ARMSTRONG'S THEORY OF LAWS AND CAUSATION: PUTTING THINGS INTO THEIR PROPER PLACES

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Abstract. Armstrong's theory of laws and causation may be articulated as something like the following, which we may refer to as the received view: "Laws are intrinsic higher-order relations of ensuring (necessitation) between properties. The instantiation of laws is identical with singular causation. This identity is a posteriori." Opponents and advocates of this view, believe that it may fairly and correctly be attributed to Armstrong. I do not deny it; instead I seek to reconsider the received view, specifically by treating it as a part of Armstrong's metaphysics. The main features that should concern us are truthmaker theory and the formal account of the constitutive parts of states of affairs. I also discuss Bird's ultimate argument against Armstrong and show how its impact is weakened by this proper reading.

Keywords: David Armstrong, laws, causation, truthmakers, Alexander Bird

The main task of this article is to rediscover Armstrong's theory of causation and laws of nature, which has not been scrutinized in the literature as a part of Armstrong's metaphysics. For this purpose I first put forth what may fairly be described as the received view, upon which both Armstrong's enemies and friends agree. I then suggest my own interpretation of his theory and establish its superiority over the received view. The crucial point is to understand Armstrong's theory of causation and laws of nature as a part of his metaphysics. Thus I just want to rediscover and re-interpret his view on the subject in a way that exhibits its position within the rest of his metaphysics. This will have an impact on discussions about his theory of laws and causation, for both his enemies and friends

Let us say something in brief about the main features of the received view. Armstrong believes in universals immanent-in-states-of-affairs. Laws of nature are relations of ensuring (necessitation) between two universal-properties. This relation (N) intrinsically holds between properties: we write N(P,Q). The instantiation of this law in two particulars is identical with singular causation between two states of affairs. This identity is a posteriori. And that is all. Again, I am not saying that these claims, or parts of them, are wrongly attributed to Armstrong; however, I insist that the role of these claims has not yet been properly appreciated within his system overall. In the first two sections below I discuss these elements of the received view and show how to read them within the context of his system.

It is important to note that the received view has been taken for granted on both sides: by those who uphold Armstrong's position on laws and causation and seek to elaborate on it, and those who criticize his position. For just one example, consider Hildebrand's recent work (2013), where he develops Armstrong's ideas on the basis of the received view. Again, the anti-Armstrong literature has widely criticized Armstrong on the same basis: just look at Bird's "ultimate" attack on Armstrong's position (2005), which is based on the vicious regress implicit in the received view, and see how some of Bird's own followers celebrated this victory (Handfield 2005). Barker and Smart (2012) have accused Bird of appealing to the same regress, to which one Bird's former post-doc student offers a reply (Tugby 2012). The point is that all contributors on both sides assume that the received view can be attributed to Armstrong. Indeed, some very recent works on Armstrong's metaphysics attack him on the same basis (see, for instance, Mumford 2016: 162).1

The natural way to understand and criticize someone's position is precisely

to consider its proper context; yet for whatever reason this has not happened for the received view. Thus, in order to provide a sounder version of Armstrong's position on laws and causation, I here seek to bring all the main features of his metaphysics into consideration.² This will prepare the ground for further developments and critiques. Specifically, *I urge that the received view is misplaced, and I aim to correct this, namely to put it in its proper place in Armstrong's metaphysics*. At the end of this paper, I show how my reading dissolves one of the famous challenges against Armstrong.

Let us begin. To tell the story according to my own reading I first set out Armstrong's position on causation and laws of nature (sections 1 and 2). In doing this, I suggest that two points need to be considered simultaneously: that the entire enterprise of metaphysics for Armstrong consists in postulating truthmakers, and that the truthmaker for the proposition "A causes B" will metaphysically explain what causation is. For this latter task, one needs to clarify his position on singularism and generalism. Although commentators have put much effort into this, they have failed to keep these two tasks in mind together. We should bear in mind that Armstrong's position on singularism and generalism aims at postulating the truthmaker for the proposition "A causes B". We have to show clearly how Armstrong's position on causation can be formulated in terms of the truthmakers of causal propositions and, in particular, to show how those truthmakers have the general Armstrongian form of truthmakers, namely states of affairs. A precise explanation here will lead

¹ No one has ever tried to read the received view in its proper context, namely within the whole of Armstrong's metaphysics. Why? The fact is that despite his clear and precise writings on laws and causation, Armstrong's position on the nature of metaphysics has not remained the same over the years (see for instance his 1979, 1999, 2004a). I think that the way that Armstrong does metaphysics has become more and more formal during this period. This gives him more power to express and reformulate his ideas on various subjects, specifically on laws and causation. By the end of his 2004b he had set out a formal account of instantiation which has not yet been sufficiently discussed. Although I am not saying that a formal approach was not present in his works prior to this (see footnote 9), it would be fair to say that it faded out in the middle and then came back at the end. Thus I think that we need to take his mature account of the nature of metaphysics into consideration.

² Developing Armstrong's metaphysics on this revised basis is a task of another essay.

us through the various ways that Armstrong has put forward his theory on causation and laws of nature. And in the end I will show how Bird fails to see the real point behind these forms of presentation (see section 4).

1. What is Singularism and Generalism?

For a singularist what makes the proposition "A causes B" true is A's causing B, where the causal relation is intrinsic to its token pairs A and B³. Nothing needs to be postulated beyond this exact causal relation. Singularists adopt a non-reductive account of causation, such that a causal attribution is true because of the causal relation which exists between each token pair of cause and effect. Consequently, observing the relation itself is sufficient for knowing that A causes B. In contrast, a generalist holds that this proposition is true in virtue of something beyond the instance of the causal relation, say in virtue of laws of nature: "A causes B" is true in virtue of a certain law that transcends, yet governs, the instance. On this account, laws are not mere regularities, but genuine entities that exist independently. 4

However, both the singularist and the generalist are confronted with a crucial question. It seems that where there are causes and effects, it is reasonable to claim that from the same cause the same effect will flow. That is, causes have a strong claim to be essentially general and law-like.⁵

Generalists have no problem in explaining this attribute of causal relations: the laws, which are metaphysically responsible for the truth of "A causes B" will simply make it true that "the causal relation between A and B is regular". However, for a singularists there is tension:

If causes actually involve laws, as it is natural to assume, then the apparent need to put the causation into instance, as singular causation says, and the apparent need to put law-like nature of the causation into regularity and not the instance stand in sharp conflict. (Armstrong 2004b: 127)

One side of the tension implies that the truthmaker of "A causes B" holds in the instance, as singularism requires, and the other side implies that something like a law governs the fact that B has been brought about from A. In one way, every instance of causal relation is intrinsically held, but in another way it holds only as an instance of a common pattern that dictates law-likeness. If each instance needs to be an instance of that common pattern, how could one, like a singularist, say that that instance is intrinsically held? There are two ways out. First, one could say that the instance is regular because it follows a common, but not a genuine, pattern. That is, laws are mere regularities and they are not genuine entities which need to be postulated over and above that instance of the causal relation. In this sense, causal relations are regular but not necessarily so. The second way out is to say that laws are genuine, but instances do

 $^{^3}$ For Armstrong A and B are states of affairs.

⁴ For further discussion, see the introduction to Psillos 2002.

⁵ Armstrong believes that regularity lies neither within the concept of causation, nor is a part of singular causation. However, he insists that causation implies regularity. He deliberately left this implication unexplained. At any rate, one thing is clear: it is misleading

to say that singular causations explain (or make true) regularities. The fact that regularities are accompanied by singular causation does not mean that causal relations explain regularities. As we will see toward the end of the paper, they could be explained only if laws of nature are taken into account.

not have to rote follow those laws. This latter option is bad metaphysics for several reasons. If instances are not necessarily instances of laws, what is the function of laws? Why need one postulate those laws at all? No one asserts such a bizarre idea.

To remove the tension, singularists usually follow the first way and believe in a regularity account of laws. According to this view, causes are singular but regularities in what causes what are mere regularities. For other reason, however, Armstrong does not believe in such laws.6 So, how does he remove the aforementioned tension? Armstrong wishes to take a position in-between. Although he sticks to singularism, he does not accept any regularity account of laws. He is against standard singularists, who accept intrinsic causal relation, but denies genuine laws. Armstrong suggests that laws are higher-order universals of ensuring (or necessitation) which hold between properties. In this account, laws are genuine and are not reduced to any other entities.

2. Bringing Together the Strong Theory of Laws and Singularism

Back, now, to our main question: how does Armstrong remove the tension between singularism and the strong theory of laws? If laws are metaphysically genuine, then it seems that the cause must bring about the effect because of the law, as the generalists say, and not because of the singular causation. However, in Armstrongian metaphysics the situation cannot be settled like this – not only because of his belief in singularism but also because of other restrictions in his metaphysics. The world is a world of states of affairs, and all truthmakers need to have the form of states of affairs. We know that every state of affairs is formally an instantiation of a universal in particular(s). How, though, could we count a law, namely "P ensures Q" (where P and Q are two properties), as a truthmaker, whereas laws do not have the form of states of affairs? A law is just a universal-relation of ensuring between two properties. So, what is the solution?

One way is to invoke levels of particularity. That is, in the same way that first-order particulars instantiate first-order universals and, consequently, constitute first-order states of affairs, we can say that those universals, P and Q, taken as secondorder particulars, instantiate a higher-order universal, say the universal-relation of ensuring (say C), and form a higher-order state of affairs, say O's being ensured by P (diagram 1). If we took this account seriously, it would then be natural to say that the laws of nature, which are certain relations between universals, have the form of states of affairs, i.e., the instantiation of the higher-order universals in second-order particulars. To this end, we might say that the truthmaker of "A causes B" would be the law of nature: "P ensures Q". Having the law of nature as the truthmaker, we do not need to postulate singular causation as the truthmaker for the proposition. In this situation the singular causation would be metaphysically redundant. This is tantamount to denying singularism.

⁶ It almost makes no sense to say that laws, as mere regularities, explain regularities. The better option, Armstrong says, is genuine laws that explain regularities. In general, he believes that we cannot adequately establish powerful metaphysics without strong laws: laws that genuinely exist.

 $^{^{7}}$ What follows is partly my formulation of what Armstrong says in various places.

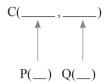


Diagram 1. A law is a state of affairs that constitutes a higher-order relation of ensuring. This relation is saturated by two second-order particulars, namely properties.

Fortunately, Armstrong does not often take laws as states of affairs. In contrast, he usually addresses two points: first that the laws are universals instantiated by pairs of particulars, and second that the singular causations and the instantiations of laws are not distinct entities or states of affairs. This. however, is not a conceptual identity but only an a posteriori identity. It is only after investigation that we come to know that what we have taken to be a causal sequence is an instantiation of a certain law. Regarding truthmakers, this does not mean that the causal proposition, say "A causes B", is true in virtue of that law, say "P ensures O": rather it is true in virtue of the instantiation of the law, and this instantiation is nothing more or less than the singular causation (diagram 2).

The above paragraph concisely reports Armstrong's view on the connection between causation and laws of nature. However, an acute reader might recognize that the issue also has an important consequence for determining the truthmaker of "A causes B". This latter part is often overlooked in the literature, and this is the very point I want to re-emphasize. Let me tell the story again and, in the next section, we will see how all of this determines the truthmaker of "A causes B".

As experiencers and observers of the world, we learn that

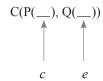


Diagram 2. A law is a higher-order relation of ensuring that is instantiated by two first-order particulars.

- (1) pairs of states of affairs are related to each other in such a way that they can be grouped together in a distinct category, i.e., those of causal relations;⁸ and
- (2) those causal relations are law-like, that is, they are governed by laws.

However, on the other hand,

- (3) scientists and investigators learn that many sequences are law-governed. Discovering laws, as genuine entities that run and control nature, is one of the main aims of science; however,
- (4) by further investigation we come to know that those causal relations are instances of the genuine governing laws.
- (5) (4) explains (2).

Notice that the identification of the instantiations of genuine laws discovered in physics with the causal relations found in pairs of states of affairs is not conceptual. The fact explored in (2) does not by itself imply that the laws, discovered by physics in (3), have to govern the instances of causal relations that have been already experienced in (1). It can only be known a posteriori that that if we commonsensically perceive a sequence as a causal one but science denies any governing law in that sequence our first

⁸ This has not been discussed here. But other parts of Armstrong's work imply this.

impression has gone astray. To summarize: although it is true that we know that causal relations are law-governed, it can only be known a posteriori that the laws discovered in physics are what govern those relations. Although singular causation seems to be an external relation between universals, it is however metaphysically identical with the instantiation of a complex universal, namely laws, in two physical objects. This identity is a posteriori.

3. So, what is the Truthmaker

Having said all this, the only *entity* that can ever be postulated as the truthmaker for "A causes B" is the intrinsic causal relation in this case of singular causation, which is identical with the instantiation of laws of nature. Does this mean that laws are not genuine? Do laws supervene upon cases of singular causation? I answer: No. Laws exist but not as truthmakers. Laws are genuine existents, but can only be found in cases of singular causation.⁹ They are the constituents of each case of singular causation. Laws are genuine in the same way as the universal white, or any other universal, is genuine. ¹⁰ Universals, including laws of nature, are constituents of states of affairs, which are the sole truthmakers. So, universals are not the things which

make propositions true.¹¹ To this extent, I think that Armstrong is a singularist, and denies generalism. However, unlike other singularists, he believes in the strong theory of laws; and, unlike other generalists, he does not believe in laws as existent entities of their own. Singularism is true because the causal relations are contained intrinsically within the instances.

Here, I would like to push the issue further. I believe that we are in a position to dissolve certain misunderstandings about Armstrong's account (see section 4). A clear assessment of our dialectical position at this point makes it plausible that the causal relation is involved in three places:

(i) Law: "P ensures (causes) Q",

or

"Something's being *P* causes something's being *Q*", where *P* and *Q* are properties;

- (ii) Singular causation: *A*'s causing *B*; where *A* and *B* are states of affairs;
- (iii) Instantiation of the law in a pair of particulars: *c*'s being *P* as causing *e*'s being *Q*, where *c* and *e* are particulars.

Although we experience the causal relation between pairs of states of affairs, nevertheless, this relation holds between universals. Armstrong believes in immanent causation between universals, but in transient causation between pairs of states of affairs (see 1997: 205 and 2004a: 456). This is tantamount to saying that the causal relation first holds between properties and then between that pair of states of affairs. To this extent, it is naïve to understand the singular causation in accordance with (ii). Causal relations,

⁹ Not that this can only be known a posteriori.

¹⁰ Apart from his remarks in (1979: 110), (1993), and (1997: 115), Armstrong rarely writes about the way that universals and particulars constitute states of affairs. In those places, he follows Scotus and suggests that these constituents are *formal* parts of states of affairs. This implies that universals and particulars do exist but cannot be postulated as truthmakers. The only beings are states of affairs. In relation to our discussion, this means that laws of nature exist, but, as they are merely universal parts of singular causations, they cannot be postulated as truthmakers. In contrast, singular causations are complex states of affairs and can be postulated as truthmakers.

¹¹ To be precise I should say that Armstrong never takes universals as the truthmakers for *contingent* propositions. In certain positions, the internal relations between universals make necessary propositions true, but this is not the concern of this paper.

unlike other relations, do not hold simply between pairs of states of affairs. A certain law needs to be instantiated. But this implies neither that laws bring about singular causal relations, nor that laws make "A causes B" true. As we have seen, in the case of singular causation the only truthmaker is the causal relation. But surely, we need to understand each instance of singular causation in the way that (iii) implies: a singular causation with a more complex construction. To this extent, the singular causation makes both of the following propositions true:

- (I) A causes B;
- (II) from the same *A* the same *B* follows, or All *P*s are *Q*s;

where (I) indicates causal relation and (II) indicates regularity of that causal relation. Apparently, singular causation, with the inner structure that has just been given in (iii), can successfully explain both the causal relation that we have experienced and the regularity we intuit in every case of causal relation.

4. Application: A Misunderstanding of Armstrong's Metaphysics

What I have said so far expresses the main idea behind Armstrong's theory of causation and the laws of nature. The different terminologies that he has used elsewhere do matter but are only manners of presentation or to serve particular pedagogical purposes. For the most significant phase of exposition, from 1983 onward, he uses the relation N in order to explain his theory of laws: if N is the relation of ensuring amongst universals, and R is the mere regularity between the instances of those universals, then N necessitates R. For instance, N(P, Q) entails (necessitates) R(P, Q) (or All Ps are Qs). That is, the ensuring

relation between properties P and Q explain why every instance of P has to be Q.

How should we understand this manner of presentation? First of all notice that R is not a state of affairs. It is simply the proposition: "All Ps are Os". Again, N is not a state of affairs. It is a law of nature. It is a universal that has to be instantiated in particulars in order to construct a more complex state of affairs, namely a singular causation. If this is so, what is the alleged relation of "entailment" between N and R? Is there a genuine metaphysical relation between the universal N and the proposition R? Nowhere in Armstrong's metaphysics do I see signs that can accommodate such a bizarre relation between universals and propositions. From what I have said in the previous section it is very clear that when Armstrong talks about entailment between N and R, he means the truthmaking relation. He simply says that wherever N has been instantiated, the state of affairs which emerges, namely the case of singular causation, will make the proposition R true. The only truthmaker here is the singular causation, understood in the way that iii indicates. This also makes I and II true (see section 3). In other words, the relation of necessitation, or entailment, is nothing other than the truthmaking relation holding between the instantiation of N, i.e., the singular causation, and the propositions I and II.

Some good philosophers mistake this point (for instance, Bird 2005 and 2007). In his well-known argument, Bird begins with the Armstrongian thesis that *natural* properties are categorical in the sense that they do not have an essential or other nontrivial modal characters. Following Armstrong, he names this thesis PROPERTIES. Then he argues against Armstrong's theory of laws of nature as follows:

Consider the following partial characterization of N from LAWS:

(I) $\langle N(F,G) \rangle$ entails $\langle R(F,G) \rangle$ This gives N a nontrivial modal property.

And then he continues:

Either PROPERTIES is false, or (I) is false, or N is not a natural relation. The idea that N is not a natural relation can be discounted immediately. Armstrong's view is that N is a genuine universal, rather than its being the case that 'N' is merely a predicate corresponding to no real ontological item. This has to be in order for laws to be genuine parts of the world that provide explanation of the way things are. The rejection of N as a genuine universal would force a retreat to Humean regularism about laws or similar. Since PROPERTIES is a key part of Armstrong's view we should preserve it as long as possible. That requires admitting the falsity of (I). (Bird 2005: 149)

Bird believes that further objections may be derived from this. I am not going to trace out the whole issue here; I show only that this very first step is on the wrong track. Bird's argument is very straightforward: LAWS, the thesis that $\langle N(F,G) \rangle$ entails $\langle R(F,G)\rangle$, is not compatible with PROPER-TIES, the idea that natural properties have no nontrivial modal attributes. Although LAWS implies that the relational attribute of "being in the relation of entailment to R" has been necessarily ascribed to N, PROPERTIES denies that any necessary attribute is ascribed to a natural property like N. I believe that Bird fails to notice the following three interrelated issues.

First, metaphysical relations in Armstrong's metaphysics hold between either two particulars, two universals, two states of affairs, or one universal and one particular. No metaphysical relation obtains between universals and propositions. Therefore, the sides of the relation of entailment here,

namely N and R, could not properly stand in any metaphysical relation.

The other issue is to remember what I have frequently repeated above: the right account of the laws of nature requires that the *instantiation* of laws, not laws as such, make regularities true. The relation of entailment is not properly seen as holding between N and R, but between the *instantiation* of N and R.

These two issues lead us straight to the fact that the relation of entailment here can be nothing other than the truthmaking relation.

The final issue, then, is that the truthmaking relation is not a metaphysical relation that can ever be *postulated* in the world. In the Armstrongian sense, the truthmaking relations are metaphysical relations but they should definitely not be postulated as part of the world. As a truthmaker theorist, when Armstrong rejects nontrivial necessary attributes for natural properties (see PROP-ERTIES), he simply refuses to postulate nontrivial necessary attributes for natural properties. Saying that a natural property, or any other suitable candidate truthmaker, necessarily makes a certain proposition true, neither refutes PROPERTIES, nor undermines the whole enterprise of Armstrongian metaphysics, which is nothing other than postulating non-necessary being. As a metaphysician, one has to avoid postulating necessary being, but this has nothing to do with the fact that whatever one has postulated will necessarily make certain propositions true. Truthmaking relations, then, are genuine metaphysical relations but they are not postulated. In Armstrong's system, PROPERTIES is concerned with postulated truthmakers while the relation of entailment between N and R, namely LAWS, is concerned with the truthmaking relation as

such. Having different concerns, and saying different things, they are not incompatible.

To understand the point, simply note that the necessitation here is in fact presupposed by every truthmaking theory: it is assumed that every fact necessarily makes a class of propositions true. What a particular truthmaker theory does, then, is to specify what that corresponding class for each fact is. So, it is obvious that a truthmaker theorist necessarily ascribes the attribute of "makes some class of propositions true" to each fact. PROPERTIES, then, is to be read as a part of this enterprise: it does not refute any necessary attribute tout court, but it denies any necessary-postulated-attribute for natural properties. This is the way that a truthmaker theorist, like Armstrong, reads PROPER-TIES. And reading it this way, no objection will be raised. What, then, is Bird's point? Does he intend to meta-metaphysically argue that no truthmaker theory can be tenable due to the fact that it necessarily ascribes the relational attribute of "makes some class of propositions true" to every entity? Or does he argue against any system of metaphysics that takes something necessary for granted? Bird has never formulated his objection in this way, and I am certain that Bird is not willing to go that far. Certainly, Bird is not a friend of truthmaking theories, 12 but that has nothing to do with his "ultimate argument against Armstrong". He does not mean to argue against all truthmaking theories whatsoever. Unarguably, he is trying to discover some inconsistency within Armstrong's system. But if this is so, he has to follow us in reading PROPERTIES as Armstrong intends it to be read: no nontrivial necessary attribute can be *postulated* for natural properties. In this

way, PROPERTIES is not applicable to the relation of entailment: for the simple fact that the relation of entailment here is a truthmaking relation and truthmaking relations are not something to be postulated. So, PROPERTIES is not incompatible with LAWS.

To summarize; while Bird's argument is seeking an inconsistency between LAWS and PROPERTIES; for the following argument I deny such inconsistency:

LAWS expresses a particular *truthmaking* relation;

Truthmaking relations are metaphysical and necessary but not postulated;

Thus, LAWS says *nothing about postulating* truthmakers.

On the other hand,

TIES:

PROPERTIES *rejects postulating* necessary truthmakers (attributes in particular); Therefore, LAWS does not deny PROPER-

Thus, Bird's argument is flawed.¹³

Conclusion

Armstrong is a singularist. He believes that the truthmaker for "A causes B" is the causal relation which is intrinsic in the case of singular causation. However, each case of

¹² From a private discussion.

¹³ I should also add that Armstrong (2005) shows sympathy with Bird. But that does not undermine my arguments here. What had concerned Armstrong from 1999 till his death, and particular in 2005, was the metaphysical explanation for some cases of necessary instantiation; say the fact that each universal must have some nomic connections to other universals. Meanwhile, he believes that this can coexist alongside the contingency of universals and laws of nature. The necessary instantiation needs explanation but this does not mean that necessity needs to be attributed to natural properties, as dispositionalism puts forth. He honestly confesses the problem but toward the end of that paper, and even years later in 2010 (chapter 6), he continues the fights against dispositionalism. I believe that my position is a good match with Armstrong's metaphysics.

singular causation needs to be understood as a complex structural state of affairs. This indicates that the law which is involved in this structure is not the truthmaker. It exists but only as a formal constitutive part of the genuine truthmaker, namely that structure. Bird's ultimate argument against Armstrong has gone astray because he misses these points.

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ARMSTRONGO DĖSNIO IR PRIEŽASTINGUMO TEORIJA – TEREIKIA JĄ TINKAMAI SKAITYTI

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Santrauka. Dėsnio ir priežastinio sąryšio standartinės sampratos gynėjai ir oponentai sutaria, kad šią sampratą teisinga yra priskirti Davidui M. Armstrongui. Iš esmės pritardamas įprastam požiūriui, šiame straipsnyje siūlau naujai pažvelgti į Armstrongo dėsnio ir priežastingumo teoriją traktuojant ją kaip Armstrongo metafizikos dalį. Labiausiai mums turėtų rūpėti verifikatorių teorija ir formalus dalykų padėtį sudarančių elementų aiškinimas. Taip kontekstualizuodamas standartinį požiūrį – matydamas jį kaip neatsiejamą nuo Armstrongo metafizikos kaip visumos, aš naujai interpretuoju jo dėsnio ir priežastingumo teoriją. Aš teigiu, kad tokia prieiga būtina norint neklaidžioti klystkeliais ir adekvačiai suprasti standartinį požiūrį. Straipsnio pabaigoje parodau, kaip būtent tokios prieigos taikymas saugo Armstrongo teoriją nuo lemtingojo A. Birdo kontrargumento.

Pagrindiniai žodžiai: Armstrong, dėsniai, priežastingumas, verifikatoriai, Alexander Bird

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