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Toward a Demarcation of Forms of Determinism[1]

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ABSTRACT: In the current philosophical literature, determinism is rarely defined explicitly. This paper attempts to show that there are in fact many forms of determinism, most of which are familiar, and that these can be differentiated according to their particular components. Recognizing the composite character of determinism is thus central to demarcating its various forms.

KEYWORDS: Determinism – fatalism – logical determinism – scientific determinism – logical fatalism.

Determinism is a basic philosophical concept. It is usually assumed that both the term "determinism" and determinism as a philosophical conception or theory are clear and obvious. In the literature, however, the precise contours of determinism are not explicitly defined – an obscurity that often leads to inconsistencies and misunderstandings.

In this article, I put to the side questions concerning the soundness or adequacy of the philosophical views I shall consider. Instead, I am interested only in the basic conceptual contours of different kinds of determinism and whether it is possible to sort them into some kind of interrelated order for the purposes of better demarcating varieties of determinism. My

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main thesis consists of three claims: (i) there are *many forms* of determinism; (ii) each form of determinism, as a philosophical conception, has a *composite character*; and (iii) conceptions of determinism can be *differentiated* according to the particular elements used in their composition.

In what follows it is suggested that a) similar (or even the same) conceptions of determinism may be designated by different names; and that b) various formulations labeled with the same name represent substantially different conceptions. Below I discuss different deterministic conceptions and emphasize some of their essential components that enable us to make their distinct features more vivid.

1. The origin of the term

When philosophers wish to label a certain philosophical conception "deterministic", they do not usually feel the need to additionally clarify or explicate what they mean. They simply take our understanding for granted. The meaning of this term varies, however, in both historical and contemporary texts.

"Determinism" has its origins in Latin. In Roman authors, we encounter use of *"determino"* or "*determinatio*", which means "to enclose within boundaries, to bound; to limit, to prescribe, to determine; to fix, to settle".[2] The Greek equivalent of the Latin *determinare* (syn. *definire*) is ἀφωρισμένης, which was used in approximately the same way. Ancient and medieval uses of these terms departed greatly from our use today.

Although philosophical conceptions of determinism have had their advocates throughout history, the specific term "determinism" arrived on the scene much more recently. A survey of Krug's *Allgemeines Handwörterbuch* reveals various uses of "*Determinismus*" *(Bestimmung*, *Predeterminismus*) and "*die Deterministen*" (see Krug 1827, vol. i, 500-501). Indeed, it contains a note on the first appearance of these terms (cf. Krug

[2] Livy uses this as a technical term to describe the augurs' division of the parts of heaven into regions (*determinavit regiones*) and for marking their boundaries [Liv. *Ab urbe condita libri*, i, 18, 7, 32]. A similar example can be found in Gellius [*Att. n.* 13, 14]. In Cicero [*Inv.* 1, 52, 98], "the conclusion [i.e. *peroration*] brings to a close and delimits the whole oration (*determinatio totius orationis*)".

1829, vol. v, 100), made by Christian Wilhelm Snell (1789) in a commentary on Kant's moral themes in *Über Determinismus und moralische Freiheit*. At several other places in the *Allgemeines Handwörterbuch*, determinism is used in the sense of "philosophical necessity". This use is related to an English source: Joseph Presley's (1799; 1780) concept of "determination"; and Krug quotes John Presley's correspondence with John Palmer (cf. Krug 1827, vol. iii, 128, 299, 303). A year after Snell (in 1790), Carl Friedrich Bahrdt in (1790, 291) also employs determinism as a theoretical concept. Soon after, the term appears in Kant's treatise on religion (see Kant 1793). In a footnote, Kant considers determinism in the context of the opposition between agency and determination by external forces. Here, it is described as *predeterminism*, and it is ultimately rejected as an "illusion" (cf. Kant 1793, 58A). That same year, Heydenreich published his *Über Freiheit und Determinismus* (see Heydenreich 1793).

Herbart uses the term once at the end of his text on Pestalozzi (1804, 281) and several times subsequently (cf. Herbart 1842). He claims that determinism is a prerequisite for action: "Determinismus ist Voraussetzung des Handelns" (Herbart 1843, 147; 152). Hegel (1816, ii, 206; 236) treated the term as a standard philosophical notion (in the context of mechanical processes, but also with respect to religion and freedom). An extensive record of the term's use in German can be found (with minor shortcomings) in the *Deutsches Fremdwörterbuch* (see Schulz et al. 1999, 442-443). Until the second part of the nineteenth century, the term was regularly used in the context of free will and its determination by antecedent circumstances, which were usually conceived as "external causes" that determine agents' decisions in the traditional sense of a "causa finalis".

2. Early demarcations

In the opening pages of his *Determinism and Indeterminism in Modern Physics*, Ernst Cassirer dates the rebirth of determinism to 1872, the year in which Emil Du Bois-Reymond (1886, 107) held a public speech on the limits of our knowledge of nature (see Cassirer 1956). Du Bois-Reymond reflected on the Laplacean roots of the notion and attempted to revive a genuine philosophical conception of determinism in the sense of complete

physical causal determinism. In fact, he simply repeated the formulation from the key passage of *Essai philosophique sur les probabilités*. Laplace's determinism, based on the principle of universal causal concatenation, was inspired by Leibniz's principle of sufficient reason. In a famous passage, Laplace writes the following:

> We may regard the present state of the universe as the effect of its past and the cause of its future. An intellect which at a certain moment would know all forces that set nature in motion, and all positions of all items of which nature is composed, if this intellect were also vast enough to submit these data to analysis, it would embrace in a single formula the movements of the greatest bodies of the universe and those of the tiniest atom; for such an intellect nothing would be uncertain and the future just like the past would be present before its eyes. (Laplace 1902, 4)

This form of determinism identifies causation and lawfulness with determinism. Laplace wants to say that predictability (p) must at least in principle be grounded in the following postulation: There exists an intellect of some sort (i) that has access to and is able to analyze all relevant data (d) – where (d) consists of information about all forces (l) and all states (the position of all items at time t) in the system (s) – and that can bring this data under a single formula (f). In short, predictability (p) on this view is the result of the ability to apply a unique function (calculability) to the relevant data. In particular, Laplace highlights the following conditions for predictability: $p=\langle i, d, f\rangle$, where (d) consists of subset $\langle l, s, t\rangle$.

Laplace's determinism is a philosophical conception, built from different components. Central to it is the idea of a system governed by causation, which in turn proceeds according to laws. In addition, it relies on the notion of exceptional abilities (to obtain, analyze and calculate data via the application of a function, on the basis of which to make predictions). The data consists of laws, states and time indices, where laws are understood as active forces that are able to cause occurrences.

Cassirer (1956) pursued a different option and sought to distinguish between a new "critical" form of determinism and the old "metaphysical" determinism. The former is based on the belief that causal relations and laws originate in the mind – i.e. their source is our experience, not nature itself. Natural laws apply not to objective things, as metaphysical determinism

conceives them, but to cognitions and their ordering. In this sense, causal relations have a necessarily epistemological foundation.[3]

At the beginning of the twentieth century, William James (1907), motivated to make space for free will, also attempted to demarcate contemporary conceptions of determinism. He identifies the old determinism with the following view:

> [P]arts of the universe already laid down absolutely appoint and decree what the other parts shall be … Any other future complement than the one fixed from eternity is impossible. The whole is in each and every part, and welds it with the rest into an absolute unity, an iron block, in which there can be no equivocation or shadow of turning. (James 1907, 150)

He calls this "old" conception "hard determinism". Hard determinism does "not shrink from words like fatality, bondage of the will, necessitation, and the like." This contrasts with the "new" determinism – "soft determinism" – according to which the following is true:

> Nowadays, we have a soft determinism which abhors harsh words, and, repudiating fatality, necessity, and even predetermination, says that its real name is freedom; for freedom is only necessity understood, and bondage to the highest is identical with true freedom. (James 1907, 149)

3. Scientific determinism and scientific fatalism

Susanne Langer associates scientific forms of determinism with fatalism (see Langer 1936, 474). Fatalism is seen as the outcome of a full-fledged determinism. Determinism, which is based on the assumption that every event has an immediate cause, is a useful thesis for scientific pur-

[3] Cassirer (1956, 114): "We find the essential significance of the causal relation, if interpreted in a critical rather than a metaphysical sense, to be that it contains a statement not immediately about things but about experience, by which and in virtue of which alone things, as objects of knowledge, can be given us. It expresses something about the content of empirical knowledge."

poses. Problems arise, however, when this thesis is connected with predictability, which leads to *scientific fatalism*. Modern scientific fatalism, according to Langer, is "the assumption that there is a theoretically knowable collection of causes for any act". The thesis is derivable, on this view, from the false assumption inherent in determinism (and illustrated via Laplace's demon) of the ability to obtain knowledge of the "total state of the universe". The assumption was thought by Russell & Whitehead (1910, 40) to involve an "illegitimate totality", since "a whole cannot be theoretically constructed"; because of this, the doctrine of determinism in its philosophical form was taken to constitute "a modern version of belief in Fate" (Langer 1936, 478). Scientific fatalism is the view that there is a theoretically knowable collection of causes for any act (see Langer 1936, 478). Although "pure" determinism and fatalism commonly posit a causal connection between the past and the future, such that the latter can be predicted on the basis of the former, they do not entail the predictability of the future, for causality does not necessary imply predictability. Even in the case of a completely causal universe, the unpredictability of human agency undermines general predictability, given the unknowability of human agency (cf. Langer 1936, 472).

Mario Bunge also views the idea "that causality is fatalistic" as mistaken and draws a distinction between scientific determinism and fatalistic determinism (going as far as to argue that the two are "incompatible"; see Bunge 1959, 101-102). His view on fatalism, causality and determinism differs slightly from Langer's, however. While causal determinism is a theory that is grounded in reason and argument and offers "the means for knowing, predicting, and consequently changing the course of events", fatalism assumes that a lawless, supernatural power (fate) drives our unknowable and inescapable destinies – a power that is above the law, works with unconditional necessity, and directs the course of events. Causality need not entail any such transcendental or supernatural agency. Moreover, it does not entail inevitability: causes can interfere with each other, background or hidden causes and conditions may obtain, human agency may intervene, and so on. Bunge inclines toward a conception known as agent-causation, according to which the presence of the elements listed above can result in different outcomes (which he interprets as a source of probability). Thus, "general determinism" need not be

viewed as holding unconditionally. It enables us to use our knowledge of laws to change or modify courses of events while leaving room for chance and freedom. In addition, Bunge firmly believes that statistical laws exclude determinism completely and are indeed incompatible with it since they are based not on causal principles but on probability and generalized correlations obtained from data. As he puts this idea, "statistical law and probability destroys determinism".

4. Determinism in terms of predictability

Karl Popper, who prefers to interpret determinism as an epistemological thesis, sums up the doctrine of scientific determinism ("the doctrine much stronger than common sense") in his *Open Universe*. On his view, scientific determinism is a view with which "most physicists would have agreed at least prior to 1927" (Popper 1982, xx). According to scientific determinism, "the structure of the world is such that *any event can be rationally predicted, with any desired degree of precision, if we are given a sufficiently precise description of past events, together with all the laws of nature*" (Popper 1982, 1-2).

On Popper's account, scientific determinism has its roots in "religious determinism" and seems to be "a kind of translation of religious determinism into naturalistic and rationalistic terms" (Popper 1982, 6). It is contrasted with the metaphysical doctrine of determinism, which holds that

> [A]ll events in this world are fixed, or unalterable, or predetermined. It does not assert that they are known to anybody, or predictable by scientific means. But it asserts that the future is as little changeable as is the past. Everybody knows what we mean when we say that the past cannot be changed. It is in precisely the same sense that the future cannot be changed, according to metaphysical determinism. (Popper 1982, 7)

Metaphysical determinism differs from scientific determinism. It is entailed by both religious and scientific determinism. However, metaphysical determinism (along with metaphysical indeterminism) is not testable, since

it lacks empirical content. With regards to testability, another distinction drawn by Popper is that between a weak version of scientific determinism and its stronger form (cf. Popper 1982, 36*ff*).

The weak version presupposes the possibility of predicting any future instant of time in a closed physical system ("even from within") "by deducing the prediction from theories in conjunction with initial conditions" (i.e. with knowable initial conditions). Theories here play the instrumental role of describing the world – asserting that it has certain properties. However, this does not mean that, if the theory that describes certain properties of the world is true, everything that can be deduced from it has a corresponding property in the world. This "stronger" kind of determinism, criticized by Popper as false, subscribes to the predictability of "any given state, *whether or not the system in question will ever be in this state*" (Popper 1982, 37). Popper is not always consistent. This part of his book seems to identify determinism with causation (cf. Popper 1982, 149), while in other places he asserts that they are different (cf. Popper 1982, 4, 19, 23). Although predictability contributes to the testability of scientific theories, Popper is critical of metaphysical and stronger forms of determinism.

Indeed, Popper is not alone in criticizing the conflation of determinism and predictability (see, e.g., Earman 1986, 9-10; Suppes 1993; Kellert 1993; and Stone 1989). Predictability, which is just one component of (Laplacean) determinism, is an epistemological concept; determinism, on the other hand, should be analyzed as an *ontic* or *physical* thesis. Thus, it is necessary to distinguish determinism proper from determinism in the sense of the ability to make predictions. Patrick Suppes appeals to the three-body problem and Turing machine examples: both are illustrations of deterministic systems *par excellence*. As is well known, there is no algorithm (which could allow for prediction) for determining whether an arbitrary Turing machine in an arbitrary configuration will ever halt (see Suppes 1993, 245-246). Suppes therefore insists on the *conceptual separation of two notions*: predictability and determinism. We have good reason to interpret certain systems as "deterministic" even though we may not be able to predict events occurring within it, which would suggest that determinism need not come hand in hand with the predictability thesis.

5. The rise of so-called "syntactical determinism"

Russell joins the discussion in his well-known lecture on the obscurity of the concept of a cause (see Russell 1917). On his view, the concept of determinism can be demystified by revealing its true nature – its standing as *a functional relation*:

> A system is said to be "deterministic" when, giving certain data, e_1, e_2, …, e_n at times t_1 t_2,…, t_n respectively [*viz.* "determinants"], concerning this system, if E_t is the state of the system at any time t, there is a functional relation of the form $E_1 = f(e_1, t_1, e_2, t_2, …, e_n, t_n)$.
>
> The system will be "deterministic throughout the given period" if t, in the above formula, may be any time within that period, though outside that period the formula may be no longer true. If the universe, as a whole, is such a system, determinism is true of the universe; if not, not. (Russell 1917, 199)

> Determinism in regard to the will … Whether this doctrine is true or false, is a mere question of fact; no *a priori* considerations (…) can exist on either side. (Russell 1917, 205).

> We were unable to find any *a priori* category involved: the existence of scientific laws appeared as a purely empirical fact, not necessarily universal, except in a trivial and scientifically useless form. (Russell 1917, 208)

Russell thus insists on revising the concepts of cause and necessity – two fundamental elements of what had been the dominant approach to science. Since "there is no *a priori* category of causality" – but merely certain observed uniformities (cf. Russell 1917, 205) – the notion of necessity is "a confused notion not legitimately deducible from determinism" (Russell 1917, 207); it must be viewed simply as a logical necessity driven by constitutive determinants as arguments of a necessary propositional function.

Although Russell turns away from the confused notions of cause and causality, his formulation leaves room for a connection between determinism and predictability: a system is deterministic if its previous states determine its later states in the precise sense in which the arguments of a function determine its values. One of Russell's important suggestions (which

concerns the traditional view that scientific laws hold absolutely) reflects "the principle of the irrelevance of time": the fact that time, in an absolute sense, cannot enter into our formulae (see Russell 1917, 205). Our laws are not *a priori* principles that, because they have held for the past and present, will necessarily hold in the future. Our formulas are "methodological precepts", not Laws of Nature that hold absolutely and eternally.

Russell was not completely satisfied with his formulation of determinism. There are several reasons for this. For any set of data points that are describable by some function, those points are in fact describable in other ways, by infinitely many functions. Further, in dynamic systems, the past state of a system, to which a formula was hitherto applicable, may well change in the future, and what is selected as the simplest way to capture the facts may therefore change as well. In addition, the way our system has hitherto been described may advance, such that formulas we have thus far relied on no longer apply. For this reason, we must bear in mind the principle of the irrelevance of time.[4]

Russell's revision seriously shook the traditional image of science held by the scientific community. As a result of his disruption, however, his critique of causation and natural laws made room for the concept of logical determinism.

6. Schlick's logical determinism

Russell's observations provided the basis for a developing conception, which Moritz Schlick would later call *logical determinism* (the first use of this term). Schlick outlines this position as follows:

> Let us see how the scientist uses the word determination – then we shall find out what he means by it. When he says that the state E at the time

[4] "In fact we might interpret the 'uniformity of nature' as meaning just this, that no scientific law involves the time as an argument, unless, of course, it is given in an integrated form, in which case *lapse* of time, though not absolute time, may appear in our formulas" (Russell 1917, 205). An extension of Russell's formula with regards to determinism in dynamical or evolutive systems is given in van Fraassen (1989, 254). Russell's function must be extended to cover all possible trajectories of the system, i.e. to encompass changes to successive states of the system.

> t_1 is determined by the state C at the time t_0, he means that his differential equations (his Laws) enable him to calculate E, if C and the boundary conditions are known to him. Determination therefore means Possibility of Calculation, *and nothing else*. (Schlick 1932, 114)

The "natural law" of science, however, "is not a prescription as to how something should behave, but a formula, a description of how something does in fact behave" (Schlick 1939, 147). Natural laws are just descriptions without any force, which do not make things to move according to their prescriptions.

The necessity of logical determinism is not the necessity of *causal nomological* determinism. It is the necessity of *functional* determination, which enables us, on the basis of a function and its determinants, to calculate the necessary relational dependencies among determinants with respect to the selected function.

Russell's and Schlick's formulations share a crucial assumption: namely that determinism is firmly linked with predictability (and, conversely, with the ability to make retrodictions). Schlick's "possibility of calculation" corresponds to Laplace's condition for making predictions (although Laplace had in mind a singular function over a complete universe). If one state of affairs is determined in the above functional sense, there is room for this state to be predicted (or to be calculated in advance) on the basis of knowledge of its previous states and the function that connects them to it.

Schlick's *calculability* (predictability) is a form of deducibility. It represents a standard understanding of logical determinism according to which one state is propositionally connected to another state via inferential power. Logical necessity must be distinguished from physical necessity and causation: "[W]hat is called causal necessity is absolutely different from logical necessity […] [F]ormer philosophers […] frequently made the mistake of confusing the two and believing that the effect could be logically inferred from the cause" (Schlick 1932, 108). Schlick calls the relationship between logical principles and reality "a problem of logical determinism" – or "a paradox" (see Schlick 1931, 159) – and locates its origin in Aristotle: "[T]he Principle of the Excluded Middle could not be applied to future events unless we assume the truth of Determinism." Most likely with Jan Łukasiewicz in mind, Schlick adds that "there are

even modern logicians who follow him [*viz.* Aristotle] in this" (Schlick 1932, 115).

7. The bivalent nature of logical determinism

Jan Łukasiewicz's formulation of determinism, developed more than a decade before Schlick's, runs as follows: "By determinism I understand the belief that if *A* is *b* at instant *t* it is true at any instant earlier than *t* that *A* is *b* at instant *t*" (Łukasiewicz 1990, 113). On this formulation, the future must be treated like the past; it differs from the past "only in so far as it has not yet come to pass". Everything is fixed in advance. The way out of determinism consists in abandoning the beliefs that lead to a conception of eternal truth and the absence of free will.

Łukasiewicz offers two arguments against determinism. One is based on "logical principles", while the other is based on "the principle of causality". Here, I wish only to emphasize his commitment to the view that the bivalent nature of propositional calculus leads to determinism. This argument relies on identifying two principles: the principle of bivalence and the law of excluded middle. Even though the argument is ostensibly valid (on the basis of propositional calculus), it must be rejected for other reasons: "Although this solution appears to be logically valid, I do not regard it as entirely satisfactory, for it does not satisfy all my intuitions" (Łukasiewicz 1990, 124).

The rejection of determinism "finds its justification both in life and in colloquial speech" (Łukasiewicz 1990, 125). The principle of bivalence is not applicable to future-oriented propositions that describe possible future (not yet generated) states of affair. Such propositions do not have "real correlates" like propositions about the present and the past. A third, "neutral" value would be more appropriate to future contingents, and intermediate sentences would "ontologically have possibility as their correlate".

The argument for determinism is logically valid. Thus, determinism is a self-consistent view; to the extent that it rests on the assumption of bivalence, however, not only is it unable to deal with future contingents but it also has unintuitive consequences with regards to human agency.

Friedrich Waismann uses the more expressive term "logical predestination" since, according to this conception, it seems "that indeed the entire

future is somehow fixed, logically preordained" (Waismann 1959, 352). Following Waismann, Zbigniew Jordan interprets logical determinism as the semantic formulation of strict determinism, "where the strict causal determinism implicitly assumes that an unending sequence of events has no limit" (Jordan 1963, 23). The principle of causality is not a necessary consequence of the principle of bivalence, but it provides a firm connection to real correlates, which secures the necessary truth of future propositions and justifies the thesis of eternal truth. In this sense, "strict determinism" is the outcome of (a) the principle of bivalence and two additional assumptions: (b) the correspondence theory of truth and (c) the timelessness or absolute character of truth (cf. Jordan 1963, 1). On Jordan's view, "strict determinism" occupies the following relative place in the transitive chain of principal dependence: "If the principle of bivalence entails strict determinism and strict determinism entails fatalism, the principle of bivalence entails fatalism" (Jordan 1963, 3). In the same spirit, Jan Wołenski has recently interpreted logical determinism as a form of radical determinism (see Wołenski 1996).

8. Inevitability

The transitivity chain traced by Jordan led to the standard representation of logical determinism as logical fatalism. This conception finds support in Aristotle's sea battle example and the case of future contingent propositions. Gilbert Ryle's lecture "It Was to Be" (see Ryle 1953), Richard Taylor's articles and the widespread discussion that followed during the sixties (cf. Wallace 2011), A. J. Ayer's "Fatalism" (see Ayer 1963) and Michael Dummett's "Bringing About the Past" (see Dummett 1964) are among the many texts on fatalism that have contributed to this tradition. Logical necessity began to be more frequently interpreted in terms of inevitability.

Even though Raymond D. Bradley warned against the confusion of logical determinism with fatalism in the late fifties, the tradition of interpreting logical determinism as fatalism (or at least a kind of fatalism) continues. In "Must the Future Be What It Is Going to Be?", Bradley restates some of Schlick's earlier warnings to the effect that logical necessity must be distinguished from causal necessity and that the truth of logical propositions and their relations has a different character than the

truth of empirical evidence (see Bradley 1959). He criticizes the common assumption that logical determinism *implies* (logical) fatalism. On his view, what is timeless differs from what is empirical. The failure in this inference consists in ascribing logical necessity to causal necessity, and causal necessity to fatalism. We can accept as valid that if *x* is causally determined, then *x* is logically determinate. However, *x*'s being logically determinate does not imply that *x* is causally determined. These two claims are not equivalent; one concerns causality and the other concerns logical necessity. Three logical principles that are to be found in Aristotle's discussion of the sea battle – the law of identity, the law of noncontradiction and the law of excluded middle – which form the crux of logical determinism, do not provide a sufficient basis for the projection of logical necessity onto causal necessity or the (actual) necessity of future truths.

9. Logical fatalism

The term "(logical) fatalism" (a view according to which time is symmetrical and all possible worlds are reduced to the actual world) has, over time, completely replaced the term "(logical) determinism". In his articulation of what is referred to as the standard argument for (logical) fatalism, for example, Taylor nowhere mentions determinism, logical or otherwise (cf. Taylor 1962). Interestingly, laws are not mentioned anywhere in the first version of the argument. Instead, he emphasizes causes. He later suggests that the only difference between the fatalist and the determinist is that the former explicitly holds that there is no difference between universal causation and inevitability. The distinction between fatalism (which claims that the future is unavoidable) and determinism (which relies on the causal assumption) seems superfluous. Fatalism as the claim that certain events are going to happen *no matter what* and *regardless of their causes* is, for Taylor, "enormously contrived": "it would be hard to find in the whole history of thought a single fatalist, on that conception of it" (Taylor 1974, 55). Fatalistic claims about *unavoidability* and deterministic claims about *truth* and *necessity* coincide and differ only with regards to the perspectives from which they are made. Like Taylor, Steven Cahn identifies fatalism with the thesis that:

> [T]he laws of logic alone suffice to prove that no man has free will, suffice to prove that the only actions which a man can perform are the actions which he does, in fact, perform, and suffice to prove that a man can bring about only those events which do, in fact, occur and can prevent only those events which do not, in fact, occur. (Cahn 1967, 8)

This attempt is supported by many authors. According to Peter van Inwagen, for example, fatalism is "the thesis that it is a logical or conceptual truth that no one is able to act otherwise than he in fact does; that the very idea of an agent to whom alternative courses of action are open is self-contradictory" (van Inwagen 1983, 23). Similarly, Paul Horwich describes fatalism as follows:

> What was true in the past logically determines what will be true in the future; therefore, since the past is over and done with and beyond our control, the future must also be beyond our control; consequently, there is no point in worrying, planning and taking pains to influence what will happen. (Horwich 1988, 29)

Finally, J. M. Fischer conceives of fatalism as "the doctrine that it is a logical or conceptual truth that no person is ever free to do otherwise" (Fischer 1989, 8).

10. Determinism and fatalisms

Taylor is only partly correct when he writes that "it would be hard to find in the whole history of thought a single fatalist", for there is a very reasonable sense in which we might hold that certain events are "unavoidable" even though they are not subject to strict causal necessity. In ancient texts, for example, we find a wide range of conceptions in which fate differs from necessity. Examples of this can be found in Cicero's *De fato* and *De divinatione* (among other of his works). These different forms of ancient fatalism can be distinguished according to certain 'topological points'. In the case of so-called event fatalism, future events are unavoidable in relation to either *time*, *place*, *means* (*the way* they are realized) or *kind* (arising from some necessary realization of disposition, etc.; cf. Marko

2011a; 2011b). In some cases, unavoidability hinges on the correlation between a sign and that which is signed, as in the Stoic example of the conditional predictive sentence "If Fabius was born during the Dogstar, he will not die at sea," where the relation between the antecedent state and the consequent state is to be interpreted neither strictly causally nor via classical propositional implication but in terms of a certain sort of *connectedness* (e.g. in terms of relevant connection or a "responsibility" relation).

Since fatalism is not always about fixed points in time, in many cases it is not connected to the examination of causes, laws, logical laws, and the like. Many of these conceptions do not make room for the possibility of agency, as is the case with conditional fate. What ancient fatalisms have in common is that they generally concern truth in advance of a given happening – once in the past, it was true that at least one kind of entity (event, occurrence, disposition or truth of proposition) would inevitably be actualized (in this or that way).

Although logical determinism (at least in Bradley's sense) and logical fatalism (in Taylor's or Cahn's sense) seem to correspond to each other conceptually, they do not necessarily equally correspond to all forms of fatalism. Some forms of ancient fatalism correspond to, for example, John Earman's naturalistic fatalism – the view that an event will occur in every physically possible world, "no matter what happens" – "for instance, that the laws of biology dictate that I am naturalistically fated to die". Earman also claims, however, that "naturalistic fatalism in this sense neither entails nor is entailed by determinism" (Earman 1986, 18).

Susan Haack argues that theological fatalism (theological determinism) is an upgraded version of the argument for logical fatalism (see Haack 1974). An additional proposition with theological content is added (for example 'God is omniscient' or 'God is omnipotent') – one that is formally inessential to the proof. Since the logical premisses are independent of theological content, the additional premise plays a superfluous role in the argument, a redundant detour from its logic.

11. Nomological determinism

Several modern arguments for incompatibilism rely on explicit deterministic assumptions (e.g. *The Direct Argument* and *The Consequence*

Argument – see van Inwagen 1983). In his exposition of determinism, van Inwagen (1983, 184-188) starts from the simple assumption that the past determines precisely one physically possible future. On his view, determinism as a thesis about propositions need not be identified with determinism based on the principle of universal causation. He does not feel obliged to accept the principle of universal causation and doubts that this principle even entails determinism or that determinism entails causation (so there is still space for immanent causation despite the fact that in complex physical events it is an open question how and whether causation can be distinguished). Laws, however, are firm constraints that limit our abilities.

Van Inwagen understands a law of nature as "any set of worlds that has as a subset the set of all worlds in which the laws of nature are the same as those of the actual world, or, as we might say, are *nomologically congruent* with the actual world" (van Inwagen 1983, 65).

Determinism is presented as a conjunction of the following two theses:

> For every instant of time, there is a proposition that expresses the state of the world at that instant.
> If p and q are any propositions that express the state of the world at some instants, then the conjunction of p with the laws of nature entails q.[5] (van Inwagen 1983, 65)

Determinism consists in the antecedent conjunction of *past truths* (Po) and *the laws of nature* (L), while agency (A), is conditioned by that conjunction [*i.e.* $\Box((\mathrm{Po} \,\&\, \mathrm{L}) \rightarrow \mathrm{A})$].

In addition to this conception, according to which human agency is determined by past truths and natural laws, we find a wide range of approaches that interpret this basis in a compatibilistic manner, allowing for agent-causation as an intervening link in the deterministic chain. The notion of causality plays a central role here. Some compatibilists, continuing in the tradition of the "soft determinism" held by James, accept both causal determinism and logical determinism, while others do not fully accept either the former or the latter.

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5 Cf. also van Inwagen (1983, 58; and 2004, 344).

Contrary to the above formulations from Schlick, the laws of nature used to be frequently understood and qualified as causes. The so-called ontic conception (cf. Salmon 1998, 54), widely accepted in scientific practice, claims that since laws are the explanatory engines of occurrences in the physical world, they can be interpreted as being responsible for occurrences: "laws of nature stand in no need of 'philosophical analysis'; they ought to be posited as ontological bedrock" (Maudlin 2007, 1).

When we appeal to laws of nature, our starting point is the conviction that they are in some sense fundamental and cannot be reduced to other, more primitive notions. They are, we assume, basic ontological notions, since "our world is governed by laws". In this sense, as Carl Hoefer puts it, a law is a cause "that makes things happen in a certain way" (Hoefer 2010).

12. Determinism without laws and causation

Is it possible to represent determinism without laws? This depends on how we interpret laws. Some interpretations of laws of nature do not depend on the notion of a cause. For example, Ernest Nagel's syntactical formulation of laws of nature conceives of them according to their logical function. On Nagel's view, a set of laws is deterministic with regards to an isolated system of bodies, relative to a definite class of properties, if, given the state of that system at any initial time, those laws logically determine a unique state of that system for any other time (cf. Nagel 1999, 281).[6] Laws are theoretical notions, and according to Nagel, "a theory is deterministic if, and only if, given its state variables for some initial period, the theory logically determines a unique set of values for those variables for any other period" (Nagel 1999, 292).

If we wish to see the relation between two states as causally connected and thus to assume a causal version of determinism, this would seem to lead us toward *ontological determinism*. For this reason, Nagel insists that causality should be kept apart from determinism. Some authors pre-

[6] We find a similar opinion in Hempel: "a deterministic theory provides a system of laws which, given the state of an isolated system at one time, determine its state at any other time" (Hempel 1962, 107).

fer to keep causality in their accounts of determinism as "a pure theoretical notion" – a useful concept that has indubitable explanatory advantages (cf. Tooley 1987, Chap. 9).

13. Deterministic theory and possible worlds

A more precise definition – one that may partly avoid the above difficulties – comes from Richard Montague (see Montague 1974; later slightly reformulated by Earman 1986, 12-14). Montague develops Nagel's (1953) earlier formulations. His idea is that determinism can be seen as a property of theories. Briefly, a theory is interpreted by a formal semantics approach and is associated with a class of models. The objects of a theory are represented as systems, properties are states, and regularities can be represented as functions that ascribe a value to some point on the *t* axis (and can be interpreted as "the laws of the theory"). Thus a theory *T* is deterministic if any of at least two possible histories (*S* and *S'*) that realize (satisfy – *Rl*)[7] *T* and which are identical at a given time t_0 are identical at all times *t*. *T* is deterministic if and only if all models of that theory that agree on the state of the world at one time also agree at certain other times.

Let us suppose that *S* is a history, where $S = \langle D_1, \ldots, D_n \rangle$ and where *D* is one argument function defined at least for all real numbers *R*, and that the state of *S* at *t* ($st_S(t)$) is defined as $st_S(t) = \langle D_1(t),\ldots, D_n(t) \rangle$. Then,

- a theory is historically determined:
  If $S, S' \in Rl(T)$, $t_0, t \in R$, $t_0 < t$, and $st_S(t_0) = st_{S'}(t_0)$,
  then $st_S(t) = st_{S'}(t)$;

- a theory is futuristically determined:
  If $S, S' \in Rl(T)$, $t_0, t \in R$, $t < t_0$, and $st_S(t_0) = st_{S'}(t_0)$,
  then $st_S(t) = st_{S'}(t)$.

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[7] A formula ϕ of *L* is realized *by* a history *S* (i.e. *Rl*) just in case there is a standard model *M* of language *L* such that history *S* is a partial model corresponding to $M(S = Pm(M))$ and formula ϕ is true in model *M*. *S* realizes a class of formulas or theory *K* (in symbols, $S \in Rl(K)$) if there is a single standard model M such that $S = Pm(M)$ and theory K holds in model M.

A theory is *deterministic* if it is both *historically* determined and *futuristically* determined. That is:

If S, S′ ∈ *Rl*(*T*), t_0, $t \in R$, and $st_S(t_0) = st_{S'}(t_0)$ *then* $st_S(t) = st_{S'}(t)$.

Earman interprets Montague's formulations in terms of physically possible worlds. Earman's modification of Montague allows for additional alternative approaches and different modes, where determinism can be interpreted not only as a property of the theory but also as a property of, for example, the set of laws, the world, the actual state of the universe (where the history is settled by the laws even though they do not determine future states of the universe), and so on.

14. Deterministic systems

Russell's observation concerning the principle of the irrelevance of time suggests an attempt to define determinism in a changing system in terms of *actual* trajectories alone rather than *possible* trajectories (which could be infinite in number and must be avoided). According to Montague, this approach will preclude the deterministic condition that a given state is always followed by the same history of state transition. Taking determinism as a modal notion, Bas van Fraassen tries to refine Russell's formulation, taking into account not only actual but also possible trajectories. On his view, a system is deterministic if two possible worlds have the same history of state transitions: "If *u* and *v* are possible histories, and $u(t) = v(t')$ then for all positive numbers *b*, $u(t + b) = v(t' + b)$" (van Fraassen 1989, 254).

Mark Stone (see Stone 1989) and Stephen Kellert (see Kellert 1993), via an analysis of Laplacean determinism, attempt to identify and extract key properties of determinism, which can serve as necessary and sufficient conditions for determinism:

a) there exists an algorithm which relates a state of the system at any given time to a state at any other time, and the algorithm is not probabilistic;

b) the system is such that a given state is always followed by the same history of state transitions;
c) any state of the system can be described with arbitrarily small (non-zero) error (cf. Stone 1989, 125).

On this view, determinism is a necessary condition for predictability, *but not vice versa*.

Stone, Clark (1989) and Kellert extend deterministic interpretation from linear to non-linear systems (systems usually interpreted as not fully stable or not transforming continually because they are affected by occasional "jumps"). These systems are deterministic, although they are only globally, not locally, predictable. Their defining feature is that, even though they behave chaotically, they periodically jump into patterned (deterministic) behavior: Although movements in these systems are characterized by infinite possibility, they oscillate within steady and predictable macro patterns. The chaotic behavior of the system is due to epistemic considerations (or to the lack of Laplacean "demonic" abilities on the part of the observer) with respect to computability and our inability to give precise initial conditions. Determinism is here accepted as an explanatory tool because some aspects of a system's evolution are coverable (not statistically or probabilistically, but) by strictly deterministic differential equations that allow for the "predictability of higher order characteristics" with respect to certain deterministic aspects of the system (related, for example, to its qualitative or topological character – cf. Kellert 1993, 56-57).

Deterministic properties can also be analyzed within the scope of quantum theory, especially quantum field theory. Some recent results support the thesis that quantum theory can also be interpreted as deterministic and that such an interpretation is entirely coherent (see Butterfield 2005).

15. The components of determinism

As we have seen in the previous sections, there are many forms of determinism and fatalism. I have referred to more than twenty different terms related somehow to these kinds of conceptions. Obviously, the list is far

from being exhaustive – it represents only a selection, here reduced to those conceptions that are in some sense dominant or frequently discussed in modern philosophy. In philosophy as well as in other disciplines (from a computer programming to economy), we could easily find other labels with some specific designations useful for a given discipline. Moreover, other expressions are frequently used to point out quite specific circumstances. For example, consider the term "fatalism" as it is nowadays used in medicine or psychology: An event, with respect to a patient's conditions, is unavoidable regardless of any treatment (or no treatment at all) – the event in question is related to some future fixed point irrespective of a way to be reached. It corresponds to the conception characterized here as event-fatalism or to Earman's naturalistic fatalism ("which neither entails nor is entailed by determinism" and it presents conception that has a very little in common with other forms of fatalism, either in a sense of scientific or logical fatalism).

Given the distinctions discussed so far, it is easy to find out that

a) similar (or even the same) conceptions of determinism may be designated by different names;

and that

b) various formulations labeled with the same name represent substantially different conceptions.

For example: a) deterministic conceptions in a sense of Russell's functional determinism, Montague's syntactical determinism, Nagel's nomological determinism (and, mostly, Popper's weak version of scientific determinism) have many elements in common. The same case is with a strong version of scientific determinism characterized by Popper and scientific fatalism sketched in Langer. Moreover, the terms like logical predestination, strict determinism, radical determinism, fatalism, etc., frequently refer to the same conception. From the other side, b) the metaphysical determinism is differently characterized by Łukasiewicz and Popper and these two are conceptually different. In addition, there are some vivid differences among the conceptions of logical determinism as characterized by Schlick, Waismann, Jordan, Wołenski, Bradley, Taylor and Cahn. In literature, these conceptions are frequently referred to by the same name. The discussion on

fatalism is alike – logical or scientific, naturalistic or event-fatalistic conceptions do not always coincide conceptually, since they do not share the same components. The component of ceaselessness, that is a substantial part of determinism, is not a necessary component of all forms of fatalism. All these cases witness a need for a more appropriate way for demarcating these conceptions.

As we have seen, the term "determinism" has been used in a very broad way to capture specific ideas and concepts that are conflicting and even mutually exclusive. The demarcation of different forms of determinism might well offer a solution – given an emphasis on their substantial differences. Since the conceptions discussed so far are complex, their differences (and varieties) can be elucidated via a matrix of some essential or fundamental properties (or their absence).

I suggest moving towards a classification of different forms of determinism from bottom-up rather than via a simple (theoretically heterogeneous) typology. Such a classificatory project would provide a more appropriate demarcation. It would enhance our understanding of the determinism's sub-forms and promote further research on the subject. Furthermore, a sorting of distinct forms of determinism that focuses on the mutual dependency of their components would offer an informative insight into the nature of these components. Simple typology only provides us with distinctions motivated by certain dominant properties. However, it cannot provide us with a satisfying picture of the mutual dependencies among singular types. For this reason, the search for a minimal common denominator of different forms of determinism is a worthwhile direction of inquiry.

It seems that this basic level must consist in the notion of "functional determination", for this represents the common core of all further elaborations. This core layer comprises only the simple "order" of variables and it is free of excessive additional features, such as, for example, a kind of relation (or nature of impact) among the entities or temporal character of direction (which is introduced when we refer to "state plus time (of occurrence)"). Such a characterization can preserve the basic order of entities, and it guarantees that entities are sorted according to a linear function. This core level, which involves only transitivity and continuity (i.e. ceaselessness), can serve as a basis for further developments of determinism, such

as those discussed by philosophers today. In addition, this feature enables opposition to ceased character of indeterminism. This basic level can be compared to John McTaggart's idea of a "flat" series of time, or a *C-series* (cf. Mc Taggart 1908, 462). It need not be understood as determinism itself; rather, it serves as a basis for the development of different forms of determinism.

If we add to this basic level a further conceptual component – the universal principle of causation – we get causal determinism. Further, by adding to this composition of causal determinism yet another element – "the laws of nature" – we have nomological causal determinism (the most appropriate with Laplace's view). If we omit the principle of causality but retain the laws of nature, we come to nomological determinism. As we have already seen, some forms of nomological determinism are advocated by Russell (who conceives of laws as functions), Nagel, Schlick and Montague (who construe laws as functions alike but with an additional emphasize on the role of the laws of thought). A form of nomological determinism is also present in van Inwagen's conception (with an additional claim that laws of nature are nomologically congruent with the actual world and that the real world inevitability can be understood as or related to a logical necessity). If we think of Salmon's, Maudlin's and Hoefer's conception as alike in their claiming that laws are responsible for occurrences and play the role of causes, then these conceptions will interfere with nomological causal determinism, too.

If we step back to the basic level and add both the principle of causation and the so-called "Aristotelian laws of thought" (the principles of non-contradiction, excluded middle and identity), this brings us to a form of logical determinism criticized by Jordan. If we enrich this new composition of the principle of correspondence (correspondence to so-called "real correlates"), then we obtain a metaphysical version of logical determinism which Łukasiewicz had in mind in his criticism of determinism. Other forms of determinism can be composed in a similar manner, with the basic lower layer amounting to a core that contains the minimal features of transitivity and continuity (ceaselessness) – the latter property serving as a component which is necessary both for the principle of causality and for the laws of nature (as well as for functions that serve as their substituents).

Another recommendation concerns the possibility of a minimal formulation of fatalism – one that has the essential property held in common by the above-listed forms of fatalism: inevitability. The minimal conditions for determinism obviously differ from the minimal conditions for fatalism. Inevitability is not a part of the minimal deterministic core (at least, as we saw above, it is not necessarily related to ceaselessness). So, it is possible to develop a minimal core of fatalism in accordance with the traditional forms mentioned above. However, it is also possible for these two core layers to intersect at a higher level. Such an intersection would require further additional assumptions related to causal, nomological or other specific properties. Some forms of the so-called logical fatalism can include layers that also belong to some forms of determinism – by reading implication causally or by interpreting inevitability as logical (or functional or lawful) necessity. The term "logical fatalism", usually used as a unique extension of logical determinism, may also be appropriate in case it includes, for instance, the principle of causality together with the laws of thought, and if it identifies necessity with inevitability. According to Jordan (contra Bradley), logical determinism (equipped with the principle of causality and the laws of thought, especially with the law of excluded middle identified with the principle of bivalence) leads to fatalistic inevitability. Taylor's formulation of fatalism also accepts causes and in the later versions he identifies universal causality with inevitability. However, the conception that accepts only the laws of thought but omits the principle of causality – frequently referred to as logical determinism – is not necessarily based on minimal core needed for determinism (i.e. ceaselessness). Bradley used to characterize such conception as timeless and Jordan relates it to timeless truths. The conception is considered by Ayer, Cahn, Ryle, Dummett and discussed under the term "fatalism" also by van Inwagen and Fischer.

Now it can be seen that if we take into account only some of the dominant components of the above mentioned conceptions and their combinations, we are able to recognize their common features and point to some basic differences between them. Let me illustrate these differences with the following table. Although incomplete, it includes the most fundamental components. Here, the names of particular conceptions are given temporarily and

marked with asterisks to avoid possible confusion with terms introduced hitherto.

	ceaselessness	*inevitability*	*the principle of causation*	*the laws of nature*	*covering function*	*"laws of thought"*
*causal determinism**	+		+			
*nomological causal determinism**	+		+	+		
*nomological determinism**	+			+		
*(functional) nomological determinism**	+				+	
*logical determinism**	+		+			+
*Taylor's "fatalism"**	+	+	+			+
*(genuine) fatalism**		+				
*logical fatalism**		+				+

With both determinism and fatalism, we are able to supply other features as building blocks (giving rise to further conceptions): time component (character of time, temporal direction, time symmetry or asymmetry), causality, logical, physical, epistemic or other properties (laws of nature, statistical laws, probabilistic laws, linear or nonlinear changes to the system, etc.). Adding any of these distinct elements results in still further distinct philosophical conceptions.

What I have tried to show above is that these combinations stem from more elementary layers that must be further investigated as the composite elements of complex conceptual structures. Each of these combinations, no

matter how far they resemble other compounds, has its own meaning and leads to a different philosophical and conceptual standpoint. My primary interest in this paper was not to provide an exhaustive, systematic list of the various forms of determinism on offer but rather to draw attention to the fact that determinism is not a unitary philosophical conception as it is frequently used in the literature. I have outlined traditional and modern philosophical approaches to determinism and have provided a sketch of the means by which we might achieve a deeper understanding of their contours and points of intersection. The forms of determinism outlined above are composite in character. Reducing them to their more elementary building blocks helps us to better understand their composite conceptual structures. A deeper understanding of these elements is crucial to our ability to assess the theoretical consistency and sustainability of particular conceptions of determinism.

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