, triumph, disappointment, gratitude, apprehension, impatience, discouragement, dismay, resignation, pity, forgiveness and vengefulness (to name but a few and in no particular order[34])? Which of them can be regarded as consequences of kluges that we have to live with and work round, and which arise from hobby-horses that we root out by patient self-training? Is the whole of our emotional life nothing but a congeries of indefensibly irrational biases, of hobby-horses and of kluges that we should try to overcome by cultivating a stern indifference to the appearances of tense?

To these rhetorical questions, a good Stoic would, on general grounds, give the unsought answer. On the whole, though, we find that philosophers of time are little inclined to any so radical and strenuous programme of personal reorientation (at least no more and no less so than any other kind of person). In particular, we would expect that *B*-theorists would, if given the choice, definitely prefer the position of *G* to that of *H* because they are not so insensitive to the temporal directions in which their various feelings point as their theory, at least *prima facie*, tells them is rational. For them, however, the mere order in which things happens *should* not be of any consequence. By contrast, an *A*-series understanding of time is more consonant with the perceived asymmetry in the attitudes that almost all humans do, in point of

[34] To the best of my knowledge, only relief has generated its own literature, in the wake of (Prior, 1959). I thank an anonymous commentator for this journal for signalling (Maclaurin and Dyke, 2002), who note that relief is 'unrepresentative of past-directed emotions' (p. 286). Both the Prior and the Maclaurin-Dyke papers are included (along with four other contributions to the *topos* that has come to be known as 'Prior's "thank goodness that's over" problem') in Vol. III of ((Oaklander, 2008) pp. 7-12 and 35-51 respectively).

undisputed and obvious fact, adopt towards what was and what is to be. This does not of itself mean that (a^A) is the truth of the matter. But it does mean that it is easier to live with.

6. SOONER OR LATER

Our rough-and-ready distinctions among kluges, hobby-horses and standpoints begins to look pretty inadequate when we come to consider the different weightings that we give to proximity and remoteness in time. For it is hard to tell which deviations from temporal impartiality we should count as hardwired, which as corrigible and which as simply reasonable. The most crashingly obvious fact is that, both with regard to the past and with regard to the future, those times closest to the present at any given time are invested with an importance that can equal or even exceed that attributed to the present itself. Given that a *B*-theorist is already committed to denying that there is any genuine fact about presentness that is not relativised either to the time or date of utterance, *a fortiori*, he will deny that there are any genuine facts about nearness-to-the-present.

There are of course some time-sensitive behaviours that a *B*-theorist can model perfectly well, such as the widespread preference for immediate gratification in conditions of uncertainty. Even a fairly thin theory of rationality can explain why, if you are offered a gratuity of €1,000 today or €1,100 to be paid a week from today, you may find yourself in such doubt about the stability of so untoward a proposal (only cranky psychologists make such offers), about the inflation rate (think Germany, 1923) or even about your survival over the next seven days (a point to which we shall return), that waiting a week for the extra €100 may not be worth it. Some problems of reasonable choice and the countervailing kluges and hobby-horses here depend on how the uncertainties are framed or presented as salient and do not particularly concern theses in the philosophy of time. It is nevertheless interesting that the tendency to take the money today is associated, so we are told[35], with activation of the limbic system, while that to delay in order to maximise gain in the long(ish) run is elaborated in the prefrontal cortex, a part of the brain much more developed in humans than in other animals. In general, it is thought that when the prefrontal cortex has the better of it, agents are acting more rationally.

The discounting of the present that allows us to take a longer view is at least a wink to the way that *B*-theories treat all times as being on a par. But, even so, if any reasonably naturalistic theory of the origin and destiny of human beings is plausible, then one might be forgiven for thinking that the only times we should ever really care about fall at least close to the sequence that runs from a little bit before the time of our birth to some fairly short time after the time of our death, and that all others are really objects of merely hobby-horse interest[36]. Rather than get embroiled in the anthropological and religious questions such an assertion raises, let us

[35] E.g. by (McLure, 2004).

[36] An eloquent and articulated exposition of advanced Epicurean thought on these matters can be found in the chapter of (Tsouna, 2007) dedicated to reconstructing the remnants of Book IV of the *De Morte* (pp. 239-311).

turn our attention to a few, admittedly extreme, cases in which our perspective on the lapse of time does seem to make a difference.

Consider the two utterances 'my father died yesterday' and 'my father died fifteen years ago'. While the former elicits the sympathy of a friend of a normally filial speaker, the latter need not. It would take a hard heart to deny the former fellow-feeling, and exceptional circumstances to think condolences still in order in response to the latter. Among such exceptional circumstances would be those in which the speaker learnt only yesterday that he had, unbeknownst to him, been an orphan for the last fifteen years: a hole will have opened up in his life that previously he thought was filled. In such a case, the sense of loss might, in some measure, be mitigated by the father's absence from the speaker's life in the intervening years. [37]

Consider, then, a *B*-theoretic rendering of our two utterances. According to favoured formalism, both might come out as 'for some person *a*, and for some time *t*, the father of *a* died at *t*' or similar. This seems to be the only genuine fact in the case and it is common to what happened yesterday and to what happened fifteen years ago. The tendency of such a rendering will be towards saying that, insofar as the quantified analysis exhausts the (genuine) facts about the paternal death, there is no particular reason to respond in different ways to each. If, then, sympathy is in order in the case of 'my father died yesterday', it should be also in the case of 'my father died fifteen years ago'. But this is clearly not so; hence the *B*-analysis has left something out. Naturally, using the machinery of token-reflexiveness or the date analysis, it is possible to render some sense of the relation between that fact and what is going on when the tensed utterances are proffered. The point, however, if that this machinery has to *work* to explain how the mere fact of the death's being at a certain time or date can make the difference.

Proceeding from announcements about the past to pronouncements about the future, but keeping to the macabre, we may recall a sequence from near the end of Luis Buñuel's *Le fantôme de la liberté* in which an urban sniper is apprehended by the police and sent to trial. Found guilty of having picked off a number of passers-by, he is condemned to death. So he walks free from the courtroom, as mortal as he was when he entered it. Whatever else one thinks about capital punishment, if a death sentence is to have any force, it had better not be of the *B*-theoretic form 'for some time *t*, you die at *t*', which is true of us all[38]. Rather, it has to have the effect of bringing it home (a) that, between now and your death, the time is short; (b) that its date may already be (artificially) fixed; and (c) that you cannot occupy yourself with any fresh project before execution.

As regards (a), we may suppose that anyone who is indifferent to how soon they will die or who cannot really conceive of their own death, is in some way avoiding the nature of the human predicament. It is hard to think of anything more pathetic – and more indicative of

[37] Again, within the exceptional circumstance, only exceptional circumstances, such as a forged correspondence from the father to the son, would reinstate the sense that the son has undergone recent bereavement, to which is superadded the shock of discovery of the fraud.

[38] John Maynard Keynes was wont to observe that, 'in the long run, we are all dead'; quoted in (Pigou, 1946), p. 13.

their level of understanding of what they face – than the fact that many prisoners condemned to capital punishment in the United States leave a favoured part of their last meal 'for later'[39]. As regards (b), we may also, if we are catholic in our cinematic tastes, recall not just the anger of the androids in *Bladerunner* at knowing that their creators made them with a built-in expiry date, but also their overpowering desire to know in advance when they are destined to die. That is to say, they want access to the content of their 'death sentence', knowing that this is already determined; what makes their position different from that of most of us, is that there is something more definite than the Biblical 'three score years and ten' to be known. And as regards (c), we may contrast the position of a prisoner on death row, who is not permitted to do anything but await execution, with that of a terminally ill person who is 'given six months to live' and consequently tries to 'live life to the full'. When an apprehension of imminent death is borne in on us, we may change strategy and no longer live for the long run, but permit ourselves, so to speak, to be governed by the limbic system rather than the prefrontal cortex[40]. And this is itself a piece of rationality.

Given that there is always some level of uncertainty about how much time we have left, there will always be some level of bias towards the nearer future that will be rational. Often enough, though, this standpoint is over-accentuated as a result of hobby-horses and kluges of varying degrees of insidiousness that prevent us giving due weight to our own future states, which in due course will become our present states and will cause us to rue our earlier improvidence. Even if it is the case that my now smoking a cigarette makes it more likely that I will die of lung cancer, my attention to my present desire satisfactions and the consequent indistinctness of my future self in an oxygen tent mean that I act irrationally if I assume a long run. That is, I can abstractly apprehend a longer run than I find myself able to act on, given my craving for nicotine.

The point of illustrating some of these tense-sensitive attitudes with the dramatic cases of the last few paragraphs is this: they inescapably carry some emotional tone that seems to get less than fully captured by a *B*-theoretic analysis of time. To put the point a little more strongly: a *B* theory has to do something to *explain* such phenomena in a way that an *A* theory doesn't because the essentially perspectival nature of our engagement with time is written into the primacy attributed to tense.

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[39] Among others, the unjustly famous Willie Horton is reported to have done just this. Boswell quotes Johnson as having said, to turn aside suspicion that, because of its vigorous rhetoric, he and not the convicted Dr Dodds was the author of the pamphlet *The Convict's Address* attributed to Dodds, 'Depend upon it, Sir, when a man knows he is to be hanged in a fortnight, it concentrates his mind wonderfully' ((Boswell, 1791), II, p. 127 (19th September 1777)).

[40] Cf. Dorothy Parker's acute reminder:

> Drink and dance and laugh and lie,
> Love, the reeling midnight through.
> For tomorrow we shall die!
> (But, alas, we never do.)
> (Parker, 1977) p. 298.

7. WHEN ALL IS SAID AND DONE

Supposing I were to become convinced, listening perhaps to a paper by Nathan Oaklander or reading yet another book by Robin Le Poidevin, that some version of the *B*-theoretic understanding is, after all, the truth of the matter in the philosophy of time, are there any opinions, propensities or biases that I now have that I should change in order to keep abreast of theoretical enlightenment? If so, which? What should replace them? And what might motivate such a change?

To respond briefly to these questions, we may distinguish between those motivations that make essential reference to what we might call the representational adequacy of my view of things and thus have to do with rationality in some narrow sense, as against those that are guided by what makes it make sense for me to live my life as a finite and mortal creature and thus have to do with the satisfactoriness for me of my world view.

If representational adequacy were the dominant motivation, I would have to deny that my commitment to finishing these notes before the deadline is any more my present business than is finishing the construction of the Great Pyramid (to take another example from McTaggart[41]) or observing next month's eclipse of the Sun (to take a future contingent that seems real enough by now). In place of my current sense of urgency, I could cultivate the serene thought that either the paper will be finished or it won't: the fact – whichever it is – is fixed. I would not be more concerned about my future states of well-being or of suffering than I am at present about the things I have enjoyed and undergone in the past. Yesterday's visit to the dentist would impinge on me no more and no less than tomorrow's. Yesterday and tomorrow would not crowd in on me any more than do the Big Bang and the heat death of the universe. All these partialities would have to go.

If liveability were my maxim, I would not feel inclined to change my priorities or my perspective one jot or tittle. I would have accepted a thesis – 'there are no tensed facts', or some more complex variant on it – as a claim to defend in the philosophy room and would leave it at that. Within the severe limits of my philosophical ingenuity, I would have adopted a piece of specialist knowledge and been none the wiser for it.

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[41] (McTaggart, 1921/7) §309.

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Book Review

A Future for Presentism

by C. Bourne

Oxford, Clarendon Press, 2006, 242 pp.

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This book is meant as a defence of presentism, the view that only the present time and present entities exist. The book is divided in two parts. In Part I, the author first offers an overview of his metaphysical position; then, he shows how such a view can be combined with some of the most popular theories of time in solving the major philosophical issues related to time. In Part II, he attempts to reconcile presentism with relativity theory.

It is widely hold that presentism is a view opposite to tenseless theories of time which currently dominates the philosophy of time (following Mc Taggart, "B-theories") and contrary to tensed theories ("A-theories"). According to tenseless theories, all times are equally real and the present is not ontologically privileged. On this view, objects – things, events, facts – are thought as being "earlier than", "later than" or "simultaneous with" *each other* and located by dates. In short, time does not flow. By contrast, tensed theories assign to the present a special metaphysical status and objects are "earlier than", "later than" or "simultaneous with" *the present*. According to tensed theories, objects change their tenses in that they are future, become present and then past. Bourne is critical of both approaches and characterizes his version of presentism as the only substantial alternative to the tenseless theory.

In Chapter 1, the author articulates a solution to the "present problem", namely the problem of explaining how we can know that our time is present and that we are not past. More specifically, the problem - that it raises when we endorse a pluralist position about time - is the following: "given that we do know we are present, and that it is absurd to doubt it, any adequate theory of time must find a way to guarantee such knowledge" (p. 21). For all tensed theories the present problem is insoluble. In fact, if we claim that the present is the moment of time that is metaphysically privileged, then the present is distinguished from whatever moment of time is picked out indexically when we use expressions such as "now" and "presently". Thus, if we suppose that Socrates is real - as tense theorists admit- then his experience of present is no different than ours but his belief that he is in the present is false. According to the author, only tenseless theories and presentism can solve this problem. In order to explain how, he draws a difference between the *indexical* use (picks out the time at which it is used, called the 'present') and the *referential* use of present (refers to the privileged time of the tensed theory, called the *present*). Tenseless theories avoid the "present problem" because they deny that our time is ontologically privileged and recognize that the

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only sense of 'present' is the indexical sense. Presentism gives a solution to this problem as well: if we admit that present is the real time, then *ex hypothesi* we are in the present.

In Chapter 2, the author develops his version of presentism - called "Ersatzer Presentism"- that avoids problems traditionally associated with this position: sets of propositions of a certain type represent in relevant way past, present and future states of affairs and their cross-temporal relations. On this view, all times are abstract objects (sets of propositions) but only one of them has a concrete realization (the *present*) and past and future are ontologically on a par. Such a way of thinking about time - according to the author - allows us to have a full range of times without being committed to the existence of full-blown concrete non-present entities (such as Socrates or dinosaurs). This version of presentism establishes that pastly and futurely located tensed facts do not exist: all concrete facts are present facts and all other facts are abstract and hence tenseless. The position the author defends is essentially: "all of us should agree that the proposition "Socrates is teaching Plato" was, at some time, true" (p. 52). More specifically, "Socrates taught Plato" is made true by "the existence of a proposition that states this is the case for some time in the past, where a time is a set of propositions that states the other truths about what happens at that time" (p.52). These sets of propositions are ordered by what the author calls "the E-relation", something different from the genuine *earlier than* and *later than* relations since it does represent the *earlier than* and *later than* relations in the way it relates times rather than spatio-temporal objects. Thus, we have a time series related by *earlier than* and *later than* relations without being committed to the existence of real or concretely realized *relata*. Therefore, a particular time is a set of "unembedded" propositions (*u*-propositions, such as "It is now the case that it was the case that Socrates is sitting") and truthmakers are abstract objects and not concrete facts. So, if we follow this proposal, we can deal with a series of standard objections about transtemporal relations without invoking past and future objects and events. According to the author, there are several advantages in adopting this picture. First, this account allows us to state truths about the past and preserve the truth-value of past-tensed statements. Second, the best virtue is, according to him, that ersatzer presentism includes a more ontological parsimony: it does not postulate neither mysterious facts in the present to make past-tensed statements true nor past and future concrete objects as truthmakers for tensed statements.

In the rest of Part I, the author focuses on some problem faced by a defence of presentism. First, Mc Taggart's problem and the issues about the unreality of time (i.e.: all objects in the A-series have all three tenses, but these tenses are all incompatible with one another; therefore, the A-series contain a contradiction). Bourne argues that Mc Taggart's problem does not affect ersatzer presentism because - according to his view - only the present, and not the other tenses, has instances. Second, he analyzes a set of paradoxes and shows how the rejection of the existence of times other than the present fits with the idea that the abstract objects and possible individuals exist. Third, the author shows that adopting ersatzer presentism's "branching future" requires a non-bivalent logic but it does not entail abandoning the laws of the excluded middle and non-contradiction. The branching structure of times enables us to distinguish between past and future and account for the truth-value links between times: the E-relation is "a one-many relation in the direction from the present to future, and a one-one

relation in the direction from the present to the past" (p.55). Finally, the author addresses the problems of transtemporal relations and shows how presentism can formulate a theory of causation. In fact, it seems that, if causation is as a relation, then presentism cannot account for it. The reason is simple. It is widely accepted that, if *c* and *e* are events and we have a true instance of "*c* causes *e*", both *c* and *e* occur and *c* is earlier than *e*. But, if *c* comes to occurrence earlier than *e*, it follows - according to presentism - that when *c* comes to occurrence, *e* does not yet occur. In order to solve this problem, the author suggests to reduce transtemporal relations to casual relations. Only in this way, presentism can make use of any theory of causation (such as Hume's regularity theory, Lewis' counterfactual theories or Mellor's probability-raising theories).

Part II of the book is entirely devoted to understanding of the philosophical issue surrounding presentism and special relativity. Chapter 5 is a quick introduction to the relevant physics and Chapter 6 concerns the Putnam-Stein debate (for Putnam, tensed talk has no place in special relativity; Stein preserves tensed talk in that context). In Chapter 7, the author explores the philosophical implications of some cosmology's models that arise from general relativity and argues that tense theorist should rethink their strategy in dealing with theories of relativity. Chapter 8 offers an account for Gödel's philosophy of time and shows that this view (the idea that time must be ideal) is too strong and leaves open the possibility for time travels.

Some questions arise for the version of presentism the author proposes. In particular, the view that times are sets of propositions creates some concerns when we have to do with past-tensed statements. If we accept the idea that times are set of propositions, it seems that the truth-value of a statement consists in what is necessary to establish (or to make) such statement true in the present. But, if we exclude that truthmakers are past facts and we rather state that they are propositions, where in the presentist's world the truthmakers are to be asserted? Are propositions asserted and available in the past or in the present? Presentist'view seems that a statement about the past, if true, must be true because a proposition such as "it is now the case that…" is available in the present. But, consider past-tensed statements for which we have lost any evidence in the present. It seems correct – from a presentist point of view - to say that an empirical statement about the past cannot be true or false if its truth condition is an observation made in the past and no more available in the present; and that the only way *in principle* available to us for establishing the truth of a statement in the past tense is on the ground of its present traces (documents, memories, testimonies). If so, the question here is: how is it possible to claim that a statement about the past is true or false when the opportunity to decide whether or not it holds good may be lost? How can ersatzer presentism guarantee the truth-value of this kind of statements; and what does ground the truth that those statements were true? The Presentist picture does not seem to offer an adequate answer to this.

Another objection is about the notion of truth and the uses of the principle of bivalence. A large class of statements is intelligible but undecidable and we are not in position to claim that they are determinately true or false before establishing them as true or as false (and we may never be in position to recognize them as true or as false). Now, a presentist can accept the view that a speaker (P) knows in the present the truth-value of a past sentence (S) if her

knowledge of *S* is manifested by the use that in the present *P* makes of *S*. This formulation is related to a conception of truth according to which the predicate "true" is identified with "correctly asserted in the present time". If so, the truth of a sentence can be given only in virtue of the knowledge available at the present and this seems to be counterintuitive.

Despite these objections, the book is interesting and should be widely read. This review does not do full justice to the variety of topics the author deals with and to richness of the book. There are many good things to be said about it: this book provides an accessible and profound introduction to the topic and at the same time it expands the framework of the current theory of presentism. Besides, his examinations of the topic and his view are well worth to be discussed. This stimulating study is warmly recommended to anyone interested in the metaphysics of time and in the relations between philosophy and physics.

Book Review

Facing the Future
Agents and Choices in Our Indeterminist World

N. Belnap, M. Perloff, M. Xu
Oxford, OUP 2001, 501 pp.

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This is not only a rich, solid, well-written study in the logic and philosophy of action but it is, first and foremost, a rare example of how logic can be successfully applied to deliver crystal-clear clarifications of hard philosophical problems. This makes the book an extremely valuable methodological guide to any formally-minded researcher in philosophy. For this reason, I will give a somewhat unconventional touch to my review, by dedicating most of the attention to the methodological aspects of the work, trying to highlight the way followed by the authors in developing their theory.

The authors start off with an analysis of the standard resources available in natural language for the expression of action, looking for a "canonical form" able to encompass them all. This quest is carried out in Chapter 1, where action expressions such as "agent i does A", "agent i brings it about that A" etc. are all regrouped under the same semantic class of "agentives" and are referred to by the "seeing to it that" grammatical form, the so-called "stit form". This aims at polishing natural language action expressions, freeing it from unnecessary nuances which would mislead the later formal analysis. Such picky quest well testifies the authors' distrust towards natural language as a guide for philosophical research. To say it with them "it is certainly a theme of stit theory that English grammar is no sure guide" (p. 117).

Once the basic grammar of action has been settled, and after having provided a brief but historically deep and instructive overview of the contributions that various logicians have given to the formal theory of action and agency (Section 1D and Chapter 3), the authors set the ground for the answer to the central question of the work: what do stit sentence mean, from a formal point of view? What is their formal semantics? Or, to use one of the several literary examples available in the book, what do we mean when we say that Don Quixote sees to it that Don Quixote attacks the windmill? (p. 259)

To follow a method means to make principled choices. The authors, in order to answer the above question, could have gone two ways. They could have either attempted an axiomatic characterization of stit sentences, by taking them as primitives and stating principles such as "if

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i stit A then [i stit [i stit A]]" in form of axioms. Otherwise, they could have proceeded by first identifying the structures on which stit sentences will have to be interpreted, that is to say, the form of the world which provides a semantics to the language of agency. The latter is the way they chose, although axiomatizations are provided at the end of the book (Chapter 16). This priority given to the logical "ontology or perhaps metaphysics or (less pretentiously) extra-linguistic portion" (p. 139) of the theory is not taken for granted in applied logic, where axiomatizations are often attempted as an always legitimate means of formal analysis. However, the authors seem to be aware of the methodological pitfalls that such a practice hides when the to-be-analyzed notions do not have a unique clear interpretation, as is the case for stit and, in general, of all notions drawn from common-sense. To say it with Tarski, "[. . .] the choice of axioms always has a rather accidental character, depending on inessential factors (such as e.g. the actual state of our knowledge). [. . .] a method of constructing a theory does not seem to be very natural [. . .] if in this method the role of primitive concepts —thus of concepts whose meaning should appear evident— is played by concepts which have led to various misunderstanding in the past" (Tarski, 1983, pag. 405-406).

So, no axioms, but rather a logical ontology providing solid grounds for a semantic analysis of the notions at issue. What kind of ontological structures are chosen by the authors, and why? The ontology of stit theory is based on two minimal and rather uncontroversial assumptions: 1) the past is settled, i.e., it cannot be changed; 2) the future is open, i.e., it can be changed by the choices the agents make. In a way, stit theory is a beautiful example of how far simple assumptions can lead you when they are taken seriously from a mathematical point of view. A theory based on such simple assumptions surely cannot make sense of all the intricacies of the philosophy of action, but it can take you a long way in explaining a number of essential features of agency. "Like geometry, it does not pretend to be that famous `theory of everything.' It concerns above all the structural aspects of how the doings of agents fit into the indeterministic causal structure of our world" (p. 178).

In fact, the simple pair of assumptions of close past and open future gives rise to the mathematically well-behaved branching-time structures. These are nothing but sets of histories structured in a tree-like shape so that, given a moment m in the structure, the set of histories going through m all coincide up to m, and possibly diverge afterwards. In this setting, to have a choice in moment m means to be able to tell sets of different histories passing through m apart. When we say that Don Quixote sees to it that Don Quixote attacks the windmill, we mean that Don Quixote can force the present towards a set of histories where, in all of them, he happens to attack the windmill, while there are histories through m in which this is not the case.

This reading of stit is called deliberative stit (dstit) and has to be distinguished by the achievement stit (astit) which enjoys a different semantics (see Chapter 2 for a compact presentation of the theory): that Don Quixote astit Don Quixote attacks the windmill means that at the present moment, the fact that Don Quixote attacks the windmill is guaranteed by a past choice of Don Quixote which forced the future in such a way that he now attacks the windmill. Getting back to methodology, it is worth making explicit what the authors achieve

here. By starting from a relatively vague and ambiguous notion taken from common-sense ("seeing to it that"), they proceeded by disentangling two different meanings of it, making use of a specific formal ontological machinery (branching-time structures). The result is an insightful disambiguation of the notion, which is readily available for shedding light on past and future philosophical discourse concerning action. I find it instructive to quote Tarski again who, much time ago, seems to advocate the very same method when faced with problems of formal concept analysis: "[. . .] it seems to me obvious that the only rational approach to such problems (of concept analysis) would be the following: [1] We should reconcile ourselves with the fact that we are confronted, not with one concept, but with several different concepts which are denoted by one word; [2] we should try to make these concepts as clear as possible (by means of definition, or of an axiomatic procedure, or in some other way); [3] to avoid further confusions, we should agree to use different terms for different concepts; and then we may proceed to a quiet and systematic study of all concepts involved, which will exhibit their main properties and mutual relations" (Tarski, 1944, p. 355).

I have started my review by claiming stit theory to be 'successful'. It is time to briefly show why I think it is, pointing at what I consider to be the neatest achievement of it, which is a strikingly simple and convincing analysis of the problematic concept of refraining (what does it mean to refrain from an action?). A clarification of the notion of refraining is of key importance for an appropriate analysis of deontic concepts such as, in the first instance, obligation which is typically viewed as a prohibition to refrain. The concept of refraining is problematic because it seems to refer to an action which is performed through inaction. If Don Quixote refrains from attacking the windmill, then he is doing something by not attacking the windmill. The puzzle is particularly difficult to be solved in modal action logics such as Dynamic Logic, where actions are treated as first-class citizens in the language (each modal operator corresponds to a different action-type), and where refraining is typically viewed as some sort of negation ranging over actions: "refraining from attacking the windmill" means NOT "attacking the windmill". In such setting refraining from A means performing any action among the available ones which is not A. However, from a formal point of view, the characterization of this negation operation is far from trivial (see Broersen 2003 for a detailed overview). Stit theory offers a strikingly simple solution: Don Quixote astit [NOT Don Quixote astit [Don Quixote attacks the windmill]]. That is to say, Don Quixote sees to it that (in the achievement sense) he does not see to it that (in the achievement sense) he attacks the windmill. Stit theory can therefore render refraining by means of a simple iteration of the stit operator itself (together with classical negation), rather than by enriching a modal theory of action with a sophisticated operation of action negation. If a theory has to be judged from the ease and elegance with which it can clarify complex and controversial notions, the notion of refraining strongly advocates for stit among the formal theories of agency which are at the moment avaliable in the literature.

Needless to say, the book provides a number of further different applications of stit theory to the analysis of deontic notions, responsibility attributions, and complex agency notions such as "could have done otherwise". It is a rich and insightful book, and it is so for its content as

well as, and perhaps primarily, for the principled method it exemplifies in applying logic to philosophical problems.

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Recensione

L'eterno Flusso Eracliteo. Il tempo fenomenologico nella fenomenologia di Edmund Husserl

E. Coppola

Milano, Guerini e Associati, 2004, 334 pp.

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Come giunge a manifestarsi una qualunque forma di oggettualità in un ambiente mutevole ed 'eracliteo' come il divenire dei fenomeni? Questo è l'interrogativo che funge da filo conduttore del lavoro di Emanuele Coppola, *L'eterno Flusso Eracliteo. Il tempo fenomenologico nella fenomenologia di Edmund Husserl*, edito nella collana *Epistemologica* per i tipi della *Guerini e Associati.*

Due sono le anime che danno vita al testo di Coppola. La prima, come indicato dal titolo, è di stampo eminentemente teorico e riguarda il problema della temporalità vissuta, o, detto altrimenti, dell'eterno flusso eracliteo. La seconda, invece, come suggerito dal sottotitolo, ha carattere storico-esegetico e concerne la ricostruzione del tema della temporalità all'interno di alcuni testi husserliani. Entrambe le anime si uniscono per dare vita ad un lavoro complesso e stratificato che, nonostante il suo livello specialistico, riesce nell'intento di rielaborare concetti, nozioni ed argomenti che, se adeguatamente confrontati con altri linguaggi filosofici, meriterebbero un riscontro maggiore all'interno dei dibattiti contemporanei in materia di tempo, costituzione, memoria ecc.

L'anima storico-esegetica del lavoro, che acquisisce tuttavia una sua identità solo compenetrandosi con i relativi interrogativi teorici, ha come obiettivo quello di fornire una ricostruzione del complesso di indagini che, in testi differenti, Husserl sviluppò sui temi della temporalità e della costituzione tra il 1983 e il 1917, periodo in cui si assiste al passaggio dalle analisi orientate in senso logico-psicologico delle *Ricerche Logiche* e della *Filosofia dell'Aritmetica* alla produzione delle *Idee per una fenomenologia pura e per una filosofia fenomenologica*. Le analisi di Coppola si concentrano in particolare sulle *Vorlesungen zur Phänomenologie des inneren Zeitbewußtsein*, risalenti al 1905, e sulla raccolta dei cinquantaquattro testi integrativi, *Ergänzende Texte zur Darstellung der Problementwicklung*, scritti tra il 1893 e il 1911. Entrambi i materiali sono stati analizzati a partire dal decimo volume dell'*Husserliana*, curato da Rudolf Boehm, dal titolo: *Zur Phänomenologie des inneren Zeitbewußtsein* (ZB).

Gli interrogativi teorici che guidano le singole argomentazioni del testo sono, a loro volta, una sorta di lungo commento all'affermazione presente nelle *Analysen zur passiven Synthese*,

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stando alla quale: "Tutto si costituisce nel divenire". Le nozioni centrali che ne organizzano i contenuti sono, in particolare, quelle di *temporalità vissuta* e *costituzione oggettuale*. Coppola ricostruisce le analisi husserliane elaborando un percorso teorico a doppio senso. Se da un lato, infatti, il problema della costituzione oggettuale può essere compreso solo se le dinamiche della temporalità vengono adeguatamente descritte e chiarite; dall'altro, il problema della temporalità vissuta può trovare una trattazione adeguata e soddisfacente solo se viene affrontato in relazione alle dinamiche costitutive. In termini più husserliani, si tratta di comprendere in che modo la pluralità delle *noesi* e dei *noemata* si costituiscano all'interno di quel flusso eracliteo che è poi il divenire dei fenomeni. A tal fine, "Gli atti intutitivi saranno presi in esame secondo la loro evoluzione diacronica, in quanto unità immanenti che si espandono nella corrente coscienziali secondo forme peculiari da analizzare." (p. 13) In questo modo il concetto di *noesi* viene restituito alla fluidità fenomenica. Parallelamente, il concetto di *noema* viene inserito nel flusso dei vissuti e anch'esso ne esce temporalizzato. Ne segue che l'ipotesi teorico-esegetica complessiva che anima l'intero testo consente di sostenere che "la temporalità, nella sua duplice struttura soggettiva e oggettiva, alla quale ogni oggetto in senso lato si trova necessariamente rimessa, fonda e giustifica le correlazioni *noetico-noematiche*, cosicché anche dopo l'introduzione del fattore temporale l'idea di una *noesi* correlata ad un *noema* continua ad essere pienamente intelligibile." (p. 13)

Il *Capitolo primo* è dedicato all'esposizione dell'armamentario concettuale delle ZB. Viene affrontato innanzitutto il problema del rapporto che lega tempo oggettivo (empirico e transiente) e tempo soggettivo (pre-empirico). La scansione statica dei vissuti temporali viene ricondotta, anche se non ridotta, alle dinamiche temporali e associative che caratterizzano le sintesi passive fra contenuti iletici. Inoltre, viene sottolineato come sia proprio la temporalità a consentire di superare la schema *statico* (dal punto di vista della correlazione) e *internalista* (dal punto di vista della considerazione della coscienza) e a condurre la fenomenologia verso analisi di stampo *genetico* e conclusioni di stampo *esternalista*.

Nel *Capitolo secondo* viene mostrato in che modo le analisi statiche possano assumere un nuovo sembiante se messe in relazione alle riflessioni sulla temporalità presenti in ZB. Esse infatti conducono all'indebolimento del paradigma esplicativo statico, poiché mostrano che la temporalità originaria non si riduce alla coesistenza-successione delle appercezioni soggettive, ma che al contrario ad essere sottoposti ad alterazione sono i contenuti iletici. La temporalità fornisce infatti la prima, più semplice e universale sintesi formale tra compagini iletiche, mentre dal punto di vista strettamente contenutistico-materiale si deve fare riferimento alle sintesi associative. L'ordinamento temporale è universale e nessuna sintesi contenutistica gli sfugge. Le due sintesi, tuttavia, possono essere considerate separatamente l'una dall'altra solo per astrazione: "la sintesi temporale non è tale – scrive Coppola – se non è simultaneamente una sintesi associativa: è questo il lampante dato di fatto che oscurerà i modelli matematici." (p. 19).

Il *Capitolo terzo* entra direttamente nel merito di come debba essere caratterizzato fenomenologicamente l'eterno flusso eracliteo. Oggetto di analisi sono, in questo caso, la sua anisotropia e la sua irreversibilità. Inoltre viene rielaborata una nozione *intensiva* dell'istante.

Il *Capitolo quarto* è poi dedicato alla struttura mereologica del presente vivente. Tale struttura è caratterizzata dall'interconnessione tra momenti materiali di tipo ritensionale, impressionale e protensionale. Come dimensione prioritaria e originaria della temporalità fenomenologica bisogna considerare *l'impressione originaria* (*Ur-empfindung* o *Ur-impression*). Ogni suo costituente temporale può essere descritto come un "sinolo di materia e forma" (p. 19). Dove la materia è la componente iletica propriamente detta (a seconda dei casi, un contenuto cromatico, acustico, tattile ecc.), mentre la forma si rivela "una componente nel tempo, che è indifferentemente concepibile in termini intensivi o estensivi [...]." (p. 19). Il *punto ora* contiene quindi una molteplicità sincronica di elementi ritensionali e protensionali al contempo.

L'ultimo capitolo, il *Capitolo quinto*, chiude il cerchio delle analisi mettendo in evidenza come sia possibile conciliare i due sensi di intenzionalità che caratterizzano il flusso temporale dei vissuti, vale a dire l'intenzionalità passiva dei contenuti iletici e quella attiva del soggetto.

L'eterno flusso eracliteo è un testo che vive di analisi attente, puntuali e estremamente specifiche. È possibile tuttavia mettere in evidenza alcuni spunti teorici più generali che possono interessare sia per la prosecuzione di un discorso fenomenologico sia per un confronto di quest'ultimo con prospettive teoriche ad esso eterogenee.

Innanzitutto, il testo getta nuova luce sul rapporto che lega immanenza e trascendenza. Infatti, se si considera come prioritaria la dimensione temporale, l'immanenza in-effettiva – o intenzionale – emerge come la somma dell'immanenza effettiva e della trascendenza effettiva, mostrandosi come un ambito che oltrepassa la sfera di ciò che è privato e che costituisce, al contrario, il terreno in cui prende corpo qualsiasi avere nella coscienza.

In secondo luogo, è il rapporto tra fenomenologia statica e fenomenologia genetica che viene affrontato e rielaborato da Coppola in maniera originale. Questi mostra infatti in che modo l'analisi genetica (tesa ad individuare sfere e ambiti di articolazione profondi che caratterizzano le configurazioni di senso già pre-oggettivate in sintesi della sensibilità, le cosiddette sintesi passive) non si contrapponga né invalidi le ricerche di tipo statico. Al contrario, la messa a punto delle prime costituisce un approfondimento delle seconde. Inoltre, nonostante le analisi genetiche forniscano la base a partire dalla quale è possibile guardare ai risultati dell'analisi statica, è possibile comunque continuare ad affermare la priorità del mondo già costituito, vale a dire delle analisi statiche.

Terzo, anche la nozione di atto, centrale per qualsiasi discorso fenomenologico, deve subire un notevole riassestamento di senso nel momento in cui viene formulato un invito a mettere a punto una rigorosa estetica fenomenologica che preveda una connessione sistematica, in termini teorici generali, fra le pre-datità del livello inferiore e le datità costituite nei livelli superiori. In questa direzione possono essere letti gli inviti dell'autore ad elaborare una fenomenologia iletica che consenta al discorso fenomenologico di concentrarsi sui problemi legati alla corporeità fenomenologica del copro proprio e alla considerazione del suo sistema cinenstetico.

Recensione

Modality and Tense: Philosophical Papers

K. Fine

Oxford, OUP 2005, pp. 387

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Il volume è composto di undici saggi, scritti da Fine tra il 1975 ed il 2005. Tutti i lavori hanno per tema, così come recita il titolo del volume, modalità o tempo. Tre sono inediti. Nello specifico, sono inediti: "Reference, essence, and identity", "Necessity and non-existence" e "Tense and reality". Il primo è il testo di una conferenza del 1984, gli altri due sono del 2005 (una versione più breve di "Tense and reality" era stata pubblicata in precedenza con il titolo "The reality of tense" su *Synthese* sempre nel 2005). Il volume, per precisa scelta dell'autore (a tal proposito si veda la prefazione), non contiene né i suoi lavori tecnici sulla logica modale né quelli filosofici sul tema dell'essenza. Due degli undici saggi sono recensioni, la prima a *Counterfactuals* di Lewis, la seconda a *The nature of necessity* di Plantinga. Il volume inizia con un'*Introduzione* in cui l'Autore traccia i contorni delle proprie tesi su modalità e tempo, e isola le tesi principali di ciascun saggio contenuto nel volume, assieme agli argomenti a sostegno delle stesse (questi ultimi sono solo abbozzati).

Le tesi di Fine sulla modalità sono formulate a partire dal rifiuto di due proposte che egli qualifica come "extreme and highly implausible" (p.1). La prima proposta, associata al nome di Quine, nega che le nozioni modali abbiano un qualche senso. Nella prospettiva di Quine non c'è nessuna distinzione intellegibile fra ciò che è necessario e ciò che è contingente, fra ciò che è essenziale e ciò che è accidentale. La seconda proposta, associata invece al nome di Lewis, consiste nell'argomentare a favore della tesi che ciò che è possibile ha pari dignità di ciò che è attuale. Una tale posizione ha come conseguenza che altri mondi possibili ed i loro abitanti siano considerati tanto reali quanto il mondo attuale ed i suoi abitanti.

Fine osserva, acutamente a giudizio di chi scrive, che entrambe le concezioni della modalità appena elencate, sebbene molto differenti, sono guidate da considerazioni generali molto simili, ovvero dall'adozione di una metodologia che privilegia considerazioni di tipo teorico piuttosto che argomenti basati sull'appello all'intuizione e da sospetti di natura empirista sulla modalità. Che la natura dei sospetti sia appunto empirista segue, per Fine, dall'osservazione generale che per una tale concezione filosofica qualcosa o succede o non succede e non c'è spazio per ciò che necessariamente deve succedere e/o ciò che può anche non succedere. Per l'empirista o si rifiuta *in toto* la modalità o la si considera come una forma di regolarità: dire che qualcosa capita necessariamente è semplicemente dire che avviene sempre, così come dire che qualcosa può capitare è dire che capita qualche volta. Senza dubbio la posizione di Quine sulla modalità è dettata da tali presupposti di natura empirista. Ma anche quella di

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Lewis ne è – a detta di Fine – fortemente influenzata. Infatti, combinando la prospettiva regolarista sulla modalità con una forma di nominalismo a proposito di ciò che c'è si ottiene una concezione molto simile a quella di Lewis sulla modalità; inoltre, secondo Fine, Lewis sarebbe scettico tanto quanto Quine sulle nozioni modali. Per entrambi la modalità sarebbe concepibile solo come una forma di regolarità: "the only difference between them lies in the range of the regularities to which their respective ontologies allow them to appeal" (p. 2).

Oltre ad una *part destruens* (che consiste appunto nel rifiuto di queste due posizioni estreme) la proposta di Fine sulla modalità ha anche una *pars costruens*. Egli, in positivo, è impegnato a sostenere: (a) il *modalismo*, ovvero la concezione secondo cui vi è una distinzione intelligibile fra ciò che si dà (a1) necessariamente e ciò che si dà invece solo contingentemente, e (a2) fra ciò che è essenziale e ciò che è accidentale; e (b) l'*attualismo*, la tesi secondo cui ciò che è attuale è ontologicamente prioritario rispetto a ciò che è meramente possibile. "My position is ... a form of modal actualism" (p.2). Primo obiettivo del modalista è difendere l'intelligibilità delle nozioni modali contro Quine.

Nella prima parte del volume – intitolata "Issues in the philosophy of language" – sono inclusi due saggi ("The problem of *de re* modality" e "Quine on quantifying in") nei quali si produce una dettagliata difesa del modalismo contro le obiezioni quiniane. Più nel dettaglio, Fine si occupa delle obiezioni di Quine alla modalità *de re*. Fine segue Quine nell'assumere che la modalità si può applicare in modo intelleggibile ad enunciati e si chiede: l'intelligibilità della modalità *de dicto* è compatibile con la sua intelligibilità *de re*? Quine propone due argomenti contro l'intelligibilità della modalità *de re*: uno metafisico ed uno logico. Il *focus* del primo argomento riguarda l'intelligibilità della proprietà di *essere necessariamente in un certo modo*, applicata ad un oggetto. Il *focus* del secondo argomento consiste invece nel dubitare che le variabili libere possano essere significativamente adoperate nell'ambito di un operatore modale. Fine osserva che nel valutare il primo argomento è importante essere chiari su quali siano le nozioni di necessità e possibilità che Quine ha in mente. Si tratterebbe, infatti, di modalità analitiche o logiche. In questi casi, per Fine, la comprensione dell'applicazione della modalità *de re* sarebbe già implicita nell'applicazione di quella *de dicto*. L'argomento di Fine a sostegno della tesi sopra espressa si basa su di una concezione della forma logica che si applica non solo ad enunciati, ma anche ad oggetti. Molta più attenzione è riservata da Fine al secondo argomento contro l'intelligibilità della quantificazione in contesti modali. L'argomento di Quine si basa sull'affermazione che l'occorrenza di termini singolari coreferenziali in contesti modali può mancare della sostitutività. Così, ad esempio, un enunciato del tipo "necessariamente 9 è maggiore 7" può essere vero, mentre l'enunciato "necessariamente il numero dei pianeti è maggiore di 7" falso, anche se il secondo si ottiene per sostituzione dal primo dei termini coreferenziali "9" ed "il numero dei pianeti". Per Quine, da ciò seguirebbe che la quantificazione nel contesto modale è inintellegibile. Non si sarebbe così in grado di dare un senso all'enunciato "necessariamente per qualche x, x è maggiore di 7". Fine prima divide l'argomento di Quine in cinque passi e poi mostra alcuni modi in cui ciascun passaggio può essere contestato. Mostra, infine, come i vari passi dell'argomento non funzionano nel caso modale.

L'altro saggio della prima parte è "Reference, essence, and identity". Qui – contrariamente alla *common view* sulla questione – si fornisce una risposta negativa alla domanda: "la teoria del riferimento diretto ci costringe ad accettare modalità *de re* e identificazione attraverso mondi?". Particolarmente interessante nell'articolo in questione è la distinzione fra antiecceitismo modale e metafisico. L'antiecceitismo modale è la tesi secondo cui tutti i mondi possibili sono dati, in ultima analisi, in termini puramente qualitativi. L'antiecceitismo metafisico è invece la tesi secondo cui l'identità degli individui va spiegata nei termini delle loro caratteristiche puramente qualititative o relazionali. Ad avviso di Fine l'incapacità di distinguere fra queste due tesi rende incomprensibile la discussione dell'identità attraverso mondi.

Nella seconda parte del volume, intitolata "Issues in ontology", Fine argomenta a favore della seconda tesi sulla modalità: l'*attualismo*. Tutti e tre i lavori ("Prior on the construction of possible worlds and instants", "Plantinga on the reduction of possibilist discourse" e "The problem of possibilia") hanno a che vedere, infatti, con questa posizione sulla modalità. In particolare, l'Autore si concentra sulla seguente difficoltà per l'attualista: *prima facie* è sensato parlare di oggetti meramente possibili; si parla e si ascolta ad esempio alla radio di una possibile guerra fra India e Pakistan. Ci pare che un enunciato che dica qualcosa a proposito di questa possibilità sia vero. Problema: come è possibile dar conto di ciò in una prospettiva attualista, prospettiva nella quale non si accettano oggetti meramente possibili? Fine analizza e rifiuta varie soluzioni al problema, nello specifico varie versioni dell'ersatzismo modale. In generale, per gli ersatzisti modali i mondi possibili sono dei surrogati di certi elementi del mondo attuale. Perciò, la loro posizione prende il nome di *ersatzismo*, dal tedesco "ersatz": "surrogato", "sostituto" (*proxy* riduzione). Si consideri, ad esempio, un enuciato del tipo (*) "Avrebbero potuto esserci più stelle di quelle che ci sono". Anche per l'ersatzista vi è una stretta relazione tra l'enunciato (*) e (**): "È possibile che ci siano stelle che attualmente non esistono". La relazione consisterà nel fatto che (**) ci impegna ad accettare la verità di un enunciato quale: (***) "C'è un mondo in cui ci sono più stelle di quante ce ne siano nel nostro mondo". Ma, quando si tratta di chiarire l'impegno ontologico di (***), l'ersatzista rifiuta di impegnarsi all'esistenza di altri enti che non siano un surrogato di enti del nostro mondo. Grazie alla critica all'esatzismo Fine propone la propria versione dell'attualismo modale.

Fine considera, in particolare, la versione dell'ersatzismo di Plantinga (nel saggio "Plantinga on the reduction of possibilist discourse") secondo il quale un mondo possibile è una descrizione, data in un certo linguaggio, completa e consistente, di uno stato di cose. Un mondo in cui ci sono più stelle di quelle che esistono nel nostro mondo non è altro che una descrizione, completa e consistente, di uno stato di cose, data, per esempio, in italiano. Per Fine la riduzione proposta da Plantinga è circolare poiché il corretto uso di descrizioni presuppone il possibile individuo in questione. La riduzione proposta da Fine del discorso possibilista non è invece da considerarsi come una forma di *proxy* riduzione. Gli oggetti possibili non sono sostituiti con altri oggetti adatti allo scopo; invece il riferimento ad oggetti possibili diviene una modalità del riferimento agli attuali. La quantificazione su oggetti possibili è trattata come quantificazione attualista all'interno dell'operatore modale. L'affermazione che un certo oggetto possibile è in un certo modo è così interpretata: "C'è un mondo attuale

tale che è possibile che ci sia qualche oggetto attuale per il quale necessariamente, se il mondo è possibile, l'oggetto è in quel modo". Anche il lavoro "The problem of possibilia", articolo introduttivo alla sezione, costituisce una critica ai vari tipi di *proxy* riduzione. Di nuovo Fine presenta la sua proposta, qui in modo più generale e meno formale.

La terza parte del volume si intitola "Issues in metaphysics". Ne fanno parte: "The varieties of necessity", "Necessity and non-existence" e "Tense and reality". I primi due articoli della sezione sostengono una forma di pluralismo modale: nel primo si argomenta contro la riducibilità di modalità metafisica, naturale, e normativa. La tesi di Fine è che la necessità naturale non può essere ridotta a quella metafisica. Analogamente, non vi è un modo plausibile di ridurre la necessità metafisica a quella normativa. Nel secondo saggio si mostra come all'interno della stessa necessità metafisica possano distinguersi due modi differenti, non riducibili l'uno all'altro, in cui una proposizione è necessaria. Il saggio in questione inizia con un *puzzle*. Si considerino i seguenti enunciati: (*) "necessariamente Socrate è un uomo"; (**) "È possibile che Socrate non esista"; da (*) e (**), si ha (***) "È possibile che Socrate non esista e sia un uomo". La prima premessa sembra vera, almeno per quelli che accettano che sia parte della natura di Socrate quella di essere un uomo. Se si è scettici sull'essenzialismo si potrà usare "identico a se stesso" invece che "uomo". Anche la seconda premessa sembra essere vera, poiché Socrate, per certo, non esiste necessariamente. La conclusione (***) sembra seguire necessariamente dalle due premesse per un banale ragionamento modale. Si tratterebbe dunque di un ragionamento corretto con premesse vere. Tuttavia la conclusione sembra essere inaccettabile. Fine, allo scopo di risolvere problemi quali quelli sopra formulati, propone di distinguere fra una necessità immanente ("worldly") ed una necessità trascendente ("unworldly"). Una proposizione è immanentemente necessaria quando la sua verità dipende dalle circostanze del mondo. Al contrario sono *trascendenti* quelle verità che non dipendono dalle circostanze del mondo. Per Fine un enuciato quale "Socrate esiste o non esiste" è un esempio di necessità immanente; al contrario "Socrate è identico a se stesso" è un esempio di necessità trascendente. È un enunciato necessariamente vero e tuttavia il suo essere necessariamente vero non dipende da come stanno le cose. Ora, come osserva Thomas Crisp nella sua recensione al volume di Fine[*] – osservazione che mi sento di sottoscrivere – che *Socrate sia un uomo* sembra essere un caso paradigmatico di verità che dipende da come stanno le cose e non come un caso di necessità che non dipende da come possono stare le cose.

Infine, nel saggio "Tense and reality" l'Autore discute la relazione fra tempo e realismo. Si tratta di un articolo interessante destinato, secondo chi scrive, ad essere ampiamente dibattuto negli anni a venire. Nel saggio si discute il significato del realismo sul tempo. Fine propone un modello per distinguere fra realisti ed anti-realisti sul tempo. Nei termini di questo modello presenta poi un'analisi del paradosso di McTaggart. È proposta una sorta di *realismo non-standard* secondo il quale la realtà è fatta, almeno parzialmente, di fatti irriducibilmente temporali, ma a differenza del realista tradizionale non vi è nessun istante privilegiato in base

[*] T. Crisp, *Review to K. Fine Modality and Tense*. In Notre Dame Journal of Philosophical Review, 2006.

al quale i fatti temporalizzati sarebbero orientati. Non vi è un unico *ora*, ma ce ne sono molti che sono ugualmente reali. Questo perché, nella concezione di Fine, non c'è un'unica realtà coerente che comprende la totalità dei fatti temporalizzati. Per il realista non-standard alla Fine o (i) ci sono molte realtà, ciascuna delle quali è *relativa* o *indicizzata* ad un qualche tempo o (ii) c'è una singola realtà, che però è in un senso importante *incoerente*: è fatta di fatti temporali incompatibili, così come *il mio stare in piedi* o *il mio stare seduto*. Il realismo non-standard, in altri termini, consiste nel sostenere la tesi che non vi è nessuna singola totalità dei fatti: vi sono molte totalità di fatti, molte realtà, ciascuna delle quali indicizzate ad un tempo.

La quarta, ed ultima, parte del volume comprende le due recensioni: la prima a *Counterfactuals* di Lewis, la seconda a *The Nature of necessity* di Plantinga. In entrambi i lavori Fine, dopo aver esposto il contenuto del libro recensito, si concentra su alcuni problemi tecnici e fornisce alcune obiezioni alle teorie modali presentate nei due saggi recensiti[†].

[†] Desidero ringraziare Roberto Ciuni per gli utili commenti ad una versione precedente di questo lavoro.

Book Review

Time and Realism

Y. Dolev

MIT Press, 2007, pp. 237

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Time and Realism is a courageous book. With a clear prose and neatly woven arguments, Dolev takes the reader through two different, although related endeavors. The first (Chapters 1-4) is an assessment of the two major conceptions of time – the so-called *tensed* and *tenseless* views;the finale of this part avers that both views, in their different versions, play against serious challenges. The second and more ambitious endeavor (Chapters 5 and 6) argues that these challenges can be 'transcended' (to use Dolev's own expression) and, hence, that philosophy can be liberated from old burdens such as explaining time's passage, or what time is, or why the future appears as open.

In this review I will first point out two desirable theoretical distinctions that are missing throughout the volume and from which I believe Dolev's study would have substantially benefited. I will then discuss two aspects of the second, more inventive endeavor. It should be stressed, however, that the first four chapters contains original sections too, such as §3.2, a rather meticulous discussion of Dummett's antirealist conception of tensed propositions, and §4.3, a discussion of Mellor's tenseless view.

Time and Realism looks into lasting philosophical conundrums that arise when we ponder the nature of time. At the core of the investigation lies the distinction between a tensed and a tenseless view of time– distinction which is, eventually, rejected by Dolev. Roughly, tensed theorists maintain that any vindication of what there is, is given within a certain temporal perspective, which breaks away time in a past, a present, and a future; thus, our world is such that Napoleon *was* exiled in St Helena between October 1815 and May 1821. Tenseless theorists, on the other hand, give a description of reality which is a-temporal: whether a subject regards a certain event as being – say – past is not constitutive of what the event is; thus, our world is such that Napoleon *is* exiled in St Helena between October 1815 and May 1821 (where 'is' has to be read a-temporally, as when we say that "The set of equilateral triangles is the set of equiangular triangles").The opposition between the tensed and the tenseless view is essentially a semantic opposition: it interests the way in which a statement is true – whether it is true a-temporally or relatively to a certain time.

Still, when it comes to the metaphysics of time, there are at least two more distinctions that typically playa relevant theoretical role. One involves so-called three- and four-dimensionalism. Roughly, the first holds that a material object is wholly present at each instant at which it exists. So, for example, on October 20, 1815, at 11:34am Napoleon is wholly

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present. Four-dimensionalists, on the other hand, maintain that a material object is only partially present at each instant at which it exists: on October 20, 1815, at 11:34am a 'temporal slice' of Napoleon is present, not the whole Napoleon. Three- and four-dimensionalism, thus, aim at providing a metaphysical account of the persistence of material objects through time. (There are other theoretical options, such as the so-called stage-view, that I am here omitting for the sake of space.)

Contenders in the other distinction are the so-called presentists and eternalists. Those defending the first view claim that only present entities exist; so, literally speaking, 'the exile of Napoleon' is an empty description, although there may be at present entities whose existence is explained also in terms of such a description. On the other side of the spectrum, eternalists claim that past, present, and future entities all exist; thus, the exile of Napoleon is real as much as the fact that you are reading this words right now. (I'm omitting here, again for the sake of space, other intermediate positions, such as the so-called growing universe view, according to which only the past and the present exist, but not the future.)

Time and Realism does not make use of the three- *vs* four-dimensionalist nor of the presentist *vs* eternalist oppositions; no mention is made of the first one, while the second is quoted on p.6, where it is regarded as equivalent to the tensed *vs* tenseless opposition. This absence renders the conceptual articulation of the book wanting in a number of places. For example, much of the discussion in Chapter 4 on the emergence of an ontology of time would benefit from the introduction of both distinctions (especially the discussion of Mellor's view, §4.3); or, the examination of Dummett's position (§3.2) would be more transparent, if Dummett were more explicitly characterized as a presentist. More generally, the sole use of a semantic distinction (tensed *vs* tenseless) throughout the volume strikes as peculiar, considering that the book deals with ontological accounts of time.

Let us now move to consider Chapters 5 and 6, where Dolev lays out his most original material. It is here that he purports to show that the major ontological issues on the nature of time can be 'transcended'. With this expression Dolev expresses anattitude, proper also of the late Wittgenstein, according to which the philosophical conundrums that arise when we peruse for longer than usual our ordinary worldview can be dissolved; and the role of the philosopher is precisely to show how this can be done. Thus,the key to transcend the ontological issues on the nature of time lies in realizing that "tense cannot be cast in ontological terms." (p. 114)This conviction is arrived at after a meticulous examination of the tensed and tenseless views, both of which – it is argued – cannot provide a satisfactory explanation of time's passage (among other issues).

Whether Dolev's assessment of these views is accurate I shall leave open. What strikes as particularly challenging is his tentative of dissolution of the ontological issues on the nature of time. Having to select some portions of it, I will concentrate, in order, on his alleged dissolution of two problems: of the duration of the present moment (§5.1) and of the presence of experience (§5.2). Other problems for which he tries to account are: the fact that remembered experiences appear as past(§5.3); the flow of time (§5.4); the tensed character of first-person experience (§5.5); the apparent openness of the future (§5.6); and the implications of Relativity Theory on our conception of time (§5.7).

How long is the present moment? On his way to reply this question, Dolev at first notices that there is "a striking discrepancy between the philosopher's vanishing present and the apparent temporal voluminousness of present events and states of affairs." (p. 118)Building on this remark, he then argues that this old and vexed question becomes problematic only once we start presuming (as the typical philosopher does) that there has to be *one* specific duration which constitutes *the* answer to such question.

It is unclear, however, whether Dolev provides sufficient ground upon which to rest his argument. He brings forward two points that are, allegedly, in his favor; but neither of them seems tenable. The first is an appeal to the reader's intuitions:"it seems evident to me that there is nothing wrong with speaking, say, of the hockey game – as opposed to some "instantaneous parts" of the game – as present event." (p. 118) With this I might agree, if it were not for the fact that it is also evident to me that there is nothing wrong with speaking, say, of the hockey game as *being partially gone and partially yet to be done*, thus implying that only a tiny fraction of it is present; this strikes me as the way in which most players, the coach and many spectators probably conceive of the game in order to make the most of it. Thus, which conception one ought to favor is unclear and it seems thatone could contemplate both at once.

The second point hinges on an analogy between the adverbs 'here' and 'now':

> It is evident that "here" is not pointlike, that by asserting that she is here, in New York, Dana does not mean that the whole of New York is somehow here, inside her room. But then why would anyone have thought that by asserting that the game is now in progress, one might have meant that the entire game, all three periods of it, are being played now, at this very instant? (p. 120)

The analogy between space and time, is, however, not always a fitting one. At least phenomenically, the reasons why 'here' differs from 'now' are readily pointed out: while we are able to*perceive* extended regions of space, we are not able to perceive extended (or, at least: comparatively extended) regions of time; we may *conceive* of the latter and thus speak of them, and perhaps we may use our adverbs as referring to what we are conceiving; but, in their most crudely acquaintance-related character, 'here' and 'now' differ substantially. Thus, Dolev's argument aiming at dissolving the problem of the duration of the present is found wanting. The suspicion is that, in order to pin down a solution to it, one would have to revert to some kind of ontological explanation– the one that Dolev is trying to avoid.

Let us now move to consider the problem of the presence of experience. In order to dissolve it, Dolev brings in an analogy with §50 and §279 of Wittgenstein's *Philosophical Investigations* (see pp. 132-136).There Wittgenstein argues that an entity cannot be the measure of itself; thus, for example, of the standard meter which is in Paris one cannot say that it is or that it is not a meter long. Along the same lines, for Dolev, "an experience's presence is like S's meterhood: it is a ghost of a phenomenon, not something in relation to which the idea of an explanation, or an account, can be given in any sense." (p. 136) That an experience is present works as a standard for sorting out what is past, what is co-present, and what is future; but, of the experience itself, it does not make sense to say that it is or that it is

not present. Indeed, "we certainly do not establish that *e* is present by *comparing* its temporal location with that of some other event." (p. 137)

Dolev's point is well-taken only if to establish what is present in one's experience turns out to be just a business of setting a standard, like when we have to measure the length of an object. However, one could argue that the presence of experience is deeply rooted in a *self-conscious realization of being alive* (as, for example, authors such as Sartre or Heidegger did). It is not accidental, one could note, that we speak of 'the presence of experience' but not of 'the length of experience' (with reference to the portion of space one is experiencing); indeed, the former is a concept which is constitutive of being a person, while the latter is not. Thus, when Mary says of her experience that it is present, she is saying something meaningful: roughly, that through such an experience she *realizes that she is alive*. And, if this is the case, then the analogy with Wittgenstein's line of argument is dispersed, and with it the alleged dissolution of the problem of the present experience.

Commentary*

Past, Present and Future

Arthur Prior

Oxord, Oxford University Press, 1967 – 2002 reprint

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In the 50's and the 60's, Arthur Prior fathered and laid out the foundations of tense logic -the logic of sentential operators like e.g. 'it was the case that …', 'it will be the case that…', or again 'it will be the case that… until...'- as we know it today. He also greatly contributed to other branches of modal logic,[1] most notably alethic modal logic, as well as to a number of other subjects of study, within logic and the philosophy of language, but also, amongst others, metaphysics and ethics.

Past, Present and Future (hereafter PPF) is one of the three books on tense logic Prior published before his early death in 1969; its publication follows *Time and Modality* (1957), and immediately precedes *Papers on Time and Tense* (1968). Although the main topic of these books is tense logic, they also all concern modal logic broadly speaking, and alethic modal logic in particular -indirectly, insofar as many considerations pertaining to tense logic are relevant to other parts of modal logic or to modal logic in general, but also explicitly. As Prior himself puts it, PPF is a sequel to *Time and Modality*. Published ten years later, at a time when the young modal logic was intensively investigated, PPF strikes the reader as a much more mature book than its predecessor. *Papers on Time and Tense* is a collection of articles of a less homogenous character than the other two books.

PPF covers a lot of material, part of it at great length and the rest in the form of shorter remarks. The topics and issues it deals with include: the pre-history of tense logic; the logical grammar of tensed discourse; the axiomatization of tensed logical systems given various alternative hypotheses about the structural properties of time, e.g. linearity, being branched, circularity / continuity, density, discreteness; the study of "non-standard" tense-logical operators, e.g. the so-called metric operators; tense logic and relativistic physics; the interaction of tense with alethic modality; determinism and fatalism; the interaction of tense and alethic modality with quantification and reference; presentism and the so-called growing-block theory; the problem of cross-temporal relations; the translation of tensed language into the language of times and truth-at-a-time, and the reverse translation. Like so many of Prior's writings, PPF mixes great philosophical insight and fine technical considerations, and displays a strong command of the relevant contemporary literature, as well as an acute knowledge of

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[1] I here follow a standard use of the phrase 'modal logic'. The expression is sometimes used only for what I hereafter call 'alethic modal logic'.

relevant figures of the history of philosophy -ancient, medieval and modern- which is always wittingly and fruitfully used for systematic purposes.

Despite its great importance, Prior's logical and philosophical work has always been in relatively great parts neglected, or even ignored. (To give but one striking example, what is now known as "hybrid logic" was invented by Prior in the mid-60's, completely forgotten soon after, and reinvented about twenty years later).[2] Part of the reason may lie in Prior's use of the unpopular Polish logical notation, as well as in the fact that in many of his writings, Prior often fails to neatly separate philosophical from formal considerations. Be it as it may, Prior's work definitely deserves to reach a wider audience than the one it currently has, and one only hopes that the recent reprint of PPF will help in this respect.

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Since the publication of PPF in 1967, the amount of work in philosophical modal logic has been tremendous, and it is still constantly growing. The content of the book, and of Prior's writings in general, is accordingly in certain respects outdated. Yet, there is a substantial part of Prior's work which has been hitherto largely overlooked, and which deserves the attention of current philosophical logicians. It is not the place here to try and make a substantial list of the currently debated issues I take Prior's neglected logico-philosophical work to be relevant to. But let me mention, and briefly elaborate on, two of them.

The first issue, which I only touch upon here, is that of the analysis and logic of essentialist statements, namely of statements of type '*a* essentially *F*s' and the like. It has long been taken for granted that such statements are to be analyzed in terms of the "metaphysical" alethic modalities. On that account, for instance, '*a* essentially *F*s' is to be understood as 'it is metaphysically necessary that *a F*s', or, according to a variant of the account, as 'it is metaphysically necessary that if *a* exists, then *a F*s'. Such modal accounts have recently been questioned, most prominently by Kit Fine (Fine, 1994). Fine's view is that it is the concept of metaphysical necessity which is to be understood in terms of the concept of essence, rather than the other way around, and that the concept of essence itself cannot be understood in fundamentally different terms.

Given his view of the concept of essence as primitive, Fine develops a proper logic of essentialist claims (Fine, 1995) and a world semantics for that logic (Fine, 2000).[3] It turns out that that semantics is Priorean in character, insofar as its foundations are essentially the same -up to a detail (albeit of some philosophical importance) concerning existence and objecthood- as those of the natural world semantics for Prior's quantified modal logic *Q*.[4] In a nutshell, the semantics for *Q* allows for truth-value gaps, and has it that a statement about an object, whatever its logical complexity, is neither true nor false at worlds where the object fails to exist. The above mentioned semantics for the Finean logic of essence also allows for gaps, and

[2] The first published writings on the topic are in PPF, Ch. V, § 6 and Appendix B, § 3. See (Blackburn, 2006).
[3] Also see (Correia, 2000).
[4] On *Q*, see e.g. (Prior, 1957), Ch. V and PPF, Ch. VIII.

has it that a statement about an object lacks a truth-value at worlds where the object fails to "be", the notion of "being" at a world being weaker than that of existing at a world.

Let me finally mention that I recently argued that modifying the natural world semantics for *Q* in the way suggested above gives rise to a non-standard conception of the metaphysical modalities, which is richer than the standard conception, and which allows one to devise a modal account of essence which escapes Fine's objections to the standard accounts. The advocated view is thus that although Fine's claim that no modal account of essence is possible may be correct if 'modal' points to a standard conception of metaphysical necessity and possibility, it is incorrect if 'modal' is understood as encompassing the richer Priorean conception.[5]

The second issue I wished to mention is that of the reduction of eternalist talk to presentist talk, and it is the proper topic of the next section.

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Presentists believe that everything -in the most unrestricted sense of the term- is present. Eternalists deny this. They believe that there are things which were present but are not so anymore, and, likewise, that there are things which will be present but are not yet so.

Although presentists disagree with eternalists, some of them may still think that (at least some) talk of merely past and merely future things makes *some* sense, and accordingly for them the task is to provide an account of *which* sense that talk may be taken to have. Prior was such a presentist, and in the following I will focus on those presentists who advocate that view. Let me use 'Σ' for the eternalists' existential quantifier, reserving '$\exists$' for that of the presentists. I take the task of our presentists to provide a translation of statements containing 'Σ' into statements which do not contain it, but which in some sense capture what eternalists take the former statements to say.

The way this can be done depends on which statements containing 'Σ' are taken into consideration. Let $\boldsymbol{L}^{Et}$ be a first-order tensed language, whose sole quantifier is the eternalist 'Σ', whose vocabulary comprises the predicates 'T' for 'is a time' and 'P' for 'is present', and whose sole tense-logical operators are '*P*' for 'sometimes in the past' and '*F*' for 'sometimes in the future'. I will suppose that the statements under consideration are those of the form '$\Sigma x \varphi x$', where 'φx' is an open formula of $\boldsymbol{L}^{Et}$ which contains no occurrence of 'Σ'. Thus, if $\boldsymbol{L}^{Et}$ comprises the predicates '…is a dinosaur' and '...is a war between … and …', and the names 'Switzerland' and 'Swaziland', then among the statements under focus are '$\Sigma x \neg$(*x* is present)', 'ΣxP(*x* is a dinosaur)' and 'ΣxF(*x* is a war between Switzerland and Swaziland)'. The restriction to these statements is rather substantial, but being more general would require considerably more space.

I wish here to present three distinct candidate presentist-friendly translations of statements of the sort under consideration which, although never put forward by Prior himself, nevertheless rather naturally come to mind given some material found in PPF and other of his writings. The first two of them can be found in some writings where Fine pursues Priorean

[5] See (Correia, 2007), and (Fine, 2007) for a response.

lines of inquiry about alethic modality and tense (see references below), but they are widely ignored by philosophers of time, probably in part because Fine's writings mostly concern explicitly only the alethic modalities.[6] As far as I know, the third translation has never been put forward.

In many cases, the adequacy of a reduction of eternalist talk to presentist talk turns on considerations relative to the structure of time. I will assume that time is linear, rather than e.g. branching towards the future or cyclic. This assumption is substantial, but dealing with other views would require too much space.[7]

Consider, then, the statement:

(1) $\Sigma x \varphi x$

where 'φx' is an arbitrary open sentence of the sort under consideration. The first presentist-friendly translation of (1) I wish to present is done into a first-order tensed language $\boldsymbol{L}^{\mathrm{Pr}}$, which is just like $\boldsymbol{L}^{\mathrm{Et}}$ except that its sole quantifier is '$\exists$' rather than 'Σ'. I will informally present that translation in two main steps. The first takes us from (1) to a translation in the language of times and truth-at-a-time, namely (3) below. The second takes us from (3) to the final translation (4).

The eternalist will say that (1) is true at a time t_0 iff there is an object x, past, present or future, such that it is true at time t_0 that φx. Using 'at t:' for 'it is true at t that', and, as before, 'T' for 'is a time' and 'P' for 'is present', the view is that (1) is true at t_0 iff the following holds:

(2) $\Sigma t' \, (\mathrm{T}t' \wedge \text{ at } t' \colon \Sigma x(\mathrm{P}x \wedge \text{at } t_0 \colon \varphi x))$.

Given that for the eternalist, for all times t and t', t' belongs to the extension of the presentness predicate at t iff $t = t'$, (1) is, from the eternalist perspective, equivalent to (i.e. true at the very same times as) the more complex:

(3) $\Sigma t \;\; (\mathrm{T}t \wedge \mathrm{P}t \wedge \Sigma t' \, (\mathrm{T}t' \wedge \text{ at } t' \colon \Sigma x(\mathrm{P}x \wedge \text{at } t \colon \varphi x)))$.

This completes the first step.

The second step can be presented in four sub-steps. The first three are rather obvious. (3) has the form 'Σt (Tt $\wedge$ Pt $\wedge$ ...)'. Eternalists typically view the presentists' quantifier '$\exists$' as a

[6] It is well known that lots of considerations about the alethic modalities apply *mutatis mutandis* to the tenses -this is the case here- and *vice versa*. Yet, sadly enough, specialists in one of these two topics are often ignorant of relevant bits of literature on the other topic. It should also be emphasized that, strangely enough, Fine's writings on the reduction of possibilist discourse to actualist discourse seem to be largely ignored even by philosophers of the alethic modalities.

[7] I should also mention that I do not aim at absolute formal precision, so at several points I will leave aside certain considerations, some of detail and others of a more substantial character, as well as certain technical niceties.

restriction of their 'Σ' to present things. On that account, 'Σt (Tt $\wedge$ Pt $\wedge$ ...)' can be rendered into '$\exists t$ (Tt $\wedge$ ...)'. The first sub-step of the translation thus takes us from (3) to:

(3_1) $\exists t$ (Tt $\wedge$ $\Sigma t'$ (Tt' $\wedge$ at t': Σx(Px $\wedge$ at t: φx))).

Given the same considerations, 'Σx(Px $\wedge$...)' can be rendered into '$\exists x$…'. The second sub-step of the translation takes us from (3_1) to:

(3_2) $\exists t$ (Tt $\wedge$ $\Sigma t'$ (Tt' $\wedge$ at t': $\exists x$(at t: φx))).

Let me use '$S\alpha$' for '$P\alpha \vee \alpha \vee F\alpha$' (read: 'sometimes, α') -and '$A\alpha$' for '$\neg S\neg\alpha$' (read: 'always, α'). Eternalists typically take it that a statement of type '$S\alpha$' is true (at a time) iff '$\Sigma t'$(Tt' $\wedge$ at t': α)' is true (at that time). The third sub-step is inspired by that account, and it takes us from (3_2) to:

(3_3) $\exists t$ (Tt $\wedge$ $S\exists x$(at t: φx)).

All that remains to be done is then to translate 'at t: φx' in (3_3).

This can be done by exploiting an idea put forward by Prior in the context of his reduction of times to "instantaneous world-states" (see below). The suggestion is to translate the expression into 'S(Pt $\wedge$ φx)'. In order to appreciate why the suggestion is adequate, it is enough to notice that for the eternalist who endorses the previous view about statements of type '$S\alpha$', a statement of type 'S(Pt $\wedge$ α)' is true (at a time) iff the statement 'α' is true at time t. The fourth sub-step accordingly takes us from (3_3) to:

(4) $\exists t$ (Tt $\wedge$ $S\exists x S$(Pt $\wedge$ φx)).

(4) is the first candidate presentist-friendly translation of (1) I wanted to present.[8]

Prior was against quantification over times as *sui generis* entities,[9] and he would accordingly not have accepted (4) as a translation of (1) as it stands. Yet he advocated a reduction of talk about times and truth-at-a-time to talk of "instantaneous world-states",[10] which naturally yields a corresponding translation.

[8] Notice that granted that always, there is one and only one present time -in the presentist language: $A\exists!t$ Tt, (4) is equivalent to any of the following:

- $\exists t$ (Tt $\wedge$ $S\exists x A$(Pt $\supset$ φx))
- $\forall t$ (Tt $\supset$ $S\exists x P$(Pt $\wedge$ φx))
- $\forall t$ (Tt $\supset$ $S\exists x A$(Pt $\supset$ φx))

and also to 'the present time t is such that sometimes, there is a present thing x such that sometimes, both t is present and φx'.

[9] See PPF, pp. 74-6.

[10] See PPF Ch. 5, and Appendix B § 3.

An instantaneous world-state is a proposition which represents the totality of what is true at a given time. Prior suggests to define 'α is an instantaneous world-state' -abbreviated below as 'Qα'- as '$S\alpha \wedge \bar{\forall}\beta(A(\alpha \supset \beta) \vee A(\alpha \supset \neg\beta))$', where '$\bar{\forall}$' is a universal propositional quantifier. In proper English: an instantaneous world-state is a proposition which is sometimes true, and which is maximal, in the sense that for every proposition, either it implies that proposition or it implies the negation of that proposition. For Prior, thus, quantification over times is to be replaced by quantification over instantaneous world-states. And he suggests that truth-a-time be accordingly understood in terms of permanent implication, i.e. that 'it is true at time *t* that β' should be understood as '$A(\alpha \supset \beta)$' -which is equivalent to '$S(\alpha \wedge \beta)$' -where α is the instantaneous world-state corresponding to *t*.

In that setting, to the notion of a time *being present* naturally corresponds the notion of an instantaneous world-state simply *being true*. The natural translation of (4) in the appropriately defined language of instantaneous world-states is thus:

(5) $\quad \bar{\exists}\alpha\,(\mathrm{Q}\alpha \wedge \alpha \wedge S\exists x S(\alpha \wedge \varphi x))$.

This is the second candidate presentist-friendly translation of (1) I wished to present. Interestingly, something equivalent to (5) can be obtained directly starting from (3) and using Prior's reduction of talk about times and truth-at-a-time. First, move from (3) to:

(3_4) $\quad \Sigma t\ (\mathrm{T}t \wedge \mathrm{P}t \wedge \Sigma t'\ (\mathrm{T}t' \wedge \text{at } t'\text{: } \exists x(\text{at } t\text{: } \varphi x)))$.

By the Priorean reduction, one then directly gets:

(3_5) $\quad \bar{\exists}\alpha\,(\mathrm{Q}\alpha \wedge \alpha \wedge\ \bar{\exists}\beta(\mathrm{Q}\beta \wedge S(\beta \wedge \exists x S(\alpha \wedge \varphi x))))$.

Given that '$\bar{\exists}\beta\,(\mathrm{Q}\beta \wedge S(\beta \wedge \delta))$' is equivalent to '$\delta$',[11] ($3_5$) is equivalent to (5).

Prior did not himself come up with (5) as a presentist-friendly translation of (1).[12] Yet, as I just stressed, the suggestion is natural given his own reductive views, and this is actually confirmed by some of Fine's work elaborating on Priorean views about alethic modality and tense.[13]

Taken at face value, (4) involves quantification over times and (5) quantification over propositions. Accepting (4) or (5) as an appropriate translation of (1) thus leads to the question

[11] The left-to-right direction is straightforward. For the other direction, see PPF p. 190.

[12] He only briefly raises the question of the reduction of 'Σ' in a context similar to the one which occupies us here in (Prior, 1968a).

[13] See the appendix to (Prior & Fine, 1977), in particular § 6, subsection "Possibilist quantifiers". For the view of (4) as a candidate presentist-friendly translation of (1), see (Prior & Fine, 1977), § 6, subsection "No sorts'", as well as (Fine, 1985) and (Fine, 2003). In all these texts, Fine's focus is on the alethic modalities and the reduction of possibilist discourse to actualist discourse, but the relevant considerations apply *mutatis mutandis* to the temporal case in a straightforward way (but see the appendix to (Prior & Fine, 1977), in particular §8, for considerations about time).

whether quantification over the relevant entities should really be countenanced or whether it should be reduced to something else, and, if it should be reduced, how the reduction should go. As we saw, Prior was unhappy with a full-fledged ontology of times and preferred to reduce talk about times to talk about propositions. In addition, he held a view about propositional quantification according to which such quantification is not objectual, and accordingly does not *per se* commit one to entities such as propositions or other abstract entities.[14] Clearly, there are various other views in this area. And equally clearly, every such view is bound to be rejected by some philosophers. For that reason, it would be nice to be able to put forward a translation of (1) which does not involve quantification over times or propositions or other potentially problematic entities.

For those who view quantification over *numbers* as unproblematic, a suggestion can be put forward, which invokes certain tense-logical operators discussed by Prior in PPF (Ch. VI), and which have actually been studied for the first time by Prior himself (Prior 1957 Ch. II) -the so-called *metric* operators. Prior never used the metric operators for the purpose of reducing eternalist talk to presentist talk, but he could easily have done so since, as the reader will realize, the idea of using them for that purpose is extremely natural.

The familiar tense-logical operators 'sometimes in the past' and 'sometimes in the future' are blind to temporal distance: 'sometimes in the past, α', for instance, if true, does not say *how long ago* 'α' was true. The metric operators are simply tense-logical operators which do express temporal distances. For the sake of illustration, let me choose the day as the unit for temporal distances, and let me use '... days ago, ---' and '... days hence, ---' as basic metric operators. Each of these two operators takes a term (name or variable) for a strictly positive number in its first position and a (closed or open) sentence in its second position to make a (closed or open) sentence. Which strictly positive numbers can be referred to, or ranged over by, terms filling in the first place of these operators depends on the structure of time: if time is continuous, for instance, an appropriate choice of numbers will be all the strictly positive reals, while if time is discrete, an appropriate choice will be all the non-null natural numbers. I shall represent '... days ago, ---' by '$P_{\ldots}$---' and '... days hence, ---' by '$F_{\ldots}$---'.

The proposed translation of (1), the third I wanted to present, is done into the language $\boldsymbol{L}^{*\mathrm{Pr}}$, which results from $\boldsymbol{L}^{\mathrm{Pr}}$ by replacing the standard operators '*P*' and '*F*' by their metric counterparts, and by adding special variables for temporal distances -call them distance-variables- with the following requirement: (i) in a formula, a distance-variable can only appear after '∃' or as filling in the first position of a metric operator, (ii) in a formula, no term other than a distance-variable can appear as filling in such a position.[15] The translation is:

(6) $(\exists n P_n \exists x F_n \varphi x) \vee (\exists x \varphi x) \vee (\exists n F_n \exists x P_n \varphi x)$.

for '*n*' any chosen distance-variable.

[14] See PPF p. 76, fn 1, and the reference therein.

[15] Notice that the standard tense-logical operators are definable in terms of the metric operators in an obvious way (see PPF p. 95), so $\boldsymbol{L}^{*\mathrm{Pr}}$ is more expressive than $\boldsymbol{L}^{\mathrm{Pr}}$.

The adequacy of (6) turns on two assumptions.[16] The first one is that time is structured in such a way that the relevant talk of temporal distances makes sense. The second one is that the numbers over which the distance-variables range eternally exist, i.e. are always present. These assumptions surely require further discussion. But they have some plausibility, and once they are in place it is clear that (6) is adequate: the expression '$\exists nP_n \exists xF_n$' then works just like a restriction of 'Σx' to past objects, '$\exists x$' like a restriction of 'Σx' to present objects, and '$\exists nF_n \exists xP_n$' like a restriction of 'Σx' to future objects.

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[16] Apart from the assumption that time is linear, which I made from the very beginning.

Commentary

Combination of Tense and Modality*

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1

Richmond Thomason's article *Combinations of tense and modality* provides the first clear exposition of $T \times W$ semantics. A $T \times W$ frame is defined in terms of a set T of times, a set W of worlds, a linear order $<$ on T , and a set $\{\approx_t: t \in T\}$ of equivalence relations on W. A $T \times W$ structure is defined by specifying a valuation on the frame that assigns truth-values to formulas relative to time-world pairs. Thus, a formula α turns out true or false at any pair (t, w), where $t \in T$ and $w \in W$. The temporal operators behave as in linear tense logic. For example, $F\alpha$ is true at (t, w) if and only if α is true at (t', w) for some t' such that $t < t'$. In addition, a modal operator $\Box$ is defined in such a way that $\Box\alpha$ holds at (t, w) when α holds at (t, w') for all w' such that $w \approx_t w'$.[1]

Thomason's exposition is accompanied by some comments that are far from enthusiastic. About the systems based on $T \times W$ semantics, Thomason says that they "do not seem particularly interesting from a philosophical point of view". According to him, the only interesting case is that in which the set $\{\approx_t: t \in T\}$ is so defined that for any t, t', if $w \approx_t w'$ and $t' < t$ then $w \approx_{t'} w'$. For in that case the relation $\approx_t$ obtains between w and w' when w and w' "share the same past up to and including t". This way $\Box$ expresses historical necessity, the property that is usually indicated by words such as 'settled' or 'inevitable'[2] .

Moreover, not even in that case Thomason is satisfied with $T \times W$ semantics. He finds more congenial tree-like semantics, where a frame is defined in terms of a set T of times and a non-linear order $<$ on T that branches forward, that is, such that it may happen for distinct $t, t', t'' \in T$ that $t < t'$ and $t < t''$ but neither $t' < t''$ nor $t'' < t'$. Thomason says "I like to think of possible worlds as overlapping, so that the same moment may have alternative futures". And again: "Intuitions may differ, but to me the natural notion is that of a possible future -not that of a possible course of events"[3] .

Tomason's attitude towards $T \times W$ semantics is largely shared. Although some technical work has been done to investigate the properties of systems based on $T \times W$ structures, in the current debate on time $T \times W$ semantics is either ignored or treated with nonchalanche. Tree-

* In Gabbay Dov and Guenthner Franz (eds) Handbook of Philosophical Logic, vol. 7, Kluwer 1984 (second edition 2002).
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[1] (Thomason , 1984), pp. 207-208.
[2] (Thomason , 1984), pp. 208-209.
[3] (Thomason , 1984), p. 207 fn. 5, and p. 222. Thomason's misgivings concerning sameness of temporal ordering will not be discussed here.

like semantics is by far more popular now. Thus, the historical role of Thomason's article is double: besides being the first that outlines $T \times W$ semantics, it is the first that dismisses it[4].

A question that may be raised, then, is whether this attitude is justified. Here it will be suggested that it is not. In the first place, there is no reason to be unsatisfied with $T \times W$ semantics if □ is taken to express historical necessity. Not only $T \times W$ semantics is at least as good as tree-like semantics in this interpretation, it is even better. Secondly, other interesting interpretations of $T \times W$ semantics are available. One in particular will be considered in which □ expresses an epistemic property called 'definiteness'.

2

Let a *history* be a possible course of events, and let a *moment* be a possible event of null temporal extension that is part of a history. In a tree-like frame histories amount to maximal chains of times, and moments amount to times. Instead, in a $T \times W$ frame histories amount to worlds, and moments amount to time-world pairs. It is quite natural to associate tree-like semantics with a metaphysical view -call it *branching*- according to which two histories can overlap, that is, they can have a temporal part in common. By contrast, it is quite natural to associate $T \times W$ semantics with a metaphysical view - call it *divergence* - according to which there is no overlap, even if two histories can have qualitatively identical temporal parts[5].

Thomason seems to prefer branching to divergence. However, the article provides no argument to justify this preference. Perhaps Thomason regards branching as more "intuitive" than divergence. But intuitions do not help much in these matters. At most, what deserves to be called an intuition is the idea that there are many ways things might go, which by itself does not decide between the two views.

Or perhaps Thomason thinks that indeterminism as it emerges from scientific theories requires branching. But indeterminism is equally compatible with divergence. Determination may be understood in accordance with scientific theories as follows: if t precedes t', the state of the world at t' is determined by the state of the world at t if and only if it is entailed by the state of the world at t and the laws of nature. Assuming that a state is a condition that can be instantiated by histories at times, it is conceivable that two histories are in the same state at any time up to t but differ at t'. This means that the state in which they are at t is compatible with two different states at t'. If indeterminism is phrased in terms of absence of determination so understood, it does not entail branching.

Apart from there being no apparent advantage of branching on divergence, there is an apparent advantage of divergence on branching. Only one among the possible futures will become *actual*. So it is plausible to suppose that only one history is the actual history. But this supposition does not harmonize well with branching. Imagine that two histories h and h'

[4] (Kutschera, 1997) and (Di Maio and Zanardo, 1998) are technical contributions on $T \times W$ logic. (Belnap et. al., 2001) and (MacFarlane, 2003) are recent works that adopt tree-like semantics.

[5] (Lewis, 1986) spells out the difference, pp. 206-209, and argues in favour of divergence. (Belnap et al., 2001), pp. 206-209, defend branching.

overlap up to a certain moment but branch after that moment, and suppose that *h* is the actual history. Then it is legitimate to ask whether the non-actual branch of *h'* is really a continuation of one and the same past. A negative answer can be given on the assumption that the actual history is the history in which we are. For if we are in *h* and not in *h'*, it is hard to see how *h'* can be connected to our past. On the contrary, divergence is clearly compatible with the supposition that there is a unique actual history. If *h* and *h'* are wholly distinct histories and *h* is the actual history, each moment along *h* has a unique continuation[6].

T × *W* semantics has a related advantage on tree-like semantics. If treelike semantics is phrased without reference to a unique actual history, as usual, there are essentially two ways in which truth can be defined. One is to define truth at a moment-history pair, that is, truth at a time relative to a maximal chain to which the time belongs. The other, which rests on the first, is to define truth at a moment as truth at all moment-history pairs. However, neither of these two definitions seems to account for truth *simpliciter*, the property we have in mind when we wonder whether a sentence about the future is true. Consider

(1) There will be a sea battle

To say that (1) is true today relative to a history in which there is a sea battle is to say that if things go as in that history, (1) is true today. Obviously, there is nothing wrong with ascribing truth so understood to (1), since the ascription requires no more than acceptance of the conditional 'If there will be a sea battle then (1) is true'. The fact, however, is that this is not what one is after when one says that (1) is true. What one seems to claim when one says that (1) is true is that (1) is true without relativization to this or that history. The claim is not about how the sentence is to be evaluated given the hypothesis that things will go a certain way. Rather, it is a claim about what hypothesis is to be advanced on how things will go. In other words, the claim is about which of many possible events will actually occur. It is in virtue of such event that truth is ascribed to the sentence.

The second option fares no better. Historical necessity is not what we are after when we ask whether (1) is true. Saying that (1) is true, one is not committed to the claim that the truth of (1) holds no matter how things will go. That would amount to claiming that the truth of (1) is independent of the way things will go, which is patently incorrect. If (1) is true, it is true in virtue of the way things will actually go. *T* × *W* semantics, by contrast, is able to explain truth simpliciter in terms of actuality, provided that one of the members of *W* is specified as the actual world. A sentence is true *simpliciter* at *t* just in case it is true at (*t, w*) and *w* is the actual world. Or equivalently, a sentence uttered at *t* is true *simpliciter* just in case it is true at (*t, w*) and *w* is the actual world.

[6] (MacFarlane, 2003), p. 325 emphasizes the conflict between branching and the supposition that there is a unique actual history.

Independently of the question whether there is reason to be unsatisfied with $T \times W$ semantics if □ is taken to express historical necessity, it should not be presumed that this is the only interesting interpretation of $T \times W$ semantics. Another interpretation that is no less interesting is that in which worlds are understood as courses of events that are possible "for all one knows", that is, histories that are apparent rather than real. In this case □ may be read as 'it is definitely the case that'. Assuming that one is a position to know that *p* when *p* holds in all courses of events that are possible for all one knows, to say that it is definitely the case that *p* is to say that one is in a position to know that *p*. To distinguish an interpretation of this kind from one in which □ expresses historical necessity, call *epistemic* the former and *metaphysical* the latter.

The epistemic interpretation differs from the metaphysical interpretation in at least two crucial respects. In the first place, it does not require that the set $\{\approx_t: t \in T\}$ is so defined that for any *t, t′,* if $w \approx_t w$ and $t' < t$ then $w \approx_{t'} w'$. The quantification involved in the definition of □ is unrestricted, as the relevant differences between worlds are not confined to the future. As far as we know, different histories may have lead to the present state of Affairs. For example, today we are not able to tell whether the number of cats that slept inside the Colosseum on September 4th 1971 is even or odd. This means that at least two histories leading to the present state of affairs are equal for all we know: one in which that number is even, the other in which that number is odd. Moreover, as far as we know there are different ways things may go at present. For example, we don't know the position of a certain whale that is now swimming in the ocean, hence we are not able to discriminate between moments that differ as to the position of that whale.

In the second place, the epistemic interpretation does not allow reference to actuality. A structure represents an epistemic state, and the knowledge of what is actual cannot be included as part of that state. This means that the structure does not tell us which of the members of *W* is the actual world. Accordingly, for any sentence that is true at a moment (*t, w*) and false at another moment (*t, w*′), such as (1), the structure does not tell us whether the sentence is true *simpliciter* at *t*. More specifically, the structure does not tell us whether (1) as uttered now is true *simpliciter*, for it doesn't tell us which moment is the present moment. On the indexical account of actuality considered, this is to say that we don't know exactly where we are.

The epistemic interpretation and the metaphysical interpretation agree on two basic facts. The first is that $\Box\alpha \rightarrow \alpha$ is true at any moment in any structure, while the converse does not hold. Suppose that $\Box\alpha$ is true at (*t, w*). Then α is true at (*t, w*), for α is true at (*t, w*′) for every *w*′ such that $w \approx_t w'$. Now suppose that α is true at (*t, w*) but false at (*t, w*′). Then α is true at (*t, w*) but $\Box\alpha$ is false at (*t, w*). The second fact is that □ does not distribute over disjunction: for some structure and some moment (*t, w*), $\Box(\alpha \vee \beta)$ is true at (*t, w*) while $\Box\alpha$ and $\Box\beta$ are false at (*t, w*). Suppose that $W = \{w, w'\}$ and consider *t, t′* such that $t < t'$. Let α be true at (*t′,w*) but false at (*t′*, *w*′) and at any later moment in *w*′. Then $F\alpha$ is true at (*t, w*) and $\neg F\alpha$ is true at (*t, w*′). It follows that $\Box(F\alpha \vee \neg F\alpha)$ is true both at (*t, w*) and at (*t, w*′). But $\Box F\alpha$ is false both at (*t, w*) and at

(*t, w'*), and the same goes for □¬*Fα.*

These two facts are understood differently in the two interpretations. Definiteness is an epistemic property, historical necessity is a metaphysical property. Definiteness entails historical necessity, but is not entailed by it. Imagine that only one course of events is possible, even though many courses of events appear possible. A sentence may be historically necessary without being definitely true, if it is true in the only possible course of events but false in some apparently possible course of events. Since definiteness and historical necessity are distinct properties, the two interpretations account for different data. Consider

(2) Either there will be a sea battle or there will not be a sea battle

There is a clear epistemic difference between (1) and (2). We are not able to tell whether (1) is true, while we are certain that (2) is true. This is easily explained in terms of definiteness: (2), unlike (1), is definitely true. Another datum is that the present state of the world, independently of what we know about it, seems to leave unsettled whether (1) is true, while it seems to settle that (2) is true. This may be explained in terms of historical necessity: (2), unlike (1), is historically necessary. The second explanation presupposes indeterminism, while the first is compatible both with determinism and with indeterminism.

Certainly, tree-like semantics may as well be interpreted epistemically, with □ read as 'it is definitely the case that'. But again, there is reason to think that $T \times W$ semantics is preferable. A modified tree-like frame could represent a plurality of apparently possible pasts, in addition to a plurality of apparently possible futures, in terms of an order that branches backward and forward. In that case there would be a point at the centre of the tree that stands for the present moment. But we saw that not even the present is unique from an epistemic point of view. It is plausible to assume that there are distinct moments such that, for all one knows, it is indetermined which of them is the present moment. Therefore, even if tree-like semantics is as good as $T \times W$ semantics as an epistemic representation of the past, it has more limited resources as an epistemic representation of the present.

$T \times W$ structures are more general than tree-like structures in the sense that every set of histories - real or apparent - that can be accommodated in a tree-like structure can also be accommodated in a $T \times W$ structure, but not the other way round. This sense is stated in more rigorous way as follows. Let A be a tree-like structure formed by a set of times T_A, a non-linear order $<_A$ and a valuation V_A. Let B be a $T \times W$ structure where M_B is the set of moments, $<_B$ is a relation on M_B such that $(t, w) <_B (t', w')$ if and only if $w = w'$ and $t < t'$, and V_B is a valuation. We say that *B transfers A* if for every subset S of T_A that is a maximal set of $<_A$-related times, there is an isomorphism f from S on a subset S' of M_B ordered by $<_B$, and for any formula α that includes no temporal or modal operator and any $t \in S$, $V_B(\alpha, f(t)) = V_A(\alpha, t)$. It is provable that for every tree-like structure, there is a $T \times W$ structure that transfers it. Let A be a tree-like structure as above, and call H_A the set of maximal sets of $<_A$-related members of T_A. Given a set of moments M_B and a relation $<_B$ defined on M_B as a union of disjoint linear orders, let f be a function that satisfies the following conditions:

1 f is injective;
2 f maps H_A into the power set of M_B;
3 for every $h \in H_A$, $f(h)$ is a maximal set of $<_B$-related moments isomorphic to h.

Since $<_B$ is a union of disjoint linear orders, from 3 we get that the range of f is a set H_B such that for any $f(h), f(h') \in H_B$, $f(h) \cap f(h') = \emptyset$. Now let V_B be a function such that for any $h \in H_A$, any formula α that does not contain temporal or modal operators and any $t \in h$, $V_B(\alpha, m) = V_A(\alpha, t)$, where m is the moment of $f(h)$ that the isomorphism from h on $f(h)$ assigns to t. For every $T \times W$ structure B whose set of moments includes M_B, whose order on times conforms to $<_B$ and whose valuation is V_B, we get that B transfers A. It is easy to see that the converse relation does not obtain. There is no sense in which tree-like structures can be shown to transfer $T \times W$ structures. Any $T \times W$ structure that includes distinct worlds that differ at every point has no equivalent tree-like structure.

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Commentary

The Sea Battle and the Master Argument. Aristotle and Diodorus Cronus on the Metaphysics of the Future,

R. Gaskin,
de Gruyter, Berlin-New York, 1995

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...and reasoned high
of providence, foreknowledge, will, and fate,
fixed fate, free will, foreknowledge absolute,
and found no end, in wand'ring mazes lost.
(*Paradise Lost*, II, 558-61)

Come risulta chiaro già dal titolo, il libro di Gaskin è diviso in due parti: la prima, che comprende i capitoli 1-14, tratta del famoso e famigerato argomento fatalista di *De Interpretatione* 9, mentre la seconda, che comprende i capitoli 15-25, è dedicata al quasi altrettanto famoso e dibattuto "Argomento Dominatore" di Diodoro Crono, nonché alle sue possibili relazioni con la "Battaglia navale" aristotelica. Seguono poi tre appendici, la prima dedicata ad alcune interpretazioni arabe e medievali di *De Interpretatione* 9, le altre due al tema della prescienza e della contingenza in Alessandro di Afrodisia.

Si tratta – è già chiaro da questo sommario – di un libro ricco e stimolante, la cui disamina approfondita richiederebbe molto più spazio di quanto ne ho a disposizione. Mi limiterò dunque a discutere innanzitutto la sua interpretazione della "Battaglia navale", e in secondo luogo il rapporto che la sua ricostruzione dell'"Argomento Dominatore" stabilisce tra Diodoro e Aristotele.

1. LA BATTAGLIA NAVALE

Il libro di Gaskin rappresenta la più ampia, vigorosa e probabilmente meglio argomentata difesa della cosiddetta interpretazione tradizionale (che però, come vedremo tra poco, forse tanto tradizionale non è), secondo la quale Aristotele risponderebbe all'argomento fatalista in due mosse:

1. accettando gli argomenti del fatalista (esposti in *De Int*. 9, 18a34-b16), in base ai quali la previa verità o falsità degli enunciati *de singulo et de futuro* comporta,

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rispettivamente, la loro necessità o impossibilità, e quindi la previa determinatezza del futuro stesso;

2. negando che per tali enunciati valga il Principio di Bivalenza, ossia il principio *semantico* che tutti gli enunciati apofantici devono essere veri o falsi.

Ora, ad essere onesti, la "soluzione" aristotelica (in *De Int*. 9, 19a23-b4) è ben lontana dall'essere esposta con chiarezza, ed è quindi difficile valutare un'interpretazione unicamente guardando alla spiegazione che offre di questo passo. Piuttosto quello che deve essere considerato è da un lato se l'interpretazione proposta quadra con quanto dice altrove Aristotele, dall'altro se e in quale misura appare in se stessa accettabile.

Molti fautori dell'interpretazione tradizionale (tra cui Gaskin) attribuiscono in effetti ad Aristotele la tesi che il principio *sintattico p* o *non-p* vale senza restrizioni[1], a differenza del Principio di Bivalenza; ma una simile tesi, alla luce della logica classica, può apparire stravagante (Quine, ad esempio, parla apertamente di "fantasy") e costituisce un'obiezione contro l'interpretazione tradizionale stessa[2]. In realtà, se si esce almeno in parte dalla logica classica, esistono diversi modi rispettabili di rendere conto di ciò, il più promettente dei quali sembra essere l'uso delle supervalutazioni (originariamente introdotte da van Fraassen in riferimento agli enunciati contenenti termini non denotanti) da parte di R. Thomason e M. White[3]. In breve (e senza tenere conto delle numerose versioni) l'idea è la seguente:

a. la verità e la falsità di un enunciato contenente indicali temporali dev'essere valutata in relazione al tempo di proferimento di questo enunciato;
b. dato il tempo presente *n*, esistono diversi futuri alternativi (possibili);
c. a *n* un enunciato al futuro è valutato in maniera standard (bivalente) in relazione ad ognuno dei futuri alternativi, ed è *supervalutato* in relazione a tutti i futuri alternativi (ossia è supervalutato vero se è vero in tutti i futuri alternativi, falso se è falso in tutti i futuri alternativi, privo di supervalutazione se è vero in alcuni e falso in altri);
d. un enunciato *p* contingente *de futuro* (ossia tale che in alcuni futuri avrà luogo ed in altri no) sarà dunque privo di supervalutazione, mentre *p* o *non-p* sarà supervalutato vero (le supervalutazioni, quindi, non sono vero-funzionali);
e. poiché per il presente ed il passato non esistono alternative, per gli enunciati che si riferiscono al presente ed al passato valutazioni standard e supervalutazioni

[1] Sulla base di *De Int*. 9, 19a28-9: "che ogni cosa sia o non sia è necessario, ed anche che sarà o non sarà". Se questo principio debba essere identificato con il Principio del Terzo Escluso nella formulazione aristotelica è per lo meno dubbio, ma non insisterò su questo punto.

[2] Non solo da un punto di vista teorico, ma (usando in maniera piuttosto disinvolta il "principio di carità") anche da un punto di vista ermeneutico: piuttosto che attribuire una tesi così implausibile ad Aristotele è meglio andare in cerca di interpretazioni alternative.

[3] Cfr. , rispettivamente, *Indeterminist Time and Truth-value Gaps*, in "Theoria", 36 (1970), pp. 264-81 e *Necessity and Unactualised Possibilities in Aristotle*, in "Philosophical Studies", 38 (1980), pp. 287-98. Per un equilibrato bilancio delle difficoltà che incontra la separazione tra Bivalenza e Terzo Escluso cfr. A.Iacona, *Future Contingents and Aristotle's Fantasy*, in "Critica, Rivista Hispanoamericana de Filosofia", vol. 39, n. 117 (deciembre 2007), pp. 45-60.

coincidono, e quindi la nozione aristotelica di verità e falsità può essere formalizzata in termini di supervalutazione.

"Rispettabile" non vuol dire "incontrovertibile", ed in effetti si è molto discusso sul valore, da un punto strettamente logico, della proposta di Thomason e delle sue numerose varianti. Tuttavia Gaskin appare molto più interessato all'interpretazione del testo aristotelico che a discutere in generale la logica degli enunciati temporalizzati e in questa sede ci limiteremo perciò a considerare il libro di Gaskin solo sotto questo aspetto.

Perché Aristotele dovrebbe accettare l'argomento fatalista? La giustificazione comunemente avanzata è che Aristotele accetta implicitamente una forma estremamente forte della teoria corrispondentista della verità, in base alla quale è necessario, perché un enunciato sia vero o falso ad un tempo *t*, che a *t* si diano le condizioni che rendono vero l'enunciato stesso: quindi se Fp[4] fosse vero ora, sarebbe già ora un fatto che si darà il caso che *p*, e *Fp* godrebbe della stessa irrevocabilità di cui godono gli enunciati *de praesenti*. O forse si potrebbe dire che un enunciato al futuro potrebbe essere reso vero ora solo da fatti futuri, ma che tali fatti, se il futuro non è predeterminato, semplicemente non sussistono.

Gaskin (cfr. soprattutto cap. 6) rifiuta la spiegazione perché a suo avviso introduce elementi di determinismo causale all'interno di un argomento che utilizza invece soltanto principi logici, e giustifica l'accettazione dell'argomento fatalista fondandosi sulla tesi aristotelica che il presente, ed anche il passato, sono, in quanto irreversibili, necessari. Secondo Gaskin, tuttavia, questa tesi deve essere espressa nella forma

(1) $Tp \rightarrow LTp$[5]

e non nella forma

(2) $p \rightarrow Lp$.

Dal punto di vista testuale tutto ciò non sembra avere molto fondamento. La tesi aristotelica della necessità del presente è formulata con queste parole (cfr. 19a23-7):

> Che dunque ciò che è sia quando è e che ciò che non è non sia quando non è, è necessario; tuttavia non è necessario né che tutto quanto ciò che è sia, né che tutto quanto ciò che non è non sia. Infatti non è la stessa cosa che tutto quanto ciò che è sia di necessità quando è e che sia di necessità in senso assoluto; lo stesso anche per ciò che non è.

dove non compare nessun accenno alla nozione di verità. Di per sé questo non significherebbe molto, se non fosse che qualche riga più avanti la nozione di verità viene introdotta

[4] Dove *F* è l'operatore temporale che esprime il futuro, mentre *P* esprime il passato: *Fp* (*Pp*) vorrà allora dire che in qualche tempo futuro (passato) si darà (è dato) il caso che *p*.
[5] Dove *L* esprime la necessità e *T* è un predicato di verità introdotto nello stile della logica aletica di von Wright.

esplicitamente ("poiché i discorsi sono veri allo stesso modo in cui stanno i fatti").[6] Il meno che si può dire è che, anche ammesso che il Principio di Bivalenza non valga senza restrizioni e che quindi tra (1) e (2) ci sia qualche differenza, la scelta dovrebbe comunque cadere su (2).

Perché dunque Gaskin sceglie decisamente (1)? La ragione è che, se in (2) sostituiamo *p* con *Fq*, otteniamo

(3) $Fq \rightarrow LFq$

ossia proprio la tesi la cui accettazione porta diritti al determinismo. Adottare (2) come formalizzazione della tesi aristotelica è dunque assurdo, a meno che non si restringa opportunamente l'ambito delle sostituzioni ammissibili per *p*; ma fare ciò – osserva giustamente Gaskin – è possibile solo semanticamente, ossia escludendo le istanze di sostituzione il cui contenuto sia un fatto realmente futuro. Tuttavia – continua Gaskin – questa esclusione è troppo restrittiva perché per Aristotele vi sono fatti futuri che sono necessari: questo dimostra che noi non escludiamo un'istanza di (2) perché si riferisce al futuro, ma perché è priva di valore di verità. L'argomento è debole: vero, un'istanza non viene esclusa perché esprime un fatto futuro, piuttosto perché esprime un fatto contingente o non irrevocabile; ma dire che ciò equivale alla mancanza del valore di verità significa, in pratica, commettere una *petitio principi* (l'argomento dovrebbe appunto dimostrare che la contingenza del futuro comporta lacune nei valori di verità). In conclusione il tentativo di Gaskin di far dipendere l'accettazione dell'argomento fatalista da parte di Aristotele dalla sua tesi sulla necessità del presente, lasciando invece da parte il corrispondentismo "forte", non sembra avere avuto successo.

Un altro punto su cui vorrei richiamare l'attenzione è la versione che Gaskin dà della cosiddetta "interpretazione dei commentatori", *scilicet* di Ammonio e Boezio (cap. 12), in base alla quale le righe 19a36-9:

> è necessario che ciascuna parte dell'antifasi sia vera o falsa, non tuttavia questa o quella, ma quale delle due capita (ὁπότερ᾽ἔτυχεν); e se pure una delle due è più vera, non tuttavia già (ἤδη) vera o falsa.

significano che la verità o la falsità di trovano in ciascuna parte dell'antifasi, ma non in maniera tale che si possa dividere e dire quale delle due parti è vera e quale è falsa. Secondo Gaskin l'interpretazione dei commentatori non è che una variante di quella da lui difesa: l'espressione "vera o falsa" deve essere infatti intesa in maniera non vero-funzionale, ossia un enunciato può essere 'vero-o-falso' senza per questo essere o vero o falso. D'altra parte l'unico modo di attribuire in maniera plausibile un significato al fatto che un enunciato *de futuro* sia

[6] Cfr. 19a33. Nell'edizione BUR a cura di M. Zanatta la traduzione suona così: "poiché i discorsi sono veri in modo simile a come lo sono i fatti", il che suggerisce un parallelismo tra la verità dei fatti e quella dei discorsi. Tuttavia le righe successive mostrano chiaramente che il parallelismo è tra lo status ontologico dei fatti ed il modo in cui i discorsi corrispondenti risultano veri, ed è questa la ragione della traduzione qui proposta.

'vero-o-falso' è interpretare ciò come se significasse che in un futuro possibile quanto asserito dall'enunciato avrà luogo, mentre in un altro futuro non avrà luogo; ma ciò, con l'aggiunta dell'ovvia condizione che la stessa cosa non potrà avere luogo e non avere luogo nello stesso futuro, non è altro che l'interpretazione difesa da Gaskin. L'unica differenza è, se vogliamo, di tipo retorico: la versione che ne danno i commentatori, se da un lato è forse meno perspicua, dall'altro dà l'impressione di salvaguardare in qualche modo il Principio di Bivalenza.

Una fonte aristotelica dell'interpretazione dei commentatori è, quasi sicuramente, *Cat*. 10, 12b35-13a13. In questo passo Aristotele dapprima osserva che nel caso di contrari tra i quali vi è qualcosa d'intermedio non è necessario che l'uno o l'altro di essi appartenga a ciò che per natura è atto a riceverlo, a meno che ciò non sia tale che uno solo dei due contrari gli appartiene per natura (ad esempio, dati i contrari 'bianco e nero', la bianchezza alla neve): in tal caso uno dei due contrari gli appartiene in maniera determinata (ἀφωρισμένως) e non quale dei due capita (ὁπότερον᾽ ἔτυχεν)[7]. Nel caso della privazione e del possesso (13a3-13), invece, anche se non esiste nulla d'intermedio, non è necessario che l'uno o l'altra appartenga a ciò che per natura è atto a riceverlo, almeno fino a quando non sarà in grado di riceverlo effettivamente (un gattino appena nato, ad esempio, non è detto né possedere la vista né essere cieco); ma qualora ne sia già in grado, sarà detto, ad esempio, in possesso della vista o cieco, tuttavia né l'uno né l'altra gli appartiene in maniera determinata, ma quale dei due capita.

Gaskin interpreta l'esempio della vista sulla falsariga della sua interpretazione della "Battaglia navale": quando il soggetto sarà effettivamente in grado di ricevere la vista, allora uno dei due contrari gli apparterrà, ma nessuna delle due possibilità (essere cieco o essere in possesso della vista) è in procinto di realizzarsi in maniera definita, ma quale delle due capiterà. Ma questa interpretazione è un'evidente forzatura. Alla lettera, infatti, il testo (13a11-3) suona così:

> Quando abbia già per natura la vista, allora sarà detto cieco o avente la vista, e di questi non uno dei due in maniera determinata, ma quale dei due capita; non [è] infatti necessario che sia cieco o che abbia la vista, ma quale dei due capita.

dove da un lato il futuro "sarà detto" non ha connotazione temporale, ma esprime, come spesso in Aristotele, la relazione di conseguenza, dall'altro, in ogni caso, "e di questi non uno dei due in maniera determinata, ma quale dei due capita" si riferisce al momento in cui il soggetto viene detto cieco o avente la vista, non al momento precedente in cui, propriamente parlando, non è né cieco né vedente. Che si tratti di una forzatura anche Gaskin lo ammette (cfr. nota 83 a p. 169), ma la ritiene inevitabile a causa della necessità del presente: infatti, a partire da quando il soggetto sarà effettivamente in grado di ricevere i contrari, in ogni momento sarà necessario che sia cieco o vedente, e non quale dei due capita. La giustificazione non regge, dal momento che la necessità di cui Aristotele sta parlando è

[7] Resta da vedere se anche Aristotele aveva in mente questo passo quando scriveva *De Int*. 9. Delle due espressioni chiave la prima, ἀφωρισμένως, non vi compare, ma la seconda, ὁπότερον ἐτυχεν, sì, per cui non esiste un'evidenza indiscutibile. In ogni caso l'interpretazione di *De Int*. 9 di cui parlerò più avanti rende per lo meno consonanti i due testi.

assoluta, non temporalmente determinata. Nel caso dei contrari con termini intermedi, infatti, si tratta di appartenenza per natura, e quindi di necessità assoluta, e non c'è ragione di supporre che nel caso del possesso e della privazione si tratti invece di necessità temporalmente determinata. Se le cose stanno così, in *Cat.* 10 non è questione di lacune nei valori di verità, ma solo di distribuzione dei valori di verità. Se dunque i commentatori hanno tratto ispirazione da questo passo, è possibile che la loro interpretazione della "Battaglia navale" attribuisca ai membri dell'antifasi un valore di verità, sia pure nell'impossibilità di determinarne la distribuzione[8].

Una simile interpretazione appare sensata solo nel quadro di una forma debole di corrispondentismo, nella quale (in generale) l'indice temporale *t* di "Vero (Falso) a *t*" ha la sola funzione di fissare il riferimento dell'indicale temporale contenuto implicitamente o esplicitamente nell'enunciato di cui si asserisce la verità o la falsità, e quindi di determinare quali sono gli stati di cose rilevanti per la sua verità o falsità. Nel caso della battaglia navale lo stato di cose rilevante è l'eventuale battaglia navale di domani, e oggi l'enunciato "Domani ci sarà una battaglia navale" è vero o falso a seconda se tale battaglia avrà luogo o meno: quindi l'enunciato sarà sicuramente vero o falso oggi, ma oggi è metafisicamente (non solo epistemicamente) impossibile stabilirlo.

Con ogni probabilità in Aristotele sono presenti sia la forma forte che quella debole di corrispondentismo. Per quel che riguarda la forma debole l'enunciazione più chiara sembra essere quella di *De An*.Γ6, 430b4-5: «Dunque è falso o vero non solo che Cleone è bianco, ma anche che lo era o lo sarà».

Per quel che riguarda la forma forte il passo più significativo è *De Gen. et Corr.* B 11, 337b4-5: «Infatti ciò che è vero dire che sarà, bisogna [δεῖ] che una volta o l'altra sia vero che è». Tutto dipende da come interpretiamo δεῖ: se indica semplicemente la necessità della conseguenza, allora questo passo è perfettamente compatibile con il corrispondentismo debole; se indica invece la necessità del conseguente, allora il suo significato è *TFq*→*LTFq*. Tuttavia bisogna ammettere che il contesto (il punto di partenza è infatti la questione se vi sono cose che esistono di necessità) favorisce la seconda ipotesi, e quindi dobbiamo concordare con Gaskin sull'interpretazione di questo passo.

Ma il Principio di Bivalenza come deve essere inteso, in termini di corrispondentismo forte o debole? Ora, in *De Int*. 9 il corrispondentismo forte è alla base delle argomentazioni del fatalista, e, dal momento che anche in Aristotele questa forma di corrispondentismo è presente, gli argomenti del fatalista sono per lui da prendere sul serio. La sua soluzione potrebbe (il condizionale è d'obbligo) essere quella di riformulare il Principio di Bivalenza in termini di corrispondentismo debole, che, come abbiamo visto, non richiede la distribuzione dei valori di verità tra i membri della disgiunzione[9]. O almeno questa sembra essere l'interpretazione che ne avevano dato i commentatori.

[8] A questo conclusione giunge anche Mignucci in *Truth and Modality in Late Antiquity: Boethius on Future Contingent Propositions*, in "Atti del Convegno Internazionale di Storia della Logica. Le teorie della modalità", Bologna 1989, pp. 47-78.

[9] Questa interpretazione ha diversi punti di contatto con quella avanzata da Whitaker in "Aristotle's *De Interpretatione*", Clarendon Press – Oxford, 1996. La differenza più rilevante è che per Whitaker non è in

2. L'ARGOMENTO DOMINATORE

Discutendo il "Dominatore" il rischio di perdersi *in wand'ring mazes* diventa una certezza. Com'è noto, di questo argomento conosciamo le premesse, grazie al resoconto (peraltro sprezzante) di Epitteto, ma di come si sviluppasse l'argomentazione non sappiamo nulla. Questo, unito al fatto che anche il significato delle premesse risulta altamente controverso, lascia campo aperto ad un numero praticamente illimitato di interpretazioni e di confutazioni delle interpretazioni altrui.

Gaskin non fa eccezione. Dopo aver mostrato la scarsa attendibilità (dal suo punto di vista, naturalmente) delle principali interpretazioni finora proposte (da Prior a Vuillemin) ne propone una che, di fatto, avvicina molto Diodoro ad Aristotele. Secondo Gaskin il significato delle premesse del "Dominatore" è il seguente:

Premessa 1. Il passato non è contingente, nel senso che tutto ciò che si riferisce al passato è necessario o impossibile (e quindi, ovviamente, tutto ciò che è vero è necessario e tutto ciò che è falso è impossibile).

Premessa 2. "L'impossibile non segue dal possibile", la cui interpretazione costituisce la caratteristica saliente dell'approccio di Gaskin. Infatti, mentre il modo standard di formalizzare tale premessa è qualcosa come $L(p\rightarrow q)\rightarrow(Mp\rightarrow Mq)$[10], per Gaskin questa premessa significa invece una parte della definizione aristotelica del contingente, ossia quella parte in cui si afferma che, se qualcosa è contingente, dall'assumerne la sussistenza non segue nulla d'impossibile[11].

Premessa 3. Esiste qualcosa di contingente che non è e non sarà vero (ossia è falso che tutto ciò che è contingente o è o sarà vero).

Inoltre in queste premesse le modalità sono "relative ai fatti". Le modalità temporalmente determinate, come la necessità del presente di cui abbiamo parlato a proposito di Aristotele ne sono un esempio. Un altro esempio segue dalla definizione aristotelica del contingente: se *p* fosse tale che la sussistenza di ciò che esprime fosse ammissibile solo in circostanze in cui *p* non è vero, allora una cosa sussisterebbe e non sussisterebbe nello stesso tempo (ovviamente ciò è impossibile) e quindi *p* non è contingente.

A questo punto è facile dimostrare l'assunto del "Dominatore", ossia che le tre premesse sono incompatibili tra loro e che quindi, se le prime due sono plausibili, la terza deve essere falsa. Gaskin fornisce una dimostrazione di ciò utilizzando una logica del primo ordine con operatori modali, in cui si quantifica sui tempi e sia gli enunciati che gli operatori modali sono temporalmente indicizzati. Tuttavia la dimostrazione informale è più intuitiva. Appare infatti

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gioco il Principio di Bivalenza (la cui validità senza eccezioni sarebbe per Aristotele pacifica), ma la possibilità di dividere i valori di verità tra i membri di una coppia antifatica.

[10] Lasciando impregiudicato se *M* esprime la possibilità intesa come duale della necessità (E_1 di Becker) o la contingenza nel senso cui abbiamo fatto riferimento parlando della premessa 1.

[11] L'intera definizione aristotelica è la seguente: "Per essere contingente e contingente intendo ciò che non è necessario e, se se ne assume la sussistenza, non segue nulla d'impossibile". (*An. Pr.* A 13, 32a18-20)

evidente che se *p* è ora contingente, in base alla premessa 2. si deve supporre che in qualche tempo si dia il caso che *p*: ma nel passato non è possibile perché nulla nel passato è contingente; nel presente o nel futuro neppure perché per la premessa 3. nel presente e nel futuro *p* è (in alcuni casi) falso ed allora, per la 2. e per il fatto che le modalità sono relative ai fatti, la realizzazione di *p* nel tempo presente o in uno futuro comporterebbe una contraddizione.

Si tratta di un Diodoro molto aristotelizzato. Non tanto perché le prime due premesse sono chiaramente di matrice aristotelica (questo è vero anche di molte altre ricostruzioni del "Dominatore", in particolare di quelle che interpretano la premessa 2. come se significasse $L(p \rightarrow q) \rightarrow (Mp \rightarrow Mq)$), piuttosto perché anche la struttura argomentativa del "Dominatore" sarebbe già presente in Aristotele. Infatti in *De Coelo* A 12 Aristotele dimostra l'impossibilità che qualcosa abbia un inizio e nello stesso tempo sia eterno con un argomento che, semplificando al massimo, suona così:

a) ciò che ha un inizio è generato e ciò che è generato può anche perire;
b) se qualcosa può perire supporre che ci sia un tempo in cui perirà non deve implicare una contraddizione;
c) ma se ciò che può perire fosse eterno, allora supporre che ci sia un tempo in cui perirà implicherebbe una contraddizione;
d) quindi se il mondo ha avuto un inizio. e può quindi perire, non è eterno.

Se le cose stanno così, perché non attribuire *tout court* il "Dominatore" ad Aristotele? Ed in effetti Gaskin conclude (p. 295):

[the argument of *De Coelo*] can be taken to follow closely the outline of my favoured reconstruction of the Master Argument.

Tuttavia questo non significa che per Gaskin Diodoro ed Aristotele siano d'accordo: Nel cap. 25, Gaskin sostiene infatti che l'argomento di Diodoro e quello di Aristotele sono certamente simili, ma la conclusione cui giunge Aristotele è più debole perché Diodoro, a differenza di Aristotele, accetta senza restrizioni il Principio di Bivalenza. Quindi, dal punto di vista di Aristotele, ma non da quello di Diodoro, la premessa 3. può essere interpretata in due modi:

3.1 Esiste qualcosa di contingente che è vero che non è e non sarà;
3.2 Esiste qualcosa di contingente che non è e non sarà.

Se dunque *p* è ora contingente, quello che la premessa 2. afferma è che possiamo ipotizzare un futuro *possibile* in cui la realizzazione di *p* non causa contraddizioni; ma in tal caso non può essere vero che *p* non è e non sarà, altrimenti il futuro in cui dovrebbe valere *p* sarebbe contraddittorio. Quindi l'argomento di Diodoro, una volta tolto di mezzo il Principio di Bivalenza, avrebbe come conclusione la negazione di 3.1, ossia la tesi perfettamente aristotelica che ciò che è contingente non è vero che non è o non è vero che non sarà.

Se le cose stanno così, la conclusione dell'argomento di *De Coelo* A 12 non sarebbe che, se il mondo ha avuto origine, allora non è eterno, ma solo che non è vero che è eterno. Ma questa distinzione tra "il mondo è eterno" e "non è vero che il mondo è eterno" significa, in ultima analisi, che l'eternità del mondo è un fatto contingente, per cui chi asserisce che il mondo ha avuto un inizio, ma non avrà una fine, non dice qualcosa di assurdo, ma solo qualcosa di non sufficientemente fondato. Per usare un eufemismo, è lecito dubitare che lo scopo di Aristotele in *De Coelo* A 12 fosse dimostrare una cosa del genere. Inoltre, se Aristotele si limitasse a concludere dall'attuale verità (nel senso del corrispondentismo forte) che il mondo è eterno all'impossibilità che non lo sia, si tratterebbe dell'ennesima applicazione della necessità del presente e buona parte dell'intricata argomentazione contenuta in *De Coelo* A 12 sarebbe del tutto irrilevante.

In realtà l'obiettivo di Aristotele è, a mio avviso, molto più ambizioso: dedurre dall'eternità del mondo, intesa come semplice dato di fatto che non condiziona (almeno non immediatamente) tutti i futuri possibili, la sua necessità. Per realizzare questo gioco di prestigio Aristotele assume la validità di qualcosa del genere[12]: il possesso, ad un tempo *t*, di una determinata potenza *P* da parte di un soggetto non eterno *S* è compatibile con il dato di fatto che questa potenza non si realizzerà nel corso dell'esistenza di *S*. Fin qui tutto bene. Aristotele ha infatti bisogno di questo principio per salvare la potenza *ad utrumlibet* (spesso anche nel caso in cui non si tratti di eventi temporalmente circoscritti come la battaglia navale): ad esempio un mantello ha la possibilità sia di essere tagliato in due sia di non esserlo, ma solo una delle due possibilità si realizzerà. Giustificare questo principio non è difficile, basta ipotizzare un futuro alternativo in cui *P* si realizzi; inoltre il dato di fatto di cui parlavamo può essere descritto da questi due enunciati:

(i) *S* esisterà fino ad un dato tempo *t*;
(ii) la potenza *P* non si realizzerà prima di *t*;

ed almeno uno dei due deve risultare falso nel futuro alternativo. Il gioco di prestigio comincia a questo punto e consiste nella scelta operata da Aristotele: (ii) diventa infatti una condizione vincolante che deve essere rispettata da ogni futuro alternativo, e quindi per la realizzazione di *P* sarà necessario che, nel futuro alternativo, *P* si realizzi oltre *t*.

Una simile scelta non appare giustificata, sarebbe infatti possibile costruire un futuro alternativo in cui *P* si realizzi prima di *t*. Probabilmente ha giocato qui l'osservazione tante volte ripetuta che chi siede ha la potenza di essere in piedi, ma non nello stesso tempo in cui è seduto, osservazione giustificata dalla necessità del presente. Analogamente se *P* si potrà realizzare solo in un tempo in cui non vale la negazione di *P*, allora dobbiamo posporne la realizzazione dopo *t*, il che significa, nella maggior parte dei casi, che nel futuro alternativo l'esistenza di *S* si prolungherà oltre *t*. Ma si tratta di un'analogia fuorviante, perché, senza giustificazione, mette sullo stesso piano la necessità del presente e quella di alcuni aspetti del futuro.

[12] L'interpretazione qui abbozzata cerca di rendere conto di quanto Aristotele dice alla righe 281b16-25.

Vediamo ora come in *De Coelo* A 12 funziona il gioco di prestigio. Se il possesso di una potenza *P* da parte di un soggetto eterno *S* fosse compatibile con il dato di fatto che *P* non si realizzerà finché *S* esiste, allora avremmo

(i)' S esisterà sempre;
(ii)' la potenza *P* non si realizzerà durante l'esistenza di *S*.

Se, come prima, (ii)' diventa una condizione vincolante sui futuri alternativi, il gioco di prestigio è fatto: la realizzazione di *P* richiederebbe un *extra time* che l'eternità di *S* rende impossibile. In particolare, se *P* è la potenza di non essere di *S* e tale potenza non può realizzarsi, pena la contraddizione, finché *S* è, allora non è possibile che *S* non sia.

A questo punto, però, anche (i)' risulta essere vero in tutti i futuri alternativi: in pratica, ciò significa che, almeno nel caso della (presunta) possibile non esistenza di una cosa eterna, non ce ne sono di rilevanti. Poiché, d'altra parte, l'Argomento Dominatore è conclusivo solo se i futuri alternativi non vengono presi in considerazione, esso risulta abbastanza simile all'argomento di *De Coelo* A 12, ma con un'importante differenza: mentre in Aristotele l'assenza di futuri alternativi era il risultato, in un caso particolare, di una linea di ragionamento che in generale li ammetteva, in Diodoro, con ogni probabilità, tali futuri non erano mai ammessi. E quindi in generale, e non solo in un caso particolare, la possibilità di qualcosa comportava la sua realizzazione nel tempo presente o in quello futuro.

Commentary

Fourdimensionalism

T. Sider

Oxford, OUP, 2001, 255 pp.

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Gli ultimi decenni del secolo scorso hanno visto una rinascita della "metafisica analitica", ossia quell'insieme di studi e discipline che si interessa ai problemi metafisici tradizionali e li affronta con il taglio tipico della filosofia analitica: uso di argomentazioni rigorose e formalismi, confronti con i risultati delle scienze "dure" come la fisica, la chimica e la biologia, e ricorso a paradossi e problemi concettuali di vario genere come "banco di prova" delle teorie. Una delle questioni che rappresentano tutt'ora uno dei punti focali della metafisica analitica è la questione della persistenza, ossia dell'esistenza attraverso il tempo, a cui *Fourdimensionalism*, uscito nel 2001, ha apportato uno dei contributi più interessanti. Molti degli argomenti e delle tematiche presenti nel libro sono stati discussi, criticati e difesi ampiamente negli anni successivi, come si desume facilmente dalla pubblicistica filosofica specialistica.

I due modelli rivali della persistenza nel tempo, che si sono andati formando nel corso del ventesimo secolo, sono il tridimensionalismo e il quadridimensionalismo. Il tridimensionalismo è spesso difeso come la posizione più vicina al senso comune, il modello che ricalca quasi fedelmente la nostra concezione ingenua di come gli oggetti ordinari (come tavoli, sedie, ma anche animali o persone)continuino a esistere a tempi diversi. Gli oggetti ordinari posseggono tre dimensioni spaziali e *perdurano* (questo il termine tecnico) nel tempo in quanto sono "interamente presenti" ad ogni istante della loro esistenza. Sedie e persone hanno parti spaziali presenti in luoghi diversi (dove è presente la mia testa, ad esempio, non è presente il mio braccio), ma non sono segmentati in parti lungo la dimensione temporale, e quindi sono interamente presenti a tempi diversi. Perdurare è dunque essere identici attraverso il tempo in senso stretto: non c'è una parte di me che possiamo chiamare "io-questa-mattina" quando preparavo il caffé per la colazione e un'altra "io-oggi-pomeriggio" intento a scrivere una recensione per *Humana.Mente*, ci sono solo io che persisto nel tempo interamente presente in ogni momento della mia esistenza. In genere il tridimensionalismo riconosce un'altra modalità di persistenza, che attribuisce non agli oggetti e le persone, ma agli eventi. Gli eventi, infatti, a differenza degli oggetti tridimensionali, hanno parti temporali e persistono nel tempo in virtù del susseguirsi delle loro parti temporali. Una partita di calcio, ad esempio, persiste per novanta minuti con l'avere un primo tempo seguito da un secondo tempo, e senza mai essere interamente presente in nessun momento della sua esistenza.

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Il quadridimensionalismo è spesso visto come una teoria della persistenza ispirata dalle concezioni scientifiche (in particolare la teoria della relatività nella formulazione di Minkowski) e dalla logica formale novecentesca. Per il quadridimensionalismo tanto gli oggetti quanto gli eventi hanno parti non solo relativamente allo spazio, ma anche relativamente al tempo. Non solo le partite di calcio e le riunioni aziendali, ma anche gli oggetti e le persone, posseggono parti temporali e persistono (*endurano*, in termini tecnici) nel tempo grazie al susseguirsi di queste. Io non sono mai interamente presente nei vari momenti della mia esistenza, perché solo le mie parti spaziali sono tutte presenti, una di seguito all'altra, nei vari momenti della mia esistenza. Ho continuato ad esistere da questa mattina a oggi pomeriggio perché diverse mie parti temporali si sono susseguite le une dopo le altre durante tale lasso di tempo. Possiamo dunque chiamare "io-questa-mattina" la mia parte temporale che era presente questa mattina, e "io-questo-pomeriggio" la mia parte temporale presente questo pomeriggio.

Sia il tridimensionalismo, sia il quadridimensionalismo sono presentati nel libro di Sider come due "ingredienti" di due visioni metafisiche della realtà temporale più ampie, che comprendono aspetti non immediatamente legati al problema della persistenza. Un approccio quadridimensionalista alla persistenza è infatti in genere difeso sullo sfondo di un'ontologia cosiddetta *eternalista* del tempo. L'eternalismo è quella posizione stando a cui il presente non ha nessun tipo di privilegio ontologico rispetto al passato e al futuro: le entità passate e future esistono allo stesso titolo e nello stesso modo di quelle presenti. Questa visione, inoltre, si sposa bene con quella che – con un a terminologia che risale al filosofo neoidealista inglese McTaggart – viene spesso chiamata la B-teoria del tempo. Stando alla B-teoria, le relazioni temporali di precedenza, successione e simultaneità sono le caratteristiche temporali metafisicamente fondamentali. Proprietà come essere presente, passato o futuro (chiamate A-determinazioni), non sono che proiezioni della nostra mente sulla catena temporale di eventi. Che un certo evento sia presente o passato, dunque, dipende solo dalla nostra posizione all'interno della catena temporale, e non è una determinazione che l'evento possegga indipendentemente da ciò.

Quadridimensionalismo, eternalismo e B-teoria del tempo costituiscono una visione della realtà temporale che si contrappone alla triade formata da tridimensionalismo, presentismo e A-teoria. Il presentismo, in contrasto con l'eternalismo, sostiene che solo le entità presenti esistano, e quindi che il presente abbia un genuino privilegio metafisico. La A-teoria, in accordo con il presentismo, sostiene che il "movimento" del presente sia una caratteristica della realtà indipendente dalle nostre rappresentazioni mentali, e di conseguenza, proprietà come essere presente, passato o futuro siano determinazioni indipendenti della realtà, non riducibili alla nostra posizione nella serie temporale ordinata degli eventi.

Il libro di Sider difende il quadridimensionalismo in un modo che si è rivelato metodologicamente molto prolifico di risultati ed ha stimolato molti dibattiti. Dopo aver presentato le linee basi della sua teoria, Sider dedica un intero capitolo alla difesa della B-teoria del tempo e ad una serie di argomenti contro il presentismo, posizione che ritiene

incompatibile con la sua visione della persistenza e la cui critica costituisce la premessa di molti argomenti successivi. In un terzo capitolo si occupa del problema di formulazioni mutuamente intelligibili della sua posizione e di quella rivale, il tridimensionalismo, fornendo una formulazione rigorosa delle tesi e dei concetti centrali di entrambe. Il quarto e il quinto capitolo costituiscono il cuore dell'opera. In essi vengono presentati una batteria di argomenti, alcuni noti, altri nuovi, a favore del quadridimensionalismo. Nel sesto ed ultimo capitolo il quadro viene completato da una serie di argomenti contro il quadridimensionalismo stesso, di cui vengono mostrati soprattutto i lati deboli.

La strategia di Sider nella parti centrali del libro è quella di portare alla luce i "costi e i benefici" di entrambe le posizioni, per arrivare a concludere che gli argomenti a favore del quadridimensionalismo sono nell'insieme più soddisfacenti e convincenti di quelli a favore del tridimensionalismo (pur non portando decisiva evidenza della verità di tale posizione rispetto alla rivale). In particolare, nel quinto capitolo, Sider prende in considerazione vari "paradossi della coincidenza". Possono due oggetti materiali occupare la stessa pozione di spazio e di tempo e condividere tutte le loro parti? La risposta ovvia sembrerebbe essere: no. Ci sono però alcuni casi in cui questa ovvietà viene messa in crisi. Ad esempio, una statua e il pezzo di creta da cui è stata ricavata hanno proprietà molto diverse: la statua esiste solo da quando l'artista l'ha creata, mentre il pezzo di creta esisteva anche precedentemente l'interveto dell'artista, e se cambiassimo radicalmente la forma del pezzo di creta questo rimarrebbe pur sempre lo stesso pezzo di creta, mentre la statua cesserebbe di esistere. Il pezzo di creta e la statua, dunque, sono oggetti distinti pur coincidendo in ogni loro parte, almeno per un certo periodo della loro esistenza. Il tridimensionalismo ha maggiori difficoltà a spiegare in maniera plausibile questa situazione, perché sembrerebbe costretto a prendere sul serio l'esistenza di due oggetti materiali interamente presenti nello stesso spazio e allo stesso tempo, mentre il quadridimensionalismo spiega la coincidenza temporanea dei due oggetti come condivisione di parti temporali. Sider, nel discutere i vari casi problematici, elabora una versione di quadridimensionalismo che egli ritiene possa rispondere in maniera più soddisfacente a questo problema, e in maniera almeno altrettanto soddisfacente agli altri presentati in precedenza. Il quadridimensionalismo "standard" o "dei vermi spaziotemporali" non si esaurisce nella tesi che le parti temporali di oggetti che persistono nel tempo esistano, ma identifica gli oggetti con la "somma" delle loro parti temporali. Le persone e le statue sono dunque somme di parti temporali (ossia dei "vermi quadridimensionali") che si estendono per tutto il periodo della loro esistenza. Il sequenzialismo (o *stage view*), la versione di quadridimensionalismo difesa da Sider, invece, identifica gli oggetti che persistono nel tempo con le loro parti temporali istantanee. L'immagine metafisica di fondo rimane sostanzialmente invariata, ma ci sono importanti conseguenze sull'uso di termini generali come 'persona' o 'statua': essi si riferiscono non alle somme di parti temporali, bensì alle varie parti temporali istantanee. Il sequenzialismo non solo spiega come sia metafisicamente possibile la coincidenza (essendo condivisione di parti temporali), ma ci permette anche di dire di fronte ad una statua di creta che c'è un solo oggetto di creta a forma di statua davanti a noi: la parte temporale istantanea condivisa da statua e blocco di creta.

Va inoltre ricordato l'argomento dalla vaghezza, che Sider presenta alla fine del quarto capitolo come l'argomento più stringente a favore del quadridimensionalismo, e che ha suscitato un ampio dibattito successivo. Gli oggetti che persistono nel tempo possono avere confini temporali vaghi: quante parti di un tavolo devo distruggere per non avere più un tavolo? Quanto deve essere sviluppato un ovulo fecondato per costituire una persona? In molti casi non è chiaramente determinato quando un oggetto inizia ad esistere, o quando la sua esistenza termini. Il tridimensionalismo è costretto a leggere questa vaghezza in termini ontologici: è l'esistenza stessa degli oggetti ad essere spesso vaga. La vaghezza ontologica, ossia l'idea che siano gli oggetti stessi e non solo il nostro modo di parlarne, ad essere vaghi, è notoriamente problematica e persino difficilmente intelligibile. Il quadridimensionalismo, invece, è in grado di gestire tale vaghezza in termini semantici, come un problema di indeterminatezza del nostro linguaggio. Che un oggetto esista o meno ad un certo istante non è di per sé un fatto vago, è solo il nostro uso di termini come 'persona', 'statua' o 'tavolo' a non essere pienamente determinato, perché può essere indeterminato se ad un certo istante uno di questi termini si applichi o meno ad una certa entità. Ma la vaghezza nel nostro linguaggio è praticamente ovunque, e il problema non ha dunque ricadute sull'ontologia quadridimensionalista.

La strategia di argomentazione "per costi e benefici" rappresenta la matura e esplicita formulazione della metodologia sottostante la rinascita della metafisica analitica che era iniziata – per voler dare una data – almeno dieci anni prima, nel 1990, con la pubblicazione di *Material Beings* di Peter van Inwagen. L'idea di dover confrontare i "risultati" delle diverse posizioni metafisiche rispetto a casi problematici e difficoltà di vario genere si è concretizzata in un folto intreccio di dibattiti in articoli su riviste, libri e raccolte. Oltre ai puzzle sulla coincidenza e al problema della vaghezza dei confini temporali, tali confronti hanno riguardato molti altri argomenti che *Fourdimensionalism* ha estesamente toccato, per ricordarne alcuni:

1. Consistenza e plausibilità del presentismo
2. Formulazioni reciprocamente intelligibile di quadridimensionalismo e tridimensionalismo
3. Il problema degli intriseci temporanei
4. Il puzzle di Tibbles e il cambiamento mereologico.
5. Il problema della costituzione materiale e della composizioni di interi.
6. Il sequenzialismo come variante del quadridimensionalismo.

L'elaborazione di risposte ai vari problemi ha inoltre portato alla difesa di posizioni "non standard" su vari fronti, come ad esempio forme presentiste di quadridimensionalismo, o forme di quadridimensionalismo che non ricorrono alle parti temporali. A questa lettura "ottimista" del percorso storico del libro, come massima espressione di una rinnovata vivacità del dibattito metafisico, è però doveroso affiancarne un'altra, dai risvolti in parte meno rosei. *Fourdimensionalism* non è solo un punto di svolta importante per le tematiche metafisiche, in esso sono presenti molte riflessioni metodologiche che sono state riprese in seguito non solo

da Sider stesso, ma da quasi tutti gli altri protagonisti della scena filosofica analitica. Questa riflessione "meta-filosofica" sembra oggi avere uno spazio sempre più centrale nel panorama generale della discussione. Basta confrontare il numero di conferenze, volumi monografici e borse di studio collegate all'argomento degli ultimi anni rispetto alla situazione di pochi anni fa soltanto – per non ricordare che è di imminente pubblicazione per la Oxford University Press un volume collettaneo intitolato *Metametaphysics*. Sicuramente molte discussioni metodologiche si sono rivelate cruciali per una comprensione più profonda dei problemi metafisici "di primo livello". Uno dei risultati di questo spostamento del centro degli interessi, però, è stato anche la rinascita di alcuni atteggiamenti "scettici" nei confronti della genuinità degli stessi dibattiti. Ad esempio, la distinzione fra quadridimensionalismo e tridimensionalismo, o fra eternalismo e presentismo è stata messa in questione, con argomenti volti a sostenere la mera "verbalità" dei disaccordi fra le parti della disputa. Lo scetticismo ha probabilmente sempre un effetto salutare in filosofia, ma questo ha in un certo senso rallentato la discussione dei problemi metafisici, arretrandola su questioni di legittimità della discussione stessa. Nel libro *Metametaphysics* sopra ricordato Ted Sider dedica il suo contributo alla difesa dell'intelligibilità di una nozione di esistenza che sia di rilevanza per l'indagine ontologica, senza cui ovviamente nessuno degli argomenti di *Fourdimensionalism* avrebbero presa. Forse per alcuni dibattiti tale situazione è dovuta al loro inaridirsi intorno a questioni che appaiono poco decisive e interessanti. Se però tale diagnosi non è applicabile in tutti i casi – come chi si interessa di metafisica probabilmente sarà portato a pensare – occorre forse rispondere allo scetticismo con una nuova inversione di rotta e tornare a trovare argomenti convincenti e interessanti all'interno delle discussioni "di primo livello" per dimostrare che la metafisica analitica non ha perso di vitalità.

Intervista

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Tempo e divenire fra fisica e metafisica

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1. Nel 1908 esce il celebre articolo di J. M. E. Mc Taggart "The Unreality of Time"[1]. Tale articolo ha ricevuto seria attenzione da molti seguenti filosofi che lavorano sul tema della metafisica del tempo e ha anche reimpostato in maniera essenziale la ricerca in tal campo. Quali meriti riconosce nell'articolo di Mc-Taggart, e quali limiti invece?

Nel 1908 viene pubblicato anche lo storico saggio di Minkowsky in cui spazio e tempo sono concepiti non più come entità separate, ma come uniti nell'unica realtà dello spaziotempo. È curioso che il 1908 sia dunque un anno molto importante sia per la fisica, che per la concezione puramente filosofica del tempo.

L'articolo di McTaggart rappresenta l'inizio della filosofia analitica sul tempo, ossia l'atto di nascita di quella ricerca filosofica che per indagare sulla natura del tempo si concentra sul modo in cui *parliamo* del tempo. Questa attenzione ai temi del linguaggio va anche vista come un riflesso della cosiddetta "svolta semantica", tipica della filosofia analitica del Novecento in generale.

McTaggart mette per primo in luce la cruciale distinzione tra proposizioni di tipo *tensionale*, del tipo "sono le tre e mezza" e proposizioni di tipo *atensionale*, come "venerdì viene prima di sabato". Mentre le prime hanno valore di verità dipendente dal contesto (alle 3 e mezza una particolare occorrenza della proposizione è vera, mentre alle 4 è falsa), il valore di verità delle seconde non varia, visto che un'occorrenza di "venerdì è prima di sabato" è vera in qualunque giorno della settimana. Distinzioni come queste hanno introdotto sicuramente maggiore chiarezza nel dibattito sul tempo, soprattutto per ciò che riguarda le conseguenze che il nostro linguaggio ha sulla concezione metafisica del tempo. L'importanza dell'argomento di McTaggart, che ha lo scopo di provare che il tempo è irreale, è illustrata anche dal fatto che i cento anni successivi alla pubblicazione dell'articolo di McTaggart sono stati quasi dominati dalla discussione sul problema se le determinazioni di tipo tensionale (che corrispondono a ciò che lui chiama A-serie, la serie che va dal passato al presente al futuro) sono più fondamentali delle determinazioni atensionali (che corrispondono alla serie di eventi lungo la B-serie, ordinate da "prima di" o "dopo di"), o viceversa. E si è oramai capito che gli indicali temporali che caratterizzano le A-espressioni A (ossia quelle che utilizzano determinazioni di tipo A) non sono traducibili in espressioni contenenti solo relazioni temporali atensionali, anche se non c'è ancora accordo sull'esistenza di fatti tensionali visti come indipendenti dalla mente, né sulla realtà del divenire temporale.

Solo per fare un esempio, lo stesso Gödel fa riferimento all'articolo di McTaggart per sostenere che il tempo non è reale. Ed è interessante notare che malgrado il fatto che l'argomento di Mc-Taggart sia stato spesso riconosciuto come non valido dalla stragrande maggioranza dei filosofi, non è stato mai facile mettere in luce perché. La mia impressione è

[1] McTaggart, J.M.E., "The Unreality of Time," in *The Philosophy of Time*, a cura di Le Poidevin, Robin, and McBeath, Murray, (Oxford University Press, 1993), pp. 23-34.

comunque che oggi l'argomento di McTaggart abbia esaurito le sue possibilità di incidere in maniera rilevante sulla ricerca futura sul tempo. Questo è decisamente anche determinato dal fatto che il metodo analitico in filosofia mostra tutti i suoi limiti quando pretende di indagare sulla natura del tempo prescindendo *in toto* dalla ricerca empirica delle scienze.

2. E' per questo che in *Futuro aperto e Libertà*[2] lei argomenta che le sole risorse della filosofia analitica non sono sufficienti per capire profondamente la natura del tempo?

Sì, quando si chiude in sé stessa, la filosofia finisce con l'isterilisti. Un po' come la matematica pura, con la quale ha molti punti di contatto: quando la matematica non ha alcuna applicazione, diventa un gioco molto brillante ma fine a sé stesso, e questa era anche l'opinione di Von Neumann. Il limite della filosofia analitica è che crede di risolvere tutte le questioni filosoficamente rilevanti tramite un'analisi del linguaggio. D'altro canto, il nostro linguaggio si basa su, e contribuisce a costruire, una teoria sul mondo che il grande filosofo americano Sellars chiamò "immagine manifesta del mondo". Il rischio che corre continuamente il filosofo analitico troppo chiuso all'indagine empirica, dunque, è quello di basare il suo lavoro solamente sull'immagine manifesta e non anche su quella scientifica del mondo. Questo è ovviamente un limite, visto che in generale la filosofia dovrebbe cercare di conciliare le due immagini in casi di conflitto, o tener conto di entrambe, e non essere una mera elaborazione dell'immagine manifesta.

Chi sostiene, come fa Simon Blackburn, che il filosofo è essenzialmente "un ingegnere dei concetti" ha fondamentalmente ragione, ma colui che lavora con concetti che provengono solo dal linguaggio ordinario non tiene conto che le scoperte scientifiche possono rivoluzionare o dimostrare l'infondatezza di parti dell'immagine manifesta. Mantenere sempre vivo il confronto tra immagine scientifica e immagine manifesta è essenziale anche nella filosofia del tempo. Solo per fare un esempio, prendiamo il presentismo, in base al quale esiste solo ciò che esiste nel presente. Ebbene, non appena si considerano le nostre più recenti teorie scientifiche, come la relatività einsteiniana, la posizione presentista, che dal punto di vista della filosofia analitica è perfettamente sostenibile, non solo perde molto del suo fascino e della sua profondità filosofica, ma diventa una posizione molto più difficilmente difendibile.

3. Nella ricerca sulla natura del tempo, la questione della realtà del divenire è stata a volte impostata nei termini di una questione sullo statuto ontologico del passato, presente e futuro. Lei invece critica tale approccio.

Quando ho cominciato nel '95 a lavorare sulla stesura di *Time and Reality*[3], sono partito dal punto di vista che, se il divenire è reale, necessariamente il futuro non può essere considerato come esistente allo stesso modo del presente e del passato, ma va concettualizzato come "aperto", solo "possibile". Portando avanti la mia ricerca, però, e grazie anche all'influenza di Steven Savitt e Yuval Dolev, mi sono poi reso conto che le discussioni sulla realtà del futuro sono soprattutto determinate da malintesi fondamentalmente linguistici. Ricordiamo che *l'eternalismo* consiste nell'asserzione che tutti gli eventi (passati, presenti e futuri) sono ugualmente reali, mentre il *presentismo* consiste nell'asserzione che solo gli eventi che fanno parte del presente sono reali. Qui l'indagine linguistica si rivela importante, perché con un po'

[2] *Futuro aperto e libertà. Un'introduzione alla filosofia del tempo*, pref. di R. Bodei, 1997, Laterza, Roma Bari.
[3] *Time and Reality*. *Spacetime physics and the objectivity of temporal becoming*. CLUEB, Bologna, 1995.

di analisi concettuale, il dibattito tra eternalisti e presentisti si rivela in effetti quantomeno mal impostato. Il punto sta nel modo in cui viene interpretata la copula "è" nella proposizione "l'evento *F* non è reale". Prendiamo un evento *F* che appartiene al cono di luce futuro del punto *p* in cui, ad esempio, proferiamo l'enunciato "l'evento *F* non è reale". Se la copula viene interpretata in senso tensionale, allora la nostra asserzione "l'evento *F* non è reale" significa semplicemente che l'evento *F* non esiste *ora* – e tale affermazione è banalmente vera. Né il presentista né l'eternalista possono essere in disaccordo. Ne segue allora che la copula deve essere interpretata in senso atensionale; ma allora l'asserzione "l'evento *F* non è reale" è ovviamente falsa, se dato che "F è reale" nel senso atensionale della copula "è" significa che l'evento F è accaduto, accade ora o accadrà in futuro, cosicché nel caso dell'interpretazione atensionale di "F non è reale" noi finiamo per negare che l'evento che accadrà in futuro accadrà In conclusione, la tesi dell'irrealtà del futuro è o banale (il futuro non esiste ora) o contraddittoria (ciò che non esisterà esisterà). Il divenire deve allora essere concepito in maniera atensionale, e la questione del suo darsi nel mondo va tenuta separata dalla questione della realtà del futuro.

4. In *Time and Reality* lei prendeva posizione a favore della teoria statica del tempo, che allora lei pensava fosse impegnata a negare la realtà del divenire temporale. Crede ancora che la nostra radicata percezione del fluire temporale sia una domanda che riguarda solo la psicologia?

Anche in questo caso c'è stata una evoluzione rispetto alle mie precedenti posizioni, soprattutto per quanto riguarda la relatività speciale. Nel '97 pensavo che la meccanica quantistica più la teoria della relatività speciale più il teorema di Stein sulla coestensione delle relazioni di connettibilità causale passata e di determinazione implicassero che tutti gli eventi sono determinati: nessun divenire.

Ora invece ritengo che persino nella relatività speciale esista un divenire indipendente dalla nostra mente, anche se di tipo più minimale rispetto al divenire di cui parlano gli A-teorici del tempo. Il divenire in relatività speciale può essere concepito come una successione di eventi in un tempo locale, un divenire quindi di tipo locale, non cosmico, ma 'relativo' a singole linee di universo, che è ancora compatibile con la teoria statica del tempo. Naturalmente, il divenire cosmico di cui parlano i cosmologi e di cui parlavo nell'ultimo capitolo del mio libro può appoggiarsi a un tempo cosmico. E su quello non ho cambiato idea! [4]

5. Einstein era profondamente turbato dalla considerazione della netta sensazione umana che ci sia qualcosa di essenziale riguardante l'*Ora* e dall'impossibilità della scienza di comprendere tale sensazione. Carnap riporta nella sua autobiografia[5] i dubbi di Einstein, concludendo poi che, a suo parere, questi derivassero dalla confusione tra esperienza e conoscenza. La scienza, dice Carnap, può dire tutto quello che c'è da dire, per cui non c'è alcuna domanda a cui essa non possa in principio rispondere. Lei condivide la risposta di Carnap, o piuttosto ritiene sensati i dubbi di Einstein?

[4] A chi volesse approfondire tali tematiche e conoscere una piu' recente posizione di Mauro Dorato in proposito, suggeriamo la lettura di "On Becoming, Cosmic Time and Rotating Universes", in *Time, Reality and Experience* a cura di C. Callender, Cambridge University Press (2001), pp. 253-277 (ndr)

[5] Carnap, R. 1963. "Carnap's Intellectual Biography" in *The Philosophy of Rudolf Carnap,* a cura di P. A. Schilpp, pp. 3-84. La Salle, IL: Open Court.

Devo ammettere che la distinzione di Carnap a tal proposito non mi è chiarissima. Ovviamente il presente non può essere parte dell'insieme di leggi fisiche, nella misura in cui l'essere presente implica l'esistenza di un *Ora* con uno statuto ontologico che non può trovare spazio nella fisica.

Credo però che Einstein avesse ragione nel dire che il presente ha un'importanza pragmatica che non può essere sottovalutata e che infatti è stata parte centrale di varie filosofie o concezioni etiche della vita. Basta considerare il profondo significato che viene attribuito al motto oraziano "carpe diem", o l'etica ellenistica, che invita a vivere il presente come se fosse l'ultimo momento della vita che abbiamo a disposizione. In un certo senso al presente viene affidato un significato quasi mistico, laddove nei momenti di gioia intensa il momento presente si dilata fino ad assumere un significato di eternità. Tali aspetti ovviamente non possono venire compresi dalla scienza, ma questo non significa, come credo abbia compreso Einstein, che essi non siano una parte importante della nostra concezione del tempo.

6. A suo avviso potremo avere a breve una migliore comprensione su come connettere i concetti di tempo che appaiono nelle nostre teorie fisiche fondamentali con il tempo fenomenologico, il fluire degli eventi come noi lo esperiamo?

Le possibilità mi sembrano davvero minime allo stato attuale della scienza. Non credo che nel prossimo futuro ci sarà la possibilità di creare un ponte tra le due descrizioni del tempo. Se potessimo dare una descrizione della mente basata sulla fisica fondamentale, avremmo risolto il problema della coscienza, e mi sembra che siamo ancora lontani da questo obiettivo, malgrado i numerosi progressi. E se pure dovessimo avere a breve una teoria riduzionista della coscienza, tale teoria sarebbe formulata nel linguaggio della neurofisiologia, non della fisica fondamentale. Le possibilità di una connessione tra fisica fondamentale e coscienza sono talmente basse che a mio parere sono da escludere. E questo malgrado uno dei migliori matematici della prima metà del secolo scorso, John von Neumann, affidasse alla coscienza il ruolo di assegnare al mondo macroscopico quei familiari aspetti definiti che sono invece compromessi dalla descrizione quantistica del mondo.

7. Torniamo alla nozione di divenire *relativo*. In "Absolute becoming, relational becoming and the arrow of time: Some non-conventional remarks on the relationship between physics and metaphysics"[6] lei sostiene che la fisica non può fornire alcuna evidenza empirica non solo per la realtà del divenire assoluto, ma nemmeno per la realtà del divenire relativo. Contrariamente alla letteratura generale sull'argomento, inoltre, nello stesso articolo suggerisce che la questione del divenire relativo sia fondamentalmente legata alle varie frecce del tempo. In che modo le due questioni sono legate e reciprocamente rilevanti nella sua concezione di divenire relativo?

Il divenire assoluto è il venire in essere degli eventi, il loro accadere, indipendentemente da una particolare struttura spaziotemporale. Se una teoria fisica assume una ontologia di eventi spazio-temporalmente separati, assume automaticamente anche il divenire, per così dire a

[6] "Absolute becoming, relational becoming and the arrow of time: Some non conventional remarks on the relationship between physics and metaphysics", *Studies in History and Philosophy of Modern Physics*, 37, 3 , Sep 2006, 559-576.

priori. Ecco perché il divenire assoluto è piuttosto una presupposizione della fisica che un elemento da valutare a posteriori alla luce della fisica. Una volta che si presuppone una struttura spaziotemporale, si ha divenire temporale se gli eventi coinvolti sono separati da intervalli di tipo tempo, divenire spaziale se gli eventi coinvolti occorrono tutti allo stesso tempo. Nel caso dello spaziotempo di Newton, si ha divenire spaziale oggettivo perché c'è una relazione assoluta di simultaneità: si ha lo stesso spazio per tutti gli osservatori inerziali; nel caso dello spaziotempo di Minkowski, c'è invece solo divenire temporale di un punto rispetto a un altro, ma non c'è divenire spaziale invariante, e ciò a causa del fatto che due osservatori inerziali in moto reciproco non condividono la relazione di simultaneità.

Avendo separato la questione del divenire da problemi ontologici legati allo statuto degli eventi futuri, si deve collocare il problema del divenire all'interno della complessa questione della freccia del tempo: per esempio, perché possiamo assumere una relazione di connettività causale passata, come fa Stein nel suo teorema? Abbiamo evidenze indipendenti dal nostro proposito di definire il divenire per fare questa mossa? E possiamo definire le altre frecce del tempo nei termini di quella causale? O forse il divenire nel tempo degli eventi è la freccia fondamentale in termini della quale definire quella causale?

8. Nel suo *Il Software dell'universo. Saggio sulle leggi di natura*[7] lei fornisce una rassegna dei vari problemi filosofici legati alle Leggi di Natura. Tra questi problemi c'e' anche quello della simmetria temporale di alcune delle leggi fondamentali della Natura. Perche' la simmetria di tali leggi e' considerato un problema fisico e filosofico rilevante?

In effetti, l'unica legge temporalmente asimmetrica è quella che regola il decadimento di alcune particelle nelle interazioni deboli (i mesoni K); queste particelle violano la cosiddetta trasformazione di Parità P (la riflessione allo specchio di un processo di decadimento non è identica al processo originario) e anche la coniugazione di carica C (la trasformazione di una particella di una carica positiva in una carica negativa e viceversa non è identica nei due casi), e quindi violano la simmetria temporale T. Questo lo si può ricavare dalla validità del cosiddetto teorema CPT, che dice che se riflettiamo allo specchio particelle e antiparticelle, invertendo la direzione del tempo otteniamo un universo equivalente al nostro. Poichè le particelle in questione violano sia C che P, affinché il teorema CPT sia rispettato devono violare anche T, cioè il loro decadimento è temporalmente asimmetrico. Tutte le altre leggi note sono invece temporalmente simmetriche, e quindi non distinguono tra passato e futuro. Più precisamente, un processo che si svolge nel modo *a*, *b*, *c* può anche svolgersi nel modo *c, b*, *a,* con opportune trasformazioni nello stato di *a, b* e *c*. Questo significa che l'irreversibilità dei processi che ci circondano, dal latte che si mischia nel caffè alla rottura di un bicchiere, o sono legati alla violazione della parità e della carica dei muoni o sono dovuti alla prevalenza di certe condizioni iniziali. La seconda ipotesi sembra attualmente più probabile della prima.

9. In *Futuro aperto e Libertà*, e più dettagliatamente nell'articolo "On Becoming, Relativity and Non-separability"[8] lei sostiene che il fatto che passato, presente e futuro abbiano lo stesso statuto ontologico sia una conseguenza della nonlocalità della meccanica quantistica. Una delle premesse dell'argomento che lei propone è che le relazioni EPR vadano spiegate con una legame causale – premessa che rifiuta chiaramente la posizione proposta da Arthur Fine che le relazioni EPR non vadano invece spiegate, ma siano da considerarsi naturali, nel senso di non causate. La pensa ancora così? Il fatto che invece le

[7] *Il software dell'Universo. Saggio sulle leggi di natura*, Bruno Mondadori, Milano 2000.
[8] "On Becoming, Relativity, and Nonseparability", *Philosophy of Science*, 64, 4, 1996, pp.585-604.

relazioni EPR non vadano spiegate casualmente, può cambiare qualcosa nelle sue conclusioni riguardo alla accettabilità della visione dinamica del tempo?

In effetti ora sono giunto alla conclusione che sia più utile assumere che le correlazioni EPR non vadano spiegate tramite qualche modello causale. Prima della misura, le due particelle, invece, vanno concepite come un unico tipo di oggetto che possiede solo relazioni. Questo, comunque, non implica che i due eventi corrispondenti alle due misure ai capi opposti dell'apparato sperimentale siano indeterminati l'uno rispetto all'altro: c'è un fatto definito che ci permette di dire che un evento è determinato rispetto all'altro, anche se tra i due eventi non c'è legame causale. Dunque il teorema di Stein è incompatibile con la meccanica quantistica. Ma Myrvold non è d'accordo e lo ha sostenuto di recente in un bell'articolo del 2003[9].

10. In *Time and Reality* lei afferma che dopo la rivoluzione relativistica, l'idea di una evoluzione del mondo nel tempo (l'avanzare del fiume del tempo) va abbandonata e rimpiazzata con un incrocio non coerente di onde associate con le 'prospettive' cronologiche dei diversi punti lungo delle linee di mondo. Mentre la relatività speciale dovrebbe dunque mettere in crisi la realtà delle determinazioni di tipo A, la relatività generale mette in crisi la realtà delle determinazioni di tipo B. La cosa è evidente nella formulazione quantistica della teoria, dato che l'equazione di Wheeler-DeWitt, l'equazione di Schrödinger per la relatività generale, è atemporale. Alcuni filosofi e fisici, tra cui John Earman e Carlo Rovelli, affermano però che la crisi delle determinazioni di tipo B è già evidente nella formulazione non quantizzata della relatività generale.

Tenderei a pensare che ciononostante la fisica classica (relatività generale inclusa) non ci insegna che il tempo e il divenire non esistono. Forse a livello quantistico, quando unifichiamo la gravità con la meccanica quantistica, allora dobbiamo far sparire il tempo, ma anche in questo settore la ipotesi è assai controversa (Smolin per esempio è in disaccordo con Rovelli su questo punto). Se si guarda alla cosmologia, che si appoggia a modelli relativistici della relatività generale, troviamo per esempio che i cosmologi cercano di descrivere *quando* avvenne la formazione dei pianeti e delle stelle, e ovviamente fanno affermazioni sul fatto che alcuni eventi avvengono prima di altri. E questo "prima di", grazie al principio cosmologico, è valido per tutti i cosiddetti osservatori fondamentali, almeno negli universi assai simmetrici (omogenei e isotropi) come sembra essere il nostro. La nozione di evoluzione, insomma, sembra la nozione unificante, anche in cosmologia. A questo livello si parla di evoluzione attraverso la postulazione di un tempo cosmico, che ha caratteri statistici, ma l'idea del cambiamento e dell'evoluzione rimane pur sempre alla base della scienza cosmologica. Quindi il tempo nella cosmologia classica (non quantistica) c'è. Poi con Massimo Pauri, nel saggio "Holism and Structuralism in Classical and Quantum General Relativity"[10], abbiamo cercato di sostenere, appoggiandoci a suoi lavori con Lusanna, che la deriva atemporale *à la* Earman riguarda solo alcuni modelli della relatività generale classica, quelli compatti, mentre nei modelli asintoticamente piatti il cambiamento rimane.

[9]Wayne C. Myrvold "Relativistic Quantum Becoming" *British Journal for the Philosophy of Science*, Sep 2003; 54: 475 - 500.

[10] "Holism and Structuralism in Classical and Quantum General Relativity", in, M. Dorato, M. Pauri, *Structural Foundations of Quantum Gravity*, a cura di D. Rickles, S. French and J. Saatsi, Oxford University Press, Oxford, 2006, pp.121-151.

11. I difensori del programma della decoerenza in meccanica quantistica affermano che la decoerenza possa spiegare l'apparenza dello scorrere del tempo, nonostante la sua irrealtà. D'altronde, altri filosofi mettono in dubbio le reali potenzialità del programma della decoerenza. Lei crede che la decoerenza possa spiegare finalmente l'apparenza dello scorrere del tempo?

Io non credo che lo scorrere del tempo sia un'apparenza. Se per scorrere del tempo si considera l'avvenire ordinato degli eventi (dove ordinato significa che esistono tra gli eventi relazioni di ordine, magari parziale), allora esso è un dato di fatto. La decoerenza può (ma è ancora presto per affermare una cosa del genere) semmai spiegare l'emergere dello scorrere del tempo in scala macroscopica, ma questo ovviamente non implica la negazione della sua realtà o che il divenire sia un fenomeno meramente mentale.

12. Crede che le nostre attuali teorie fisiche ci aiutino davvero a capire la direzione del tempo, ossia il fatto che sembra esistere una direzione preferita nel flusso degli eventi dal passato verso il futuro? Per esempio, sentiamo spesso parlare di "freccia del tempo termodinamica", ossia l'idea che la seconda legge della termodinamica (che afferma che l'entropia di un sistema chiuso continui ad aumentare) individui una direzione preferita. Se però si guarda più a fondo, suggeriscono alcuni autori, tali spiegazioni implicano assunzioni che possono essere considerate dubbie (ad esempio che l'universo era inizialmente in uno stato di bassa entropia). Lo stesso, per inciso, vale anche per la decoerenza. Pensa che la seconda legge della termodinamica ci dia una comprensione della direzione del tempo?

La seconda legge della termodinamica non spiega la freccia del tempo: è ciò in cui in parte consiste. La seconda legge ammette infatti quella simmetria temporale tipica delle situazioni paradossali di Loschmidt, di Zermelo, o il teorema di ricorrenza di Poincaré, creando un potenziale conflitto tra la asimmetria temporale della termodinamica e la simmetria temporale della meccanica. L'assunzione dell'iniziale bassa entropia dell'universo (quella che viene chiamata the past hypothesis, e che tenta proprio di spiegare la freccia termodinamica del tempo) manca in effetti essa stessa di una spiegazione, ma pare essere l'assunzione più plausibile per spiegare perché l'entropia dell'universo cresce.

13. Se il determinismo presuppone una struttura lineare, mentre l'indeterminismo presuppone una struttura del tempo ad albero, con un passato determinato ed un futuro aperto, come si può conciliare il determinismo con libertà umana?

In effetti la concezione di libertà sulla quale secondo me possiamo fare affidamento è una forma di libertà meno ampia di quella che è generalmente presupposta dal senso comune. Certo, non possiamo più sostenere di possedere una libertà del *volere*, dato che questa è in effetti incompatibile con le nostre moderne conoscenze scientifiche. La libertà che continuiamo a possedere è invece una libertà del *fare*, che è determinata dal nostro potere causale rispetto al nostro corpo e alla nostra mente. In questo senso, una persona libera è una persona che può controllare la propria mano senza avere tremori che rendano impossibile la prensione, o una persona che è libera da manie ossessive, e che riesce dunque almeno in parte a controllare i propri pensieri.

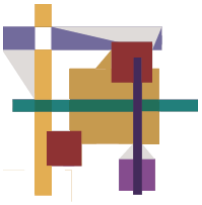
Libertà, in questo senso, implica un *parziale* controllo delle proprie azioni e della propria mente: la possibilità di compiere quelle azioni che vogliamo compiere, benché i desideri siano fissati in senso deterministico.

14. Nella relatività generale esistono soluzioni delle equazioni di Einstein che ammettono la possibilità di viaggi nel tempo – ovvero l'esistenza di curve di tipo tempo chiuse. Sulla base di tali risultati, molti filosofi immaginano affascinanti scenari fantascientifici che poi usano per trarne conclusioni filosofiche. D'altro canto, lei pensa che qualcuna di questi soluzioni sia davvero fisicamente possibile? In altre parole, pensa che perché una soluzione possa rappresentare un mondo fisicamente possibile, è sufficiente che essa soddisfi le equazioni fondamentali della relatività generale? Oppure crede che perché possiamo giustificatamene credere che una soluzione sia fisicamente possibile ci siano altre condizioni che devono essere soddisfatte?

Io penso che se una soluzione è compatibile con una legge fisica (le equazioni di campo), allora è fisicamente possibile per definizione. Poi ci sono le difficoltà logiche dei viaggi nel tempo (uccidere il nonno prima che questo genera il proprio padre, etc.). Ma anche queste possono essere risolte, postulando limiti alla fattibilità di certe azioni: se torno indietro nel tempo e provo a uccidere il mio nonno giovanetto inciampo e cado, oppure non lo riesco a colpire, etc. Naturalmente il mio nonno giovanetto ha un passato con un evento di questo tipo: viaggiare indietro nel tempo non implica affatto la possibilità di cambiare il passato, ma neanche si può dire che possiamo cambiare il futuro.

15. In relatività speciale, spazio e tempo vengono uniti nello *spaziotempo* e diventano aspetti di una entità quadridimensionale unificata. Da questa prospettiva, però, sembra curioso che lo "spazio" abbia tre dimensioni, mentre il "tempo" solo una, o che il tempo abbia una direzione, mentre lo spazio no. Cosa rende il tempo così speciale?

Ci sono teorie che postulano una doppia dimensione anche per il tempo, ma effettivamente per ora non hanno preso piede. Le tre dimensioni dello spazio per Kant erano legate alla legge di gravitazione universale di Newton, e poi ci sono stati altri tentativi di spiegarle, a partire da spazi con dimensioni compattificate, cioè ripiegate su sé stesse, come nella teoria delle stringhe. La unidimensionalità del tempo sembra legata alla nostra esperienza, ma cio' non implica affatto la sua linearità, ovvero il fatto che il tempo non possa essere ramificato. E sebbene i branching models (modelli ramificati) dello spazio-tempo postulati dalla teoria a molti mondi della meccanica quantistica non mi convincano, essi complicano certamente il nostro guardare al tempo come a una semplice "linea retta" isomorfa alla retta dei numeri reali.



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