Max Kistler

The Causal Criterion of Reality and the Necessity of Laws of Nature

I propose an argument for the thesis that laws of nature are necessary in the sense of holding in all worlds sharing the properties of the actual world, on the basis of a principle I propose to call the Causal Criterion of Reality (CCR). The CCR says: for an entity to be real it is necessary and sufficient that it is capable to make a difference to causal interactions. The crucial idea here is that the capacity to interact causally - or to contribute to determining causal interactions - is not only the ultimate metaphysical ground for the *existence* of an entity, but it also provides a criterion for determining the *nature* of that entity, i.e. its properties.

The alternative is to conceive of laws of nature as contingent[1]: they could be different from what they are like in the actual world, where that possibility is understood to be metaphysical, not only epistemic. For the sake of this paper, I shall accept Armstrong's (1983; 1997) thesis that laws of nature are relations between universals. I also follow Armstrong in the view that both the existence and the properties of *particulars* are metaphysically independent of the existence and identity of other particulars[2]. However, what is controversial and what I shall challenge is his thesis that *universals* are like particulars in the following respect: according to Armstrong, each universal is a logically distinct entity whose existence and identity is independent of the existence and identity of other universals. My aim in this paper is to show that the identity of a universal is entirely determined by its lawful relations to other universals. The crucial premise I use is the thesis that the CCR is a universal criterion, which applies both to particulars and universals. From the thesis that the identity of a universal is exclusively determined by laws, it follows that laws are necessary in the sense that they cannot differ without the universals they link also being different. This creates a difficulty for those authors who, as Armstrong, accept the CCR but nevertheless defend the view that laws are contingent.

1. The Causal Criterion of Reality

According to a traditional metaphysical principle, all and only those entities exist which make a causal difference. Armstrong has called it the "Eleatic principle" by reference to its formulation by the Eleatic Stranger in Plato's *Sophist*[3]. In Armstrong's words, "everything that exists makes a difference to the causal powers of something" (Armstrong 1997, p. 41), and

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[1] Cf. Armstrong (1983, chap. 11), Armstrong (2000), Lewis (1986b, p. 163).
[2] Their existence and properties are of course *causally* dependent on other things, but it is metaphysically possible that they exist and have the properties they actually have even if their actual particular causes and effects don't exist. In other words, the causal relation between particular events is an external relation.
[3] Plato, *Sophist*, 247d-e.

conversely, I should add, everything that makes a difference to the causal powers of something, exists[4]. This Causal Criterion of Reality can serve as a justification of the postulation of the existence of both particulars and universals. It can be justified by the claim that it is a central part of scientific methodology. One version of scientific realism consists in extending its validity to cover even metaphysics[5].

First, the postulation of the existence of *particulars* has a causal background: Particulars are needed to make the existence of universals compatible with the acceptance of the CCR, for universals cannot interact causally by themselves but only through their instantiation in particulars. Conversely, just as there cannot be causal interactions without particulars that interact, there cannot either be particulars that do not, in principle, interact. Accepting the CCR forbids the postulation of particulars that are absolutely causally idle - the probability of a neutrino interacting causally with anything may be extremely low, but if it were zero, we wouldn't be justified in postulating the existence of the neutrino in the first place.

Second, and most important for us, the ultimate justification for the existence of a *universal* is that the best explanation of the fact that a set of (elementary) particulars exhibits a specific pattern of causal interaction is that those particulars instantiate a specific universal responsible for that type of interaction. For each primitive type of interaction, there is a simple universal. The dependence goes both ways: just as there is no type of interaction without its universal, similarly there is no universal without its specific type of interaction. The reason for this is that, in an analogous manner to the case of particulars, it would contradict the CCR to postulate a universal whose instantiation by a particular does not make any difference at all to the causal interactions of that particular[6].

Two general remarks before we put the CCR to work. The first concerns the epistemological status of the CCR: Is it purely conceptual or is it rather empirical notwithstanding its generality? As a generalization from a principle derived from the criteria which science uses to justify the postulation of entities, it might seem that the CCR is not entirely a priori, and that it would have to be abandoned in its full generality if it turned out not to be respected in science. Let us conceive a situation in which physics would postulate, say for considerations of symmetry, a perfectly idle universal whose instantiation by a particular would not change at all that particular's capacity to interact. There are two reactions

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[4]Armstrong himself insists that the CCR is only methodological but not metaphysical. See discussion below, in the conclusion. Jaegwon Kim has called it "Alexander Dictum" (Kim 1992, p. 134), in honour of Samuel Alexander (1920) who has defended it as a metaphysical principle: "*To be real is to have causal powers*" (Kim 1992, p. 135; Kim's italics).

[5]According to scientific realism the postulation of universals is justified by the need to explain the way things interact with each other and, through perception and action, with us.

[6]It is important to note that the acceptance of the CCR does not necessarily lead to denying the existence of such entities as possible worlds, possible or necessary states of affairs, or of such allegedly non spatio-temporal entities as numbers and classes. Rather, in order that the type of entity in question can be acknowledged within the overall metaphysical scheme, what has to be shown in each case is that these entities are either identical or at least supervene on entities which obey the CCR. On the condition that the subvenient entities obey the constraints of the CCR, so do the supervenient, even in such a controversial case as that of numbers.

to such a situation that seem to be more plausible than to conclude that it refutes the overall validity of the CCR. First, one might conclude that the fact that a scientific theory leads to the postulation of an idle universal pleads against the theory rather than against the universal validity of the CCR. Second and more importantly, even if the theory is accepted, one can interpret the idle property as a "mere Cambridge", or merely relational, property, just as the property of being a widow: The acquisition by Xanthippe of the relational property of being a widow right at the moment of Socrates' death, leaves her unchanged from a causal point of view. Being a widow is a merely relational property, and not a real universal. I conclude that if the CCR is not purely a priori, it seems to be a principle that is more central to our conceptual scheme (and in particular to the part of the scheme used in science) than the most general empirical principles[7].

The second remark concerns the reference to capacities or dispositions in the above formulation of the CCR. For particulars, I think it is plausible to suppose that all of them interact causally at least twice: when they come into existence and when they disappear. These causal interactions affect even a particular neutrino that does not at all interact with anything between the events of its creation and its annihilation. Still, our formulation of the CCR would allow for the possibility that the universe has neither a beginning nor an end in time and that there exist eternal particulars that never interact. (This is not actually the case if the big bang theory is true). Their existence is nevertheless in agreement with the CCR as long as their probability of interaction differs from zero[8]. For universals, the reference to capacities is more important. Think of a universal which is instantiated by very few particulars and which bestows a very low probability of interaction on these particulars. Is it possible that the universal exists even if, by accident, it does in fact never influence any actual causal relations at all? It seems to me that the answer should be yes. It is metaphysically possible because its existence would be a scientifically legitimate hypothesis which can be evaluated in accordance with the CCR (our leading principle is the generalisation of the domain of legitimate application of the CCR, from science to metaphysics): To confirm it, one would have to try to increase the rate of instantiation of the hypothetical universal and the frequency of the interactions in which the probability of its manifestation is non-zero, up to the point where there is sufficient reason either to accept or to reject the hypothesis of the existence of that universal.

This reasoning shows that the acceptance of the CCR gives us a fresh look on the traditional divide between "Aristotelian" and "Platonist" conceptions of universals. The former is characterised by what Armstrong calls the "Principle of Instantiation" (Armstrong

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[7] I follow Quine in thinking both that the distinction between what is a priori or analytic and what is a posteriori or synthetic is one which admits of degrees, and that this fact does not make the distinction useless or meaningless.

[8] This implies that space-time points do not exist independently from what occupies them. Indeed the existence of space-time is dependent on the existence of the matter and radiation occupying it. The latter is grounded according to the CCR.

1983, p. 82), which says that every universal must be instantiated at least once, whereas the latter allows the possibility of universals that are never instantiated. Rather than taking a general stand on that question, on a priori grounds, the CCR suggests the following position: What is illegitimate is the postulation of a universal for which the probability, once it is instantiated, that it influences causal interactions is strictly zero. It is however legitimate to make the hypothesis of the existence of a universal whose probability of contributing to causal interactions is non-zero, but which happens not to have been instantiated, on the condition of obeying the following general rule of scientific methodology: the hypothesis must in principle be able to be confirmed or refuted, meaning that there must be a way to increase the rate of instantiation of the hypothetical universal U which would in turn lead to the manifestation of the non-zero probability of its exercising an influence on interactions. In brief, a universal U exists if and only if both the probability that instantiations of U make a causal difference to the instantiation of other universals is non-zero and if there exist certain other universals V such that the probability that instantiations of V contribute to causally provoking instantiations of U is also non-zero.

2. Quiddity and haecceity

My main thesis is that the adoption of the CCR as a general methodological principle is incompatible with the view - held by Armstrong and others - that the laws of nature are contingent rather than necessary.

The conception of laws as contingent is of a piece with a conception of universals, which assimilates them to a special type of particulars (Armstrong calls them indeed "second-order particulars"): as entities whose existence and identity is independent of the existence and identity of other entities of the same type (i.e. particulars or universals, respectively). True, it is part of the concept of a *particular* that it is independent in this way of the existence and identity of other particulars. However, what I argue for is that there is a fundamental difference between particulars and universals as to the grounds of their respective identity: in the case of particulars, there are scientific grounds for thinking that their identity is not exhausted by their properties (two particulars can differ numerically while sharing all properties) whereas there are no such grounds in the case of universals. The identity of a universal *is* entirely determined by its properties[9].

Following Armstrong's (1989) terminology, we shall formulate the question whether the identity of particulars and universals is exclusively or only partially determined by their properties, by asking whether these entities have, over and above their properties, an individual essence - called "haecceity" in the case of particulars and "quiddity" in the case of

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[9]These properties are second order properties. As we shall see, following the CCR, those second order properties are determined by all and only the laws in which the universal takes part.

universals - which is the metaphysical ground for their individual identity. Armstrong himself examines in detail only the question of haecceity and contents himself, for the parallel question regarding universals, with saying that "quidditism for universals seems very plausible. Each universal must surely have its own nature" (Armstrong 1989, p. 59).

2.1. Haecceitism and anti-haecceitism

The affirmative answer to the question whether there exists a metaphysical ground for the individual identity of a particular, over and above the set of its properties, may be called "haecceitism", the negative answer "anti-haecceitism". Let me briefly discuss haecceitism and anti-haecceitism, with the help of an example of Armstrong's (1989). This may then facilitate our inquiry into the analogous question for universals. Take an extremely contracted possible world which contains only two particulars, *a* and *b*. Each instantiates one and only one property, in one case F, in the other G, so that this world consists in the following conjunctive state of affairs:

I Fa $\wedge$ Gb.

Now the different positions with respect to haecceitism diverge in the replies they give to the question of which worlds are possible that contain the same particulars and universals as (I). One possible response is haecceitist: Each of the seven state-descriptions (in Carnap's[10] terms) generated by combining F and G with *a* and *b*, corresponds to a different possibility:

| I Fa $\wedge$ Gb. | III Fa $\wedge$ Fb $\wedge$ Ga | V Fa $\wedge$ Ga $\wedge$ Gb |
| II Ga $\wedge$ Fb | IV Fa $\wedge$ Fb $\wedge$ Gb | VI Fb $\wedge$ Ga $\wedge$ Gb |

VII Fa $\wedge$ Fb $\wedge$ Ga $\wedge$ Gb.

Consider pair I/II. In both of these possible states of affairs (or possible worlds) there is exactly one individual that is F and exactly one that is G[11]. Haecceitism is characterised by the thesis that nevertheless, I and II express different possibilities. (The fact that the two individuals existing in our contracted world are named by different individual constants "*a*" and "*b*" might already suggest the haecceitist position. But the mere difference of *names* of the individual which has F respectively in world I and world II is no proof that these are really different possibilities. After all, it often happens within the actual world that the same individual has different names. We would be misled in following the suggestion that difference of name entails difference of identity.)

Both haecceitism and anti-haecceitism come in a weak and a strong form. According to strong haecceitism, *a* and *b* have an individual essence distinguishing them and making worlds I and II different. This doctrine can be motivated by the strong intuition that it makes a

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[10]Cf. Carnap (1962, chap. III, §§ 18 and 27).
[11]In Carnap's terms, they have the same structure-description.

difference whether it is *this* (pointing to it) thing which is F and not G or whether it is rather *that* (pointing to it) thing which is F and not G (where the second particular is G and not F). Strong haecceitism can indicate a clear ground for the intuition that I and II are different possibilities. It could be seen as resulting from a generalisation of Kripke's (1972) position with respect to macroscopic objects such as tables and persons, extending it to cover all particulars, even elementary particles. What makes such a position controversial is that the notion of the essence of a particular used here by the haecceitist seems to be an elusive and obscure notion, for it does not consist of some subset of its properties. Moreover, it is doubtful whether Kripke's intuitions regarding macroscopic objects have any plausibility regarding elementary particles.

Armstrong (1997) adopts *weak* haecceitism: as a form of haecceitism it holds that I and II are different possibilities although they do not differ with respect to properties. However, contrary to strong haecceitism it rejects individual essences, to recognise only what is minimally required to ground the difference between two particulars that are indistinguishable according to their properties. Arguing for this position, Armstrong (1997, p. 108) develops the following thought experiment. He considers a possible world consisting of two indistinguishable regions both of which contain parts resembling our own Earth. At some point, one of the regions ceases to exist. Weak haecceitism (as well as strong haecceitism, of course) can justify the intuition that, for the people living in one of these regions, it makes a difference whether it is them or the people on the other Earth who cease to exist. However, the fact that the particulars' haecceity it postulates is at least as obscure as the richer notion of individual essence of strong haecceitism pleads against weak haecceitism. I shall come back to Armstrong's thought experiment in a moment, to challenge its premise.

We can find arguments in favour of the alternative position, anti-haecceitism, in Armstrong (1989) where he adopted it. Armstrong conceives of "thin" particulars as perfectly bare and only numerically different from each other[12]. He calls particulars in the ordinary sense - particulars with all their properties - "thick" particulars and analyses them as (conjunctive) states of affairs: the state of affairs of the thin particular possessing its non-relational properties. The thin particular does not have any individual essence; it acts only as an anchor, which permits the instantiation of universals. If this is so, no difference whatsoever corresponds to the difference in name between *a* and *b*. Therefore, the anti-haecceitist concludes, the descriptions I and II do not express genuinely different possibilities, but rather describe the same possibility in different ways.

As haecceitism, anti-haecceitism also comes in a weak and a strong form. The strong form follows from the thesis that particularity is reducible, either by arguing that particulars

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[12]See Armstrong (1997, chap. 8.3.). Armstrong justifies his postulate of thin particulars with the necessity of the existence of anchors that allow the instantiation of universals. If universals themselves are only "ways things are" there must be something which can be this or that way, and this something, considered in abstraction of the universals it instantiates, is the thin particular.

are bundles of universals (Russell 1948, chap. 8) or of tropes (Williams 1953; Campbell 1990). Now, if the nature of a particular is exhausted by its properties, then the Identity of Indiscernibles must hold: there can be no "mere numerical" difference which would not be a difference with respect to some property or other. This means, in our example, that world VII would contain, contrary to the appearance of its description, only one individual. In the description of VII, this unique individual is named twice by two different names.

However, the existence of indistinguishable yet numerically different elementary particles gives a powerful argument against this view. Contemporary quantum physics tells us that there are systems of interacting bosons in which all particles share all properties, including spatial localisation. Nevertheless, these particles can be counted. Weak anti-haecceitism recognises (contrary to strong anti-haecceitism) the possibility that world VII contains two numerically different particulars. But it doesn't go any further than recognising this possibility of numerical difference. Without attributing particulars a haecceity that would make them metaphysically distinguishable (even though they are physically perfectly indistinguishable) it provides a metaphysical grounding for the denial of the Identity of Indiscernibles, more precisely for the physical fact that there can be numerically different particulars sharing all properties. (Recall however what both weak and strong anti-haecceitism share - against haecceitism - the thesis that I and II express the same possibility.)

It seems to me that the only defensible positions are weak haecceitism and weak anti-haecceitism. Against strong anti-haecceitism, it is reasonable (on physical grounds) to say that world VII may contain two particles not one, and against strong haecceitism, parsimony dictates to postulate as few obscure metaphysical entities as necessary, and thus to try to do without a rich individual essence, especially with respect to elementary particles.

Among the weak positions, I think we should prefer weak anti-haecceitism: world VII contains two particles, but I and II are the same possibility counted twice. The reason is the obscurity of the notion of haecceity even in its minimal form. As there is a sensible option doing without haecceity, it is preferable. Let us return for a moment to the thought experiment mentioned above that Armstrong (1997) uses to argue against weak anti-haecceitism. What makes weak anti-haecceitism implausible according to Armstrong is that its advocate must say that there is no objective (not even metaphysical) difference between its being the one or the other Earth-like region which is destroyed. So when one of them ceases to exist there can be no question as to which: sharing all their properties, they don't have enough individuality to make this into a sensible question. I think that this argument overlooks the difference between two macrophysical objects (the two Earth-like regions in the thought experiment) and two interacting bosons, which in each case, by hypothesis, share all properties.

The difference is that macrophysical objects must, again for physical reasons, differ with respect to spatial localisation. The set-up of Armstrong's thought experiment is physically impossible. As such, it should not constitute a sufficient motivation to postulate a general

metaphysical principle granting them haecceity over and above their numerical difference. We do not need to postulate haecceitism to be able to account for the intuition that it makes a difference on which of those two Earths you live, because the different spatial localisation of the two Earth-like regions, by making them different individuals, suffices to ground that difference. The macroscopic size of the Earth-like regions is essential to the argument: if a and b were elementary particles, e.g. indistinguishable bosons, there would be no analogous intuition showing that I and II should be counted as different possibilities. To sum up, in the microscopic case, the intuition needed for the argument is not available, and in the macroscopic case, we have the clear intuition that I and II are different possibilities, but we don't need to postulate an individual haecceity for a and b to give that difference a metaphysical grounding.

2.2. Quidditism and anti-quidditism

Let us now turn to the analogous question about the identity of universals. According to a naturalist metaphysics of properties (or universals), the role science attributes to a given property, is the only source of determination of its *existence* and *identity*. First, existence: The postulate that certain properties are real (universals) is justified by its explanatory value: it allows saying very easily why different particulars resemble each other, why two particulars can both be similar and dissimilar, namely in different respects, and why similar particulars behave in a similar way[13]. This conception of what makes a property a universal goes hand in hand with the CCR. But, second, the crucial and less obvious point concerns not the existence, but the *identity* of universals: According to the CCR, it is not only the question of *whether* a certain property is real that is decided by the interactions it induces, but those interactions also decide the question of what is the identity of the property. Thus, the CCR also provides a criterion for determining the nature, i.e. the second-order properties of universals.

This follows from the acceptance of the CCR as a truly universal metaphysical principle. For let us see what it means to ask for the properties of a universal: what are the properties of the universal M of, i.e., having a mass of 30 kg? (Later on we shall ask, in analogy with our question with respect to particulars, whether those properties exhaust the identity of the universal or whether it has quiddity over and above them.) According to the CCR, the universal M has all and only those properties that make a causal difference to its instantiations. Now what causal difference makes an instantiation of M? Here we rely on the thesis of the nomological theory of causation (NTC) according to which all causal relations

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[13]Which properties are universals depends on the roles those properties play according to ideal science. Intuitions about which properties are universals are regularly over-ruled by the adoption of scientific theories.

are determined by laws of nature[14]. According to the CCR, the properties of M are what determines the causal difference M's instantiation can make. But according to the NTC, what determines this in turn are the laws in which M takes part (the M-laws). Following the NTC, it is only the M-laws that determine M's contribution to the determination of causal interactions and, following the CCR, only what M can contribute to causal interactions determines its properties. Therefore, the identity of M, the set of its properties, is exclusively determined by the set of M-laws.

Take as an example this table's having M. The fact that it instantiates M is what permits to explain all the facets of its behaviour which are due to its massiveness, most importantly its being heavy and its resisting acceleration. Such connections to gravitational force and acceleration, i.e. connections with other properties which are at least indirectly linked to observable properties, are the only features of mass that are identified by science.

Now let us ask the crucial question: Does M have an individual essence or "quiddity" which goes beyond the set of its properties (as haecceitism claims in the case of particulars)? Or does it at least possess a principle of numerical difference which would allow (as weak anti-haecceitism allows in the case of particulars) the possibility that there be two perfectly indistinguishable yet numerically different universals?

Let us try to reason in an analogous way as we have done before in the case of particulars, to examine the plausibility of quidditism and anti-quidditism. Let W0 be the actual world and M be the property of having a mass of 30 kg. Having M leads to mass-behaviour such as falling and resisting acceleration. Quidditism, which holds that M has an individual quiddity over and above its properties, and independent of them, implies that there is a possible world W1 in which M exists although it has different properties from those it has in W0.

As we have seen, for haecceitism there is a difference between I and II: it makes sense to ask which of the two particles has F and not G, and which has G and not F. Each particular having its individual haecceity, switching all properties results in a different possible state of affairs. Similarly according to quidditism, there is a possible world W1 in which M switches its roles with a property of electrical charge, say E, the property of having a charge of 30 Coulomb.

W0: MB(M) **Erreur ! Source du renvoi introuvable.Erreur ! Source du renvoi introuvable.** CB(E).

W1: MB(E) **Erreur ! Source du renvoi introuvable.Erreur ! Source du renvoi introuvable.** CB(M).

M: having a mass of 30 kg. E: Having an electrical charge of 30 Coulomb. MB: Mass Behaviour, CB: Charge Behaviour.

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[14]See Davidson (1995) for the view that this is a conceptual truth, Heathcote and Armstrong (1991) for the view that it is only empirically true.

In W0, having M leads to mass-behaviour like falling, whereas having E leads to behaviour characteristic of electrically charged bodies (or "charge-behaviour"), like being attracted to bodies bearing the opposite charge, whereas in W1, it is the other way round: in that world, it is having M that leads to behaviour characteristic of electrically charged bodies, like being attracted to bodies bearing the opposite charge, whereas it is having E that leads to mass-behaviour like falling.

Now, it seems to me that this position - quidditism - violates the criterion of identity for universals we have developed above. If all the properties of a given universal are determined by the laws in which it takes part, then there is no ground for identifying M in W0 with M in W1: these universals share no property. In fact, according to our causal criterion of identity for universals, it is simply E in W1 that is identical to M in W0 (and M in W1 is identical to E in W0). The universals have the same properties in each world in which they exist. When we consider possible world W1, what we do, instead of switching the properties of the universals M and E, while keeping their identity constant in spite of that switch, is just switch their names. We can call M by E's name, but whether it is identical to this world's M is determined by whether it bestows mass-like behaviour to the particulars instantiating it.

If it is (ideal) science that not only alone decides whether a property is real, but also what its nature is by way of discovering its lawful contribution to causal interactions, then there can be no metaphysical identity between two universals (M in W0 and M in W1) which bestow a different pattern of resemblance and of regularities on the things possessing them in W0 and W1. Individual quiddity, which would allow such an identification of M in W0 with M in W1, does not pass the test of causal contribution: Nothing causal is common to these universals, therefore the CCR rules out the existence of quiddity.

But, one might object, how it is possible to draw a modal conclusion about the essential nature of a universal from premises bearing only on its actual nature? Such conclusions are clearly not valid for particulars. David Lewis is a philosopher, but the fact that he actually has this property is not sufficient for concluding that he has it essentially: He might have been a plumber. However, the conceptual independence between a particular and its accidental properties rests on the fact that we do not conceive of particulars as of entities whose identity is determined by the set of their actual properties. This is possible because we are particulars ourselves. I can form a concept of myself independently of my actual properties, and this allows me to think that I could have had other properties. Through ostension, I can form a concept of *this* thing, conceiving of it in complete independence of all its properties. Such a conception of the thing independently of its properties allows us to judge that *it*, thus conceived, might have had other than its actual properties[15]. But universals are different. We

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[15] It seems plausible to speculate that our capacity to conceive of other particulars separately of their actual properties depends on our capacity to do so in our own case.

cannot conceive of them independently of their properties, in any of the ways in which this is possible for particulars. We are no universals, and therefore do not have the direct access to their identity that we have to the identity of the particulars that we are ourselves. We cannot point to them, and therefore do not have to universals the perceptual access we have to particulars because we are particulars ourselves. Therefore, in virtue of the radically different ontological status of universals and particulars, there is no legitimate ground for the postulation of a non-qualitative quiddity independent of the actual properties of a universal, which would parallel the ground we have for such a postulate in the case of particulars.

As we have rejected haecceitism and concluded that I and II do not express genuinely different possibilities, but only different ways to describe the same possibility, so we must conclude here that W0 and W1 just describe the same (second-order) state of affairs by calling the universals by different names. Furthermore, no intuition similar to Armstrong's (1997) seems to be available here to argue at least in favour of weak quidditism.

We are left with the choice between weak and strong anti-quidditism. Remember that weak anti-haecceitism has turned out to be the position that best corresponded both to intuition and scientific facts with respect to particulars. Weak anti-haecceitism denies that I and II are different possibilities, but allows a numerical difference between indistinguishable particulars, and thus denies the Principle of Identity of Indiscernibles. It allows world VII to contain two not just one particle.

At this point I think that the situation is different for universals than for particulars. To justify the denial of the Principle of the Identity of Indiscernibles for a given category of entities, it is necessary to give a strong argument. We found such a strong scientific argument in the case of particulars, but none seems to be available in the case of universals. Weak anti-haecceitism is backed by the physical fact that elementary particles can be numerically different and still share all of their properties. However, on the level of properties no analogous fact can be found that would justify the postulation of two purely numerically distinct properties that share all *their* properties, i.e. which are nomically indistinguishable. It would once more go against our causal criterion of identity to allow two different universals of having a mass of 30 kg, which would be embedded in exactly the same laws. This would be a purely nominal distinction without a real difference.

The acceptance of the CCR as a general metaphysical criterion of existence and identity leads to strong anti-quidditism with respect to universals. The identity of a universal is exclusively determined by its properties, which are in turn determined by the laws the universal participates in. It is only apparently (or epistemically) but not metaphysically possible that the very same universal exists in two different worlds while having different properties in each, i.e. while taking part in different laws in each.

Can this result be reconciled with the above-mentioned intuition (Cf. Armstrong 1989, p. 59) that each universal has its own nature? In fact, taking this intuition into account does not

require attributing quiddity to universals. Instead, we can consider the nature of a universal as something which is determined by its relations, and in particular its nomic relations, to other universals, in other words by the laws in which it takes part. Having a specific nature does not presuppose - nor does it entail - having an essence independent of lawful dependencies. In this respect, particulars are similar: the fact that particular *a* has a specific nature doesn't entail that anything in this nature is essential to *a*. Without postulating an essence, the specific nature of an individual simply consists in its properties[16].

But, you might ask, doesn't our reasoning lead to the conclusion that all of a universal's properties are essential to it, rather than none? What we call an essential property of something is a property without which the thing wouldn't be the thing it is. If we follow Kripke (1972) in holding that its origin is essential to a thing, I would not be the person I am if I'd had different parents. In an analogous manner, we could call those properties of a universal essential to it without which it would lose its identity. According to the conclusion we have just drawn[17], this is the case for *all* of a universal's properties. So we would be led to the view that *all* of a universal's properties are essential to it. However, this seems absurd for the concept of essence contains the idea of something that remains constant despite variation (within or across worlds). Instead of saying that all properties are essential, it seems more correct and less misleading to say that a universal has no essence at all, and that its nature is determined by the set of its properties, which are themselves determined by the universal's lawful links to other universals. A given universal A exists in all and only those worlds in which there exists a universal which possesses all and only A's properties, i.e. its lawful links to other universals. Conversely, in all possible worlds where the universal A exists, it is embedded in the same laws. If it took part in different laws, it would not be A. In this sense the laws are necessary.

If our reasoning is correct, we are forced to question the legitimacy (or the interpretation) of what we do when we reason about possible situations that are not only counterfactual but counterlegal, i.e., in which the actual laws of nature do not hold. Worlds containing our actual universals but in which the laws of nature differ from the actual world are only doxastic but not metaphysical possibilities. The description of a counterlegal (and doxastically possible)

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[16]Compare the reasoning Armstrong offers in support of the thesis that the simplicity (or complexity) of a universal belongs to its nature, in the sense that it could not change from one world to another. If it could, universal F could be simple in W1, but complex in W2, e.g., by being identical with the conjunction G&H in W2. His argument against this possibility is that it is absurd to claim that "simple F in W1 is identical with G&H in W2" (Armstrong 1989, p. 67). However, this is not an argument for quidditism although it has been interpreted in this way (Forbes (1991, p. 352) takes the argument to show that "a property's logical structure is essential to it"): to make the hypothesis that a given universal is complex rather than simple, means to make a hypothesis about laws. The hypothesis that F is identical to G&H has content only if G and H have their own nature which means that they are lawfully linked to still other universals or that they enter into the constitution of other universals. In both cases, the hypothesis is equivalent to attributing properties to F. Armstrong's argument establishes that if a universal has such properties, it must have them in every possible world where it exists. But this is just the opposite from quidditism: the essence or quiddity of a universal would be something which would allow it to be identical across worlds *in spite of and independently of* its changing properties.
[17]This conclusion seems comforted by Armstrong's analysis of the case discussed in the preceding note.

world does not describe a metaphysical possibility because it contains a contradiction: A counterlegal world is a world that contains a universal (or several universals) which is strictly identical to an actual universal, but which is embedded in different nomic links to other universals. Yet, if the CCR requires, nomic links determine the identity of a property, these constraints contradict each other. In a possible world with different laws, those laws cannot link the same properties that are instantiated in the actual world.

3 What kind of necessity is the necessity of laws? Are there alien universals?

We have come to the conclusion that insofar as we reason about possible worlds which contain the universals existing in the actual world, it is not possible that the laws of nature holding in these worlds be different from what they actually are. Does this mean that the laws of nature are necessary in the metaphysical sense that the laws are the same in all possible worlds?

It should be clear from the preceding discussion that this is not the case. The laws are the same as those of the actual world *only* in those worlds that contain the same universals as our world. The CCR does not prevent the existence of possible worlds with universals different from those of the actual world or, in Lewis' (1986a) terms, "alien" universals. The CCR allows - in fact predicts - that such alien worlds have laws that differ from all actual laws. The possibility of alien worlds matches with the intuition that there might have been other - or more - properties than there actually are. We must distinguish between simple and structurally complex universals here. First, complex universals: if we had different - or additional - sense organs, e.g. organs like those that guide bats by detecting ultrasounds, it seems plausible that we would have experiences of a phenomenologically different quality. If there were a superheavy element of atomic number 130, it would have different properties from all actual elements. Both the phenomenological property of experiencing ultrasound and the physical properties of atoms of atomic number 130 are complex properties resulting from the structural combination of actual universals. They are either identical to, or at least supervene on, combinations of actual properties. Such properties could exist even if the laws of nature were unchanged. Therefore their possibility does not yet establish that laws are not necessary in a strong metaphysical sense.

For this, we must consider the metaphysical possibility that there be alien elementary particles with alien *fundamental* properties. Such fundamental alien universals need non-actual laws to determine their identity. Instantiating the alien universal A determines a certain lawful behaviour, for the laws connecting it to other properties make it the property it is. But these laws are different from all actual laws, for no actual law contains (by definition of the concepts of *alien* and *actual*) any alien universal like A. Let us follow the implications of such a situation. If alien A-particles can interact with B-particles, these latter must be alien

too because no actual particle has the property to interact in a certain way with A-particles. And so for all types of particles with which A interacts: If a particle of type X interacts with alien particles, it must itself be alien. The same reasoning applies to all universals which are lawfully connected to some universal or other which is lawfully connected to A. In the end, in a possible world with alien universals and alien laws, there could be non-alien universals and laws only in the following case: There might be, within an alien world, a set of universals which are not lawfully linked at all to any of the alien universals. As a matter of law, there could be no interaction that would depend both on alien and non-alien properties. With the exception of such mixed worlds in which there is no interaction between the alien and the non-alien part, worlds that contain one alien universal will contain *only* alien universals and, by consequence, only alien laws.

The following situation has emerged from our investigation: with respect to universals, there are three different types of possible worlds. The actual laws of nature are necessary in a sense which is weaker than logical or metaphysical necessity: they hold in all and only the possible worlds of the first two types: those which contain the same universals as the actual word, either exclusively or in addition to alien ones. However, our actual laws do not hold in completely alien worlds, which are the worlds of the third type, which contain only alien universals and only alien laws. Conversely, non-actual laws are not impossible in a strong metaphysical sense because possible worlds of the second and third type contain such laws.

In the end, are the laws of nature necessary or contingent? Constructing a possible world by recombining only actual universals, forbids changing the laws, for changing the laws means changing the properties. This means that the laws of nature are necessary relatively to the actual universals. As far as one reasons about actual universals, counterlegal worlds containing these properties are metaphysically impossible. Thus, those authors as Shoemaker (1980; 1998), Swoyer (1982), Fales (1993) and Ellis and Lierse (1994) who have argued that the laws of nature are necessary in a metaphysical sense, are partly right. But with the exception of Tweedale (1984) and Freddoso (1986) they have, it seems to me, overlooked possible worlds that differ from the actual world both with respect to universals and to laws[18]. If nothing stands in the way of considering this as a genuine possibility, it shows that laws are not absolutely necessary. In this respect, our conclusion is compatible with the thesis held by Kneale (1949), Pargetter (1984) and von Wright (1984) that nomic necessity can be reduced neither to metaphysical nor to logical necessity.

4 Some objections

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[18]Bigelow, Ellis and Lierse (1992) also relativize the necessity of laws to worlds "of the same natural kind as our world" (Bigelow et al. 1992, p. 387). Cf. also (Ellis 2001, p. 253ff. and 277f.).

Let us now consider some important objections. To begin with, Mellor and Oliver contest the inference from the premise that "a property like mass may well be identified, i.e. distinguished from all others, by the laws (of motion, gravity, etc.) that link it to other properties and thereby fix its powers" (Mellor and Oliver 1997, p. 30) to the conclusion that the laws are necessary. According to them, such a relational identification of a property does not force us to abandon the intuition that it is possible for mass to "figure in slightly, if not entirely, different laws" (*ibid*.). Whether this inference is valid depends indeed on the crucial point whether universals have quiddity. Only that would make it possible to refer to them rigidly, as it is possible with particulars, and to reason counterlegally about them, as it is possible to reason counterfactually about a rigidly designated particular. But universals are entities whose existence is hypothesized theoretically by an inference to the best explanation, and that inference is well justified only insofar as the identity of the hypothesized universal is determined by their lawful connections to other properties. If the universal whose existence we are justified in hypothesizing lacks quiddity, the possible world considered by Mellor and Oliver in which mass figures in slightly different laws, is an "alien" world in which not only the laws but also the universals are, however slightly, different from our actual universals. Having different properties from our mass and in the absence of a common quiddity, that otherworldly "mass" is not our mass. What Mellor and Oliver's case shows is that an alien possible world may be quite similar to the actual world, and an alien universal quite similar to an actual universal; but not that it is possible to change the laws without changing the properties the laws relate.

Armstrong (1983, p. 162f.; 2000, p. 8f.) raises the following objection against Shoemaker's (1980) causal theory of properties according to which "what makes a property the property it is, what determines its identity, is its potential for contributing to the causal powers of the things that have it" (Shoemaker 1980, p. 212). Although we have been led to the conclusion that the identity of a property is determined by its lawful relations, not its relations to causal powers, Armstrong's argument is also an objection to our own proposal for it is generally directed at theories which conceive of the identity of properties as determined by relations. According to Armstrong, any theory that considers that the identity of a universal is exhaustively determined by its second order-properties has the unacceptable consequence that it reduces properties to mere potentialities, which means that "act, so far as it occurs, is just shifting around of potencies" (Armstrong 2000, p. 14). In other words, if the identity of a property is entirely determined by its relations to other properties whose identities are themselves also exclusively determined by relations to still other properties, the theory faces a regress[19]. As P.J. Holt has put it, such a theory makes us "lose the substance of the world" (Holt 1976, p. 23). I think this objection can be overcome by conceiving of the

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[19] Armstrong calls this argument "Swinburne's regress" (Armstrong 1999), after Swinburne (1983) who raises it as an objection against Shoemaker.

determination of the identity of properties along the lines of the Ramsey-Lewis account of the implicit definition of theoretical terms[20]. If we had an ideal theory explicitly stating all the actual laws of nature then we could implicitly define all the natural properties. From the realist point of view, the fact that we can't actually so define them for want of knowledge of the laws, is no obstacle to our conceiving properties in this way. This consideration shows that the relational determination of their identity doesn't make "pure potentialities" of real properties, just as the fact that the meaning of the theoretical concept of an electron is exhausted by its relations to other concepts in physical theory does not make it a concept of a pure potentiality. If one tries to state the identity of properties one by one, one is indeed led into a circle; but a circle that is so big as to include all laws of nature, is a virtuous one.

Another objection Armstrong raises against theories that, like ours, let the identity of properties be determined by (nomic) relations, is that it makes indistinguishable properties impossible. However, Armstrong suggests that "it seems possible that a system both of causal properties, and of nomic properties, might have a symmetrical structure so that every property had its 'opposite' in the net, and that such opposite properties should perfectly image each other in their causal/nomic position in the property-net" (Armstrong 2000, p. 9). The idea seems to be that Leibniz' law of the identity of indiscernibles might be violated on the level of properties, just as it appears to be violated on the level of particulars which can be - as quantum physics teaches us for the case of interacting bosons - numerically different although they share all properties, even their spatial localisation. He suggests that it might be the case in an analogous way that there be two numerically different universals which share all their (second-order) properties. This, or so goes the argument, pleads against relational theories of universals for they are built on the validity of the principle of the identity of indiscernibles in the case of universals, and therefore cannot acknowledge the possibility described by Armstrong. Now, it seems to me that any denial of Leibniz' law needs to be motivated on independent grounds. Physics gives us such grounds for the case of particulars: It tells us that some elementary particles in interaction constitute a counterexample to Leibniz' law which is thus shown not to be generally valid for particulars. But in the case of universals, there seems to be no independent ground for postulating two numerically distinct though qualitatively indistinguishable universals, and thus Armstrong's argument only begs the question against relational theories of the identity of properties. Armstrong gives no independent argument against the analysis which the relational theory of properties would give of the situation described in the quote above: There is just one net of properties which is counted twice.

Does our theory of properties face the "Meinongian problem" (Armstrong 2000, p. 10) that each of an object's properties is necessarily related to non-existent lawful consequences of non-actual but possible situations? In Armstrong's example, the possession by an object of

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[20]Mellor (1991, pp. 167/8 and 175) suggests that the Ramsey sentence of a complete scientific theory would give definite descriptions of all real properties.

the property of "4 kilograms exact in rest-mass" necessitates, in non-actual situations where a given non-actual force acts on that object, a well-determined acceleration, according to the laws that are essential to the property. It seems to me that it is not at all inevitable to draw from this premise the Meinongian conclusion that "the object's having that mass-property [...] is [...] related to [...] the non-existent" (Armstrong 2000, p. 11). The relational theory is not committed to a dubious ontology allowing for the presence of mere possibilia in the actual world. It just makes a negative claim about which non-actual worlds are or are not possible. What it says is that there is no possible world in which some object having the property of 4 kilograms exact in rest mass is acted upon by a given force and in which this action is not followed by the acceleration dictated by the laws of nature of the actual world which govern that property in all possible worlds in which it exists. No Meinongian consequences are forced on the relational theory of properties.

Finally, the specification of the truth conditions of counterfactuals makes it, according to David Lewis (1973), necessary to consider possible worlds in which there occur "small miracles" which are events violating the actual laws of nature. Otherwise, says Lewis, one could not coherently conceive of a world which is very similar to ours but in which the antecedent of the counterfactual is true. Without miracles, at least in a deterministic world, even the slightest deviation from the actual world concerning the fact mentioned in that antecedent would require a huge divergence reaching back through the whole chain of causal ancestors of that fact[21]. The relational theory of properties implies indeed that there can be no miracles, no possible worlds with the same properties as exist in the actual world but where the actual laws governing those properties are not (always) followed. But this seems to plead rather against Lewis' theory of the truth-conditions of counterfactuals than against our theory of properties. For how reliable is the judgment one makes about the truth-value of the consequent of a counterfactual by looking at the possible world which is closest to the actual among those in which its antecedent is true, if that world allows for miracles? By definition, just anything can happen in such a world, the consequent can be true or false by a miracle that is sufficiently small not to threaten the overall closeness to the actual world.

5 Dispositional essences, causal powers, and natural kinds

Laws are second-order relations between properties, and thus equivalent to second-order relational properties of properties. At least some of these nomological properties of properties are essential to them, in the sense that the property would not be the property it is if it did not possess it. Thus the laws corresponding to these nomological properties are necessary in a particular sense: although they do not hold in all possible worlds - they are not

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[21] Armstrong (2000, p. 16ff.) raises this objection but acknowledges, citing Tweedale (1984), that his own conception of laws as contingent raises other difficulties for the evaluation of counterfactuals.

logically necessary - they hold in all worlds in which the property exists. This account is in some respects similar to "dispositional essentialism" (DE), a position defended by Bigelow, Ellis and Lierse (1992), Ellis and Lierse (1994), and Ellis (1999; 2000; 2001). According to DE, "among the *essential* properties of many different *natural kinds* of things, we must include certain important *dispositional* properties" (Bigelow 1999, p. 45). As a consequence, "The causal laws [...] are grounded in the intrinsic properties and structures of the natural kinds. [...] [These properties] include the causal powers, capacities and propensities which determine how the various natural kinds of things are disposed to behave and interact with each other." (Ellis 1999, p. 21/2). The position defended in the present paper shares with DE the rejection of the Humean doctrine of the contingency of laws. But there are several important differences between DE and the view defended here.

1. Kinds vs. properties. According to DE, laws are grounded in dispositions that are essential properties of *natural kinds*, which are primitive and fundamental kinds of entities. "If K is a natural kind of thing, then everything of that kind must have the appropriate structure and properties. The general form of such a law is: For all x, if x is an instance of K, then Px" (Ellis 1999, p. 28). On the view defended here, it is the essential nomological properties of *properties* that provide the grounding of laws. My main reason for holding that (natural) properties are more fundamental than natural kinds is that kinds are complex types of substances that share structural properties. But the constituents of such a structural property are simpler properties which the laws holding for them bind together in this. So it seems that the identity of a kind depends on the identity of its constitutive properties, together with the relevant laws[22].

2. Causal power vs. nomic dependency. The fundamental essences of DE are *causal powers* belonging to natural kinds. We have found that the fundamental essences belong to properties, and that the essence of a property consists more generally in the set of its *nomic dependencies*, of which causal powers are only a special kind. It is, e.g., essential for Cu-atoms that crystals made up of them are good conductors of electricity. However, the property of being a component of a crystal which is a good conductor, is not a causal power of the Cu-atom, because there can be no causal relation between different properties one object has at one time (the properties of being a Cu-atom and of being a constituent of a good conductor). To be a conductor of electricity is of course a causally powerful property, but here we are talking about the nomic relation between being a Cu-atom and forming (with other Cu-atoms) a conductor, and this relation though essential for being a Cu-atom, is not causal[23].

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[22]Ellis (2001, p. 91f.) admits that natural kinds could be considered as a special type of property, distinguished from other properties by their capacity to have "freestanding tropes" (Ellis 2001, p. 91) whereas normal properties must be instantiated *in* objects that also have other properties. But he denies (Ellis 2001, p. 68f.) that the complex structural properties that might thus be identified with natural kinds, can be reduced to their constituents and the laws linking them.

[23]The necessity to distinguish nomic dependencies in general from causal powers, exists just as well for a theory such as Ellis' where the fundamental bearers of essences are natural kinds and for a theory such as the one

3. DE says that laws depend on dispositional essences[24], whereas I have defended the idea that dispositions depend on laws. On the latter view, nomic *relations* are fundamental. However, DE conceives of the dispositional essences as atomic and separate for each kind. But then, how can an instance of an atomic essence necessitate the instantiation of other properties by other individuals? The relational nature of laws avoids this problem, because many laws link properties of one particular to properties of other particulars. The presence of a massive body here lawfully imposes on massive bodies there a tendency to move. How could one reduce this relational lawful fact to an atomistic essence characterising one massive body in itself?

4. Dispositional predicates must be distinguished from dispositional properties or powers. Dispositional predicates are defined by a conditional linking a test condition (in its antecedent) to a manifest behaviour (in its consequent). The defenders of DE do not always take this distinction seriously enough. Ellis says that, if P is a dispositional property (a causal power), "necessarily, anything that has P must be disposed to display P in some appropriate circumstances. [...] A causal law identifies P by describing both the circumstances C and the display E. The general form of a causal law is therefore: For all x, necessarily, if Px and Cx then Ex." (Ellis 1999, p. 28). This characterization echoes the verificationist definition of dispositional predicates, in terms of an observable test condition C and an observable manifestation E of the disposition[25]. The conditional truth condition for (propositions involving) dispositional *predicates* can only be used for characterising the essence of a dispositional *property* if it is qualified in two ways, only the first of which is recognised by DE: first, the essence of the property is constituted not by one conditional but many. Ellis (2001) now clearly endorses Mellor's "principle of multiple manifestation" according to which "a real property must manifest itself in more than one way" (Ellis 2001, p. 122). It implies that a power cannot be exhaustively characterised simply by one conditional linking a test condition to a manifestation, in the same way in which one can define a dispositional predicate. But Ellis' behavioural characterisation overlooks a second important fact about dispositional properties: The lawful links essential to a property do not necessarily link it to manifest, or observable properties, whereas in Ellis characterisation of a dispositional property, the triggering and response conditions must be observable. According to Ellis, if a disposition <C,E> to have the effect E in circumstances C is "causally determinate" then "an

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defended here in which the fundamental bearers of essences are properties. The above example of Cu-atoms being essentially components of crystals that are good conductors of electricity fits as well in an essentialist theory of natural kinds.

[24] Cartwright (1989) and Mumford (1995; 1998a; 1998b) have also argued that capacities (Cartwright) or dispositions (Mumford) ground natural regularities, thereby making the postulate of laws superfluous.

[25] Bigelow (1999, p. 50) notes that Ellis' proposal to define dispositional properties by conditionals leads it into difficulties analogous to those encountered by the phenomenalists reduction of statements about the external world to conditionals about sensations, and Ryle's reduction of statements about mental states to conditional statements linking observable stimuli to observable behaviour. Such conditionals will almost never be true except ceteris paribus.

event of the kind E must occur to x [..] as a result of a C-type event occurring to x at t" (Ellis 2001, p. 130). Ellis conceives of the "law of action" of a causal power as relating categorical properties. The causes and effects in which a causal power manifests itself, are "changes that would occur in the relation between things, or in the structures of things", but these changes in relations "are not causal powers, or propensities or liabilities, or anything of the sort." (Ellis 2001, p. 137)[26]. However, perfectly deterministic dispositions do not obey this condition because their effects are typically themselves dispositional and do not always manifest themselves in a way that only depends on C. For example, a negative electrical charge at point P has the disposition (in virtue of a deterministic law) to create an electrical field that has, at some point Q distant from P, the strength E. But if, as will generally be the case, the charge is not the only one around, the total electrical field strength at Q will not be E, as determined by the charge at P, but the result of the superposition of many dispositions for an electrical field at Q.

6 Conclusion

Let us return to the CCR, which has been the centrepiece of our argument for the necessity of laws. We still have to meet the challenge posed against our metaphysical use of that principle by Armstrong's thesis that it is "not [...] a necessary truth, but merely good methodology" (Armstrong 1984, p. 256). According to Armstrong, the CCR has only the status of a methodological principle that has no force to decide questions of metaphysical possibility and necessity. There is no better way to find out about the nature of a universal than to examine its causal powers, yet for Armstrong these causal powers do not make up its identity. This allows him to maintain the thesis that the laws of nature are contingent, and that universals have an intrinsic nature, a quiddity, which is ontologically independent of the causal powers associated with the universal (or, in other words, independent of its nomic links to other universals).

This is a very abstract issue - it belongs to meta-metaphysics dealing with the question of which arguments are to be used and accepted in metaphysical discussions and by which criteria to judge the adequacy of those arguments. I have chosen to follow the lead of naturalistic metaphysics, which consists in adopting the principle that it is (ideal) science that should ultimately decide about the existence and identity of all entities. Armstrong's alleged possibilities fall outside the framework of such a metaphysics: the alleged identity between the universal M of the actual world with a universal E of a different possible world where E does not share any property at all with our actual M is by hypothesis inaccessible to science.

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[26] Ellis thinks this is the only way to avoid the regress mentioned above (section 4), according to which nothing could ever become manifest if causal powers caused only (changes in) other causal powers.

The quiddity, which Armstrong postulates in order to ground such a cross-world identity, is no less obscure than the scholastic forms from which it takes its name[27].

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