The Necessity of Laws, Quiddity and the Causal Criterion of Reality

Max Kistler

I propose an argument for the thesis that laws of nature are necessary in a metaphysical sense, 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 is that the capacity to interact causally - or to contribute to determining causal interactions - is not only the ultimate justification 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 that 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. Naturalism and the CCR

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 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. The philosophical position 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 naturalism – as I shall call the position characterised by the acceptance of the CCR and its consequences - 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 in principle not interact. Naturalism forbids the postulation of particulars which 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 being that, in an analogous manner to the case of particulars, it would contradict naturalism 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 to such a situation, which 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. 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. Would it be a legitimate hypothesis 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, for such an hypothesis can be evaluated in accordance with the CCR: 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 acceptation of the CCR gives us a fresh look on the traditional divide between "Aristotelian" and "Platonistic" conceptions of universals. The former is characterised by what Armstrong calls the "Principle of Instantiation" (Armstrong 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, it is reasonable to postulate the existence of U 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 still other universals V

such that the probability that instantiations of V contribute to causally provoking instantiations of U is also non-zero.

2. Quidditism and anti-quidditism

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 that 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, 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[8]) 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 universals is exclusively or only partially determined by their properties, by asking whether these entities have, over and above their properties, a non-qualitative individual essence - called "quiddity" in the case of universals - which is the metaphysical ground for their individual identity[10]. Armstrong himself examines in detail only the question of the individual essence of particulars 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).

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[11]. 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: naturalism leads to the view that 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. The CCR also provides a criterion for determining the nature, i.e. the second-order properties of universals.

This follows from the role of the CCR as a truly universal metaphysical principle characterising naturalism. 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 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 are determined by laws of nature[12]. 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 the crucial question is this. Does M have an individual essence or "quiddity" which goes beyond the set of its properties? Or does it at least possess a numerical identity which would allow the possibility that there be two perfectly indistinguishable yet numerically different universals?

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. 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: $MB(M) \wedge CB(E)$.
W1: $MB(E) \wedge CB(M)$.

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

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 charge-behaviour, whereas it is having E that leads to mass-behaviour.

Now, it seems to me that 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 differ with respect to their properties. 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. It turns out that W0 and W1 just describe the same (second-order) state of affairs by calling the universals by different names.

We have arrived at anti-quidditism according to which the inter-world identification of universals is determined exclusively by the universal's nomic properties. Let us briefly look at a related question: Couldn't there be, within one world, two (numerically different) indistinguishable universals sharing all their nomic properties? I shall call the position resulting from an affirmative answer "weak anti-quidditism", the position resulting from a negative answer "strong anti-quidditism". It is not a trivial question to ask whether the Principle of the Identity of Indiscernibles should be denied for universals for science seems to require such a denial in the case of particulars. Weak anti-haecceitism for particulars is backed by the physical fact that elementary particles can be numerically distinct and yet indistinguishable. 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 acceptation 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[13].

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, 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 also 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 dox-

astically possible) 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 as naturalism 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) they have, it seems to me, overlooked possible worlds that differ from the actual world both with respect to universals and to laws. 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. Conclusion

The CCR 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, which 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. 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[14].

Notes

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.

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's 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 acceptation 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 with or at least supervene on entities which obey the CCR. On the condition that the subvenient entities obey the constraints of naturalism, so do the supervenient, even in such a controversial case as that of numbers.

[7] I assume 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] According to quantum mechanics this is true within systems of so-called "identical particles".

[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.

[10] In the case of particulars, such an non-qualitative individual essence is generally called "thisness" or "haecceity". Several terms have been used for the putative essence of universals, in particular "haecceity", "suchness" and "quiddity". Following Armstrong, I shall call the putative non-qualitative essence of a particular a "haecceity" and the putative non-qualitative essence of a universal a "quiddity".

[11] Which properties are universals is decided by 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.

[12] 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.

[13] 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.

[14] I am grateful to my auditors in Bielefeld and to David Armstrong for helpful comments and criticism on an earlier version of this paper, as well as to Joan Cullen for linguistic advice.

References

Alexander, S. (1920): *Space, Time and Deity*, 2 vols, London: Macmillan.

Armstrong, D. M. (1983): *What is a Law of Nature?*, Cambridge: Cambridge University Press.

Armstrong, D. M. (1984): Replies, in: R.J. Bogdan (ed.), *D.M. Armstrong*, Profiles Vol. 4, Dordrecht: Reidel, p. 225-269.

Armstrong, D. M. (1989): *A Combinatorial Theory of Possibility*, Cambridge: Cambridge University Press.

Armstrong, D. M. (1997): *A World of States of Affairs*, Cambridge: Cambridge University Press.

Armstrong, D. M. (2000): The Causal Theory of Properties: Properties according to Shoemaker, Ellis and others, in: *Metaphysica* 1, p. 5-20.

Davidson, D. (1995): Laws and cause, in: *Dialectica* 49, p. 263-279.

Ellis, B. and Lierse, C. (1994): Dispositional Essentialism, in: *Australasian J. of Phil.* 72, p. 27-45.

Fales, E. (1993): Are Causal Laws Contingent?, in: J. Bacon, K. Campbell, L. Reinhardt (eds.), *Ontology, Causality and Mind. Essays in Honour of D.M. Armstrong*, Cambridge: Cambridge University Press.

Forbes, G. (1991): Review of Armstrong (1989), in: *Phil. Quarterly* 41, p. 350-352.

Heathcote, A. and Armstrong, D. M (1991): Causes and Laws, in: *Nous* 25, p. 63-73.

Kim, J. (1992): "Downward Causation" in Emergentism and Non-reductive Physicalism, in: A. Beckermann, H. Flohr, and J. Kim (eds.), *Emergence or Reduction? - Essays on the Prospects of Nonreductive Physicalism*, Berlin, New York: de Gruyter.

Kneale, W. (1949): *Probability and Induction*, Oxford: Oxford University Press.

Kripke, S. A. (1972): Naming and Necessity. in: G. Harman and D. Davidson (eds.), *Semantics of Natural Language*, Dordrecht: Reidel.

Lewis, D. (1986a): *On the Plurality of Worlds*, Oxford: Basil Blackwell.

Lewis, D. (1986b): *Philosophical Papers, vol. 2*, New York: Oxford University Press.

Mellor, D.H. and Oliver, A. (1997): Introduction, in: D.H. Mellor and Alex Oliver (eds.): *Properties*, Oxford: Oxford University Press, p. 1-33.

Pargetter, R. (1984): Laws and Modal Realism, in: *Phil. Studies* 46, p. 335-347.

Shoemaker, S. (1980): Causality and Properties, in: *Identity, Cause, and Mind*, Ithaca (N.Y.), Cornell University Press, 1984.

Shoemaker, S. (1998): Causal and Metaphysical Necessity, in: *Pacific Phil. Quarterly* 79, p. 59-77.

Swoyer, C. (1982): The Nature of Natural Laws, in: *Autralasian J. of Phil.* 60, p. 203-223.

Tweedale, M. M. (1984): Armstrong on Determinable and Substantival Universals, in: R.J. Bogdan (ed.), *D.M. Armstrong*, Profiles Vol. 4, Dordrecht: Reidel.

von Wright, G. H. (1984): Natural Modality, in: *Truth, Knowledge, and Modality. Philosophical Papers, Vol. III*, Oxford: Basil Blackwell, p. 117-133.