CAUSATION

Chapter 3

Humean Reductionism: General Objections

Objections to Humean reductionist theories of causation are of two sorts. First, there are objections to the supervenience theses to which such theories are committed. Secondly, there are objections that are directed against specific theories. The former are the focus of the present section.

3.1 Reductionism with Respect to Causal Laws

The distinction between strong and weak reductionism with respect to causal laws is important for understanding what options are open when one is setting out an account of the nature of causation. It is not, however, crucial with respect to the choice between reductionist and realist approaches to laws, since strong and weak reductionist views are exposed to precisely the same objections.

Philosophers such as Dretske (1977), Tooley (1977 and 1987, section 2.1.1), Armstrong (1983), and Carroll (1994) have argued that reductionist accounts of the nature of laws are exposed to several very strong objections. Let us briefly consider, then, some of the more important ones.

3.1.1 Laws versus Accidental Regularities

First, then, there is the familiar problem of distinguishing between laws and accidental regularities. For example, there may well be some number *N* such that, at no time or place in the total history of the universe is there ever a sphere of radius *N* meters that contains only electrons. But if there is such a number, does that mean that it is a *law* that no sphere of radius *N* meters can contain only electrons? Might it not, instead, be merely an accident that no such sphere exists? But if so, what serves to differentiate laws from mere cosmic regularities?[1]

3.1.2 Basic Laws without Instances

A second objection concerns the possibility of basic, uninstantiated laws, and may be put as follows. Suppose, for the sake of illustration, that our world contains psychophysical laws according to which various types of brain states causally give rise to emergent properties of experiences Let us suppose, further, that at least some of these psychophysical laws connecting neurophysiological

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[1]For a much fuller discussion of the problem of distinguishing between laws and accidental uniformities, see Armstrong, (1983, ch. 2).

states to phenomenological states are basic -- that is, incapable of being derived from any other laws, psychophysical or otherwise -- and, for concreteness, let us suppose that the psychophysical law connecting a certain type of brain state to experiences involving a specific shade of purple is such a law. Finally, let us assume that the only instances of that particular law at any time in the history of the universe involve sentient beings on Earth. Given these assumptions, consider what would have been the case if our world had been different in certain respects. Suppose, for example, that the earth had been destroyed by an explosion of the sun just before the point when, for the first time in history, a certain sentient being would have observed a purple flower, and would have had an experience with the corresponding emergent property. What counterfactuals are true in the alternative possible world just described? In particular, what would have been the case if the sun had not gone supernova when it did? Would it not then have been true that the sentient being in question would have looked at a purple flower, and thus have been stimulated in such a way as to gone into a certain neurophysiological state, and then to have had an experience with the relevant emergent property?

It seems to me very plausible that the counterfactual in question is true in that possible world. But that counterfactual cannot be true unless the appropriate psychophysical law obtains in that world. In the world where the sun explodes before any sentient being has looked at a purple flower, however, the law in question will not have any instances. So if the counterfactual is true in that world, it follows that there can be basic causal laws that lack all instances. But if that so, then causal laws cannot be logically supervenient upon the total history of the universe.[2]

3.1.3 Probabilistic Laws

A third objection concerns a problem posed by probabilistic laws. Consider a world where it is a law that the probability that an event with property *P* has property *Q* is equal to one half. It does not follow that precisely one half of the events with property *P* will have property *Q*. Indeed, the proportion that have property *Q* need not be anywhere near one half: it can have absolutely any value from zero to one.

The existence of the law in question does have, of course, *probabilistic* implications with respect to the proportion that will have property *Q*. In particular, as the number of events with property *P* becomes larger and larger, the *probability* that the proportion of events with property *P* that also have property *Q* will be within any specified interval around the value one half approaches indefinitely close to one. But this is, of course, perfectly compatible

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[2]I have discussed the question of the possibility of uninstantiated basic laws in more detail in *Causation* (1987, p. 47-51).

with the fact that the existence of the law in question does not *entail* any restrictions upon the proportion of events with property P that have property Q.

More generally, any probabilistic law is compatible with *any* distribution of properties over events. In this respect, there is a sharp difference between probabilistic laws and non-probabilistic laws. Any non-probabilistic law imposes a constraint upon the total history of any world containing that law -- namely, the corresponding regularity must obtain. But a probabilistic law, by contrast, imposes no constraint upon the total history of the world. Accordingly, unless one is prepared to supplement one's ontology in a very unHumean way -- by postulating something like objective, ontologically ultimate, single-case chances -- there would not seem to be even a potential reduction base in the case of probabilistic laws.[3]

3.1.4 Justifying Beliefs about Cosmic Regularities

The fourth and final objection that I shall mention concerns an epistemological problem that arises if one attempts to identify laws either with cosmic regularities in general, or with regularities that satisfy certain additional constraints. On the one hand, the evidence for any law consists of a finite number of observations. On the other, any law has a potentially infinite number of instances. Can such a finite body of evidence possibly justify one in believing that some law obtains, if laws are essentially just regularities? For if laws are merely certain kinds of regularities, with no further ontological backing, is it not in fact *likely* that the regularities that have held with respect to the cases that have been observed so far will break down at some point?

This objection can be formulated in a more rigorous way by appealing to some general, quantitative account of confirmation, according to which any generalization of the sort that expresses a possible law has a probability infinitesimally close to zero relative to any finite body of evidence. Carnap's system of confirmation, for example, has that property.[4] It is possible to argue, of course, that any system with this property is necessarily defective. But then the challenge is to construct a system that assigns non-zero probability to generalizations expressing possible laws, upon finite observational evidence, in an infinite universe, and while there have certainly been attempts to meet this

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[3]A fuller account of the problem posed by probabilistic laws can be found in *Causation* (1987, pp. 42-7.)

[4]For a discussion of this, see Rudolf Carnap, *Logical Foundations of Probability*, 2nd edition, Chicago: University of Chicago Press, 1962, pp. 70-5.

challenge,[5] I think it can be argued that they are *ad hoc*, and fail to appeal to independently plausible principles.

But how is the realist any better placed with respect to this epistemological problem? The answer is that a realist can view the existence of a causal law as constituted by a single, atomic state of affairs, rather than by a potentially infinite conjunction of states of affairs. Thus, for example, if laws are identified with certain second-order, atomic states of affairs involving irreducible relations between universals, it can be argued that this type of realist account enables one to prove that quite a limited body of evidence may make it very probable that a given law obtains (Tooley, 1987, pp. 129-37).

To sum up. Reductionist accounts of causal laws face at least four serious objections. First, they appear unable to draw a satisfactory distinction between laws and accidental uniformities. Secondly, they cannot allow for the possibility of basic, uninstantiated laws. Thirdly, probabilistic laws seem to pose an intractable problem. Fourthly, it is difficult to see how one can ever be justified in believing that there are laws, if one adopts a reductionist account. A realist approach, by contrast, can provide satisfactory answers to all of these problems.

3.2 Reductionism with Respect to Causal Relations

General objections to reductionist approaches to causal relations fall into two groups. First, there are objections that center upon the problem of giving an account of the direction of causal processes, and which claim that there are possible causal worlds where reductionist accounts of the direction of causation either do not apply at all, or else do apply, but generate the wrong answers. Secondly, there are objections involving what may be referred to as problems of underdetermination. For what these objections attempt to establish is that there can be worlds that agree with respect to, first, all of the non-causal properties of, and relations between, events, secondly, all causal laws, and thirdly, the direction of causation, but which disagree with respect to causal relations between corresponding events.

3.2.1 Direction of Causation Objections

Here I shall mention two objections. The thrust of the first is that there are possible causal worlds to which reductionist accounts of the direction of causation do not apply, while that of the second is that there are possible causal worlds for which reductionist accounts yield wrong answers with respect to the direction of causal processes.

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[5]See, for example, Jaakko Hintikka, "A Two-Dimensional Continuum of Inductive Methods", in Jaakko Hintikka and Patrick. Suppes (eds.), *Aspects of Inductive Logic*, Amsterdam: North Holland, 1966, 113-32.

3.2.1.1 Simple Worlds

Our world is a complex one, with a number of features that might be invoked as the basis of a reductionist account of the direction of causation. First of all, it is a world where the direction of increase in entropy is the same in the vast majority of isolated or quasi-isolated systems. Secondly, the temporal direction in which order is propagated -- such as by the circular waves that result when a stone strikes a pond, or by the spherical wave fronts associated with a point source of light -- is invariably the same. Thirdly, consider the causal forks that are involved when two events have either a common cause, or a common effect. A fork may be described as open if it does not involve both a common cause and a common effect. Then it has been claimed that it is a fact about our world that all, or virtually all, open forks are open in the same direction - namely, towards the future.[6]

Can such features provide a satisfactory account of the direction of causation? One objection arises out of possible causal worlds that are much simpler than our own. In particular, consider a world that contains only a single particle, or a world that contains no fields, and nothing material except for two spheres, connected by a rod, that rotate endlessly about one another, on circular trajectories, in accordance with the laws of Newtonian physics. In the first world, there are causal connections between the temporal parts of the single particle. In the second world, each sphere will undergo acceleration of a constant magnitude, due to the force exerted on it by the connecting rod. So both worlds certainly contain causal relations. But both worlds are also utterly devoid of changes of entropy, of propagation of order, and of open forks. So there is no hope of basing an account of the direction of causation upon any of those features.

What account can a reductionist give, then, of the direction of causation? The answer is that there is only one possibility. For, given that the simple worlds just described are completely symmetrical in time, events themselves do not exhibit any structure that serves to distinguish between the direction from cause to effect and the inverse one from effect to cause. So if the direction of causation is to be reduced to anything else, it can only be to the direction of time. But, then, in turn, one will have to be a realist with respect to the latter. There will be no possibility of reducing the direction of time to any structure present in the arrangement of events in time.

Could the reductionist instead respond by challenging the claim that such worlds contain causation? In the case of the rotating-spheres world, this could

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[6]For the first, see Hans Reichenbach (1956, pp. 117-43), and Adolf Grünbaum (1973, pp. 254-64). For the second, see Karl Popper (1956, p. 538). For the third, see Reichenbach (1956, pp. 161-3), and Wesley Salmon (1978, p. 696)

only be done by holding that it is logically impossible for Newton's Second Law of Motion to be a causal law, while in the case of the single particle world, one would have to hold that identity over time is not logically supervenient upon causal relations between temporal parts. But, in addition, such a challenge would also involve a rejection of the following very plausible principle:

The Intrinsicness of Causation in a Deterministic World

If C_1 is a process in world W_1, and C_2 a process in world W_2, and if C_1 and C_2 are qualitatively identical, and if W_1 and W_2 are deterministic worlds with exactly the same laws of nature, then C_1 is a causal process if and only if C_2 is a causal process.

For consider a world that differs from the world with two rotating sphere by having additional objects that enter into causal interactions, and one of which collides with one of the spheres at some time *t*. In that world, the process of the spheres rotating around one another during some interval when no object is colliding with them will be a causal process. But then, by the above principle, the rotation of the spheres about one another, during an interval of the same length, in the simple universe, must also be a causal process.

But is the Principle of the Intrinsicness of Causation in a Deterministic World correct? Some philosophers have claimed that it is not. In particular, it has been thought that a type of causal situation to which Jonathan Schaffer (2000, pp. 165-81) has drawn attention -- cases of 'trumping preemption' -- show that the above principle must be rejected.

Here is a slight variant on a case described by Schaffer. Imagine a magical world where, first of all, spells can bring about their effects via direct action at a temporal distance, and secondly, earlier spells prevail over later ones. At noon, Merlin casts a spell to turn a certain prince into a frog at midnight -- a spell that is not preceded by any earlier, relevant spells. A bit later, Morgana also casts a spell to turn the same prince into a frog at midnight. Schaffer argues, in a detailed and convincing way, that the simplest hypothesis concerning the relevant laws entails that the prince's turning into a frog is not a case of causal overdetermination: it is a case of preemption.

It differs, however, from more familiar cases of preemption, where one causal process preempts another by preventing the occurrence of some event that is crucial to the other process. In this action-at-a-temporal-distance case, however, both processes are fully present, since they consist simply of the casting of a spell plus the prince's turning into a frog at midnight.

A number of philosophers, including David Lewis (2000), have thought that the possibility of trumping preemption shows that the Principle of the Intrinsicness of Causation in a Deterministic World is false, the idea being that there could be two qualitatively identical processes, one of which is causal and the other not. For example, at time t_1, Morgana casts a spell that a person turn into a frog in one hour's time at a certain location That person does turn into a frog, because their was no earlier, relevant spell. At time t_2, Morgana casts precisely the same type of spell. The person in question does turn into a frog, but the cause of this was not Morgana's spell, but an earlier, preempting spell.

Is this a counterexample to the Intrinsicness Principle? The answer is that it is not. Causes are states of affairs, and the state of affairs that, in the t_1 case, causes the person to turn into a frog is not simply Morgana's casting of the spell: it is that state of affairs together with the absence of earlier, relevant spells. So when the complete state of affairs that is the cause is focused upon, the two spell-casting cases are not qualitatively identical. Trumping preemption is not a counterexample to the Principle of the Intrinsicness of Causation in a Deterministic World.

3.2.1.2 Temporally 'Inverted' Worlds

It is the year 4004 B.C. A Laplacean-style deity is about to create a world rather similar to ours, but one where Newtonian physics is true. Having selected the year 3000 A.D. as a good time for Armageddon, the deity works out what the world will be like at that point, down to the last detail. He then creates two spatially unrelated worlds: the one just mentioned, together with another whose initial state is a flipped-over version of the state of the first world immediately prior to Armageddon - i.e., the two states agree exactly, except that the velocities of the particles in the one state are exactly opposite to those in the other.

Consider, now, any two complete temporal slices of the first world, *A* and *B*, where *A* is earlier than *B*. Since the worlds are Newtonian ones, and since the laws of Newtonian physics are invariant with respect to time reversal, the world that starts off from the reversed, 3000 A.D. type state will go through corresponding states, B^* and A^*, where these are flipped-over versions of *B* and *A* respectively, and where B^* is earlier than A^*. So while the one world goes from a 4004 B.C., Garden of Eden state to a 3000 A.D., pre-Armageddon state, the other world will move from a reversed, pre-Armageddon type of state to a reversed, Garden of Eden type of state.

In the first world, the direction of causation will coincide with such things as the direction of increase in entropy, the direction of the propagation of order in non-entropically irreversible processes, and the direction defined by most open forks. But in the second world, where the direction of causation runs from the initial state created by the deity -- that is, the flipped-over, 3000 A.D. type of state -- through to the flipped-over, 4004 B.C. type of state, the direction in which entropy increases, the direction in which order is propagated, and the direction defined by open forks will all be the opposite one. So if any of the latter were used to define the direction of causation, it would generate the wrong result in the case of the second world.

As with the 'simple universes' argument, it is open to a reductionist to respond by holding that the direction of causation is to be defined in terms of the direction of time. But here, as before, this response is only available if one is prepared to adopt a realist view of the direction of time. For any reductionist account of the latter in terms of the structure exhibited by events in time cannot possibly generate the right results in both cases for two worlds that are 'inverted twins' - such as the two worlds just described.

3.2.2 Underdetermination Objections

A reductionist approach to causal relations is also exposed to a variety of 'underdetermination' objections, the thrust of which is that fixing all of the non-causal properties of, and relations between, events, all of the laws, both causal and non-causal, all of the dispositional properties, propensities, and objective chances, and, finally, the direction of causation for all possible causal relations that might obtain, does not always suffice to fix what causal relations there are between events.

The first of the two arguments that I shall set out here focuses upon a world with probabilistic laws, while the thrust of the second argument is that the same conclusion holds even in a fully deterministic world.

3.2.2.1 The Argument from the Possibility of Uncaused Events plus Probabilistic, Causal Laws

Three arguments that can be advanced against reductionist accounts of causation are variations on a single theme -- all of them focusing upon problems that arise concerning causal relations in indeterministic worlds. However they differ slightly in their assumptions. One argument assumes only that indeterministic causal laws are logically possible. A second argument, on the other hand, incorporates the further assumption that there is nothing incoherent in the idea of an uncaused event. The third argument -- and the one that I shall set out here -- also involves that assumption, plus the additional assumption that probabilistic laws are logically possible.[7]

The argument in question runs as follows. First, can statements of causal laws involve the concept of the relation of causation? Consider, for example, the following statement: "It is a law that for any object *x*, the state of affairs that consists of *x*'s having property *F* causes a state of affairs that consists of *x*'s having property *G*." Is this an acceptable way of formulating a possible causal law?

Some philosophers contend that it is not, and that the correct formulation is, instead, along the following lines:

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[7]All three arguments are set out in Tooley (1990, pp. 215-36).

(*) "It is a causal law that for any object *x*, if *x* has property *F* at time *t*, then x has property *G* at ($t + \Delta t$)."

But what reason is there for thinking that it is the latter type of formulation that is correct? Certainly, as regards intuitions, there is no reason why there should not be laws that themselves involve the relation of causation. But in addition, the above claim is open to the following objection. First, the following two statements are logically equivalent:

(1) For any object *x*, if *x* has property at time *t*, then x has property *G* at ($t + \Delta t$);

(2) For any object *x*, if *x* lacks property *G* at time (t + Δt), then *x* lacks property *F* at *t*.

Now replace the occurrence of (1) in (*) by an occurrence of (2), so that one has:

(**) "It is a causal law that for any object *x*, if *x* lacks property *G* at time (t + Δ*t*), then *x* lacks property *F* at time *t*."

The problem now is that it may very well be the case that while (*) is true, (**) is false, since its being a causal law that for any object *x*, if *x* has property at time *t*, then x has property *G* at ($t + \Delta t$) certainly does not entail that there is a backward *causal* law to the effect that for any object *x*, if *x* lacks property *G* at time (t + Δt), then *x* lacks property *F* at *t*. So anyone who holds that (*) is the correct way to formulate causal laws needs to explain why substitution of logically equivalent statements in the relevant context does not preserve truth.

By contrast, no such problem arises if one holds that causal laws can instead be formulated as follows:

It is a law that for any object *x*, the state of affairs that consists of *x*'s having property *F* at time *t* causes a state of affairs that consists of *x*'s having property *G* at time ($t + \Delta t$).

Let us assume, then, that the natural way of formulating causal laws is acceptable. The next step in the argument involves the assumption that probabilistic laws are logically possible. Given these two assumptions, the following presumably expresses a possible causal law:

L1: It is a law that, for any object *x*, *x*'s having property *P* for a time interval Δ*t* causally brings it about, with probability 0.75, that *x* has property *Q*.

The final crucial assumption is that it is logically possible for there to be uncaused events.

Given these assumptions, consider a world, *W*, where objects that have property *P* for a time interval Δ*t* go on to acquire property *Q* 76 percent of the time, rather than 75 percent of the time, and that this occurs even over the long term. Other things being equal, this would be grounds for thinking that the relevant law was not (*L1*), but rather:

($L2$) It is a law that, for any object x, x's having property P for a time interval Δt causally brings it about, with probability 0.76, that x has property Q.

But other things might not be equal. In the first place, it might be the case that ($L1$) was derivable from a very powerful, simple, and well-confirmed theory, whereas ($L2$) was not. Secondly, one might have excellent evidence that there were totally uncaused events involving objects' acquiring property Q, and that the frequency with which that happened might be precisely such as would lead to the expectation, given law ($L1$), that situations in which an object had property P for a time interval Δt would be followed by the object's acquiring property Q 76 percent of the time.

If that were the case, one would have reason for believing that, on average, over the long term, of the 76 cases out of a 100 where an object that has had property P for Δt and then acquires property Q, 75 of those cases will be ones where the acquisition of property Q is caused by the possession of property P, while one out of the 76 will be a case where property Q is spontaneously acquired.

There can, in short, be situations where there would be good reason for believing that not all cases where an object has property P for an interval Δt , and then acquires Q, are causally the same. There is, however, no hope of making sense of this, given a reductionist approach to causal relations. For the cases do not differ with respect to relevant non-causal properties and relations, nor with respect to causal or non-causal laws, nor with respect to the direction of causation in any potential causal relations. Moreover, if dispositional properties, propensities, and objective chances are logically supervenient upon causal laws plus non-causal states of affairs, then the cases do not differ with respect to dispositional properties, propensities, or objective chances. Alternatively, if one rejected the latter supervenience claim, and held that dispositions, propensities, and objective chances were ultimate, irreducible properties, that would not alter things, since the relevant dispositions, propensities, and objective chances would be the same in both cases. The conclusion, consequently, is a very strong one: causal relations between events are not logically supervenient upon the totality of states of affairs involving non-causal properties of, and relations between, events, all of the laws, both causal and non-causal, all of the dispositional properties, propensities, and objective chances, and, finally, the direction of causation for all possible causal relations that might obtain. But if causal relations are not logically supervenient upon these states of affairs, what can they be supervenient upon? It seems difficult to avoid the conclusion that causal relations must be ultimate and irreducible relations between states of affairs.

3.2.2.2 The Argument from the Possibility of Exact Replicas

The argument just set out appeals to the possibility of indeterministic worlds. The thrust of this second argument, by contrast, is that a reductionist approach to causation is exposed to counterexamples even in the case of deterministic worlds.

Suppose that event *P* causes event *M*. In general, there will certainly be nothing impossible about there also being an event, *M**, which has precisely the same properties[8] as *M*, both intrinsic and relational, but which is not caused by *P*. But what about relations? Is it logically possible for it also to be the case that either (1) the only relation between *P* and *M* is that of causation, or else (2) any other relation that holds between *P* and *M* also holds between *P* and *M**?

If either situation obtained, one would have a counterexample to a reductionist approach to causal relations. For on a reductionist view, *P*'s causing *M* is logically supervenient upon the non-causal properties of, and the non-causal relations between, *P* and *M*, together with the causal laws. So if *M** has precisely the same non-causal properties as *M*, and also stands to *P* in the same non-causal relations as *M* does, then it follows, on a reductionist view, that P must also cause *M**, contrary to hypothesis.

But are such situations possible? In support of the claim that they are, consider the idea of a world, *W*, that satisfies the following two conditions. First, in *W*, the only *basic* external relations between different temporal slices of the world, or between parts of different temporal slices, are temporal relations and causal relations. Secondly, *W* possess an appropriate sort of symmetry -- specifically, rotational symmetry, such as characterized the simple Newtonian world, described earlier, that consisted of only two spheres, of the same type, connected by a rod, that rotated endlessly about one another on circular trajectories.

Are such worlds possible? The requirement of rotational symmetry seems unproblematic, but what about the requirement that the only basic external relations between different temporal slices of the world, or between parts of different temporal slices, are temporal relations and causal relations? Can one argue that, as a matter of logical necessity, there would have to be some other type of basic external relation that held between things at different times?

What might such a candidate be? About the only possibility that comes to mind is that of spatial relations between different objects at different times. But this suggestion seems problematic in two ways. First, it is not clear why a world

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[8]The only restriction upon properties here is that they must not involve particulars - so that, for example, being five miles from the Grand Canyon does not count as a property.

need contain any basic, trans-temporal spatial relations. Secondly, such trans-temporal spatial relations are surely not such as could be immediately given in experience, and so some analysis of the concept of such relations is needed. The natural analysis, however, is in terms of spatial relations, at different times, to one and the same enduring frame of reference. But then the question arises of how the idea of an enduring frame of reference is to be explained. To bring in trans-temporal relations would render the analysis circular. But if one uses only temporal and causal relations, then the only basic external relations between things existing at different times will be temporal and causal relations.

Accordingly, the claim that worlds such as *W* are logically possible appears reasonable. If so, the argument proceeds as follows. Given that world *W* possesses rotational symmetry, there must be at least two particles that have precisely the same properties, both intrinsic and relational, in virtue of the rotational symmetry. Let *A* and *A** be two such particles, and let *P* be the extended temporal part of particle *A* that consists of all temporal parts of *A* which exist at times prior to some time *t*, and let *M* be the extended temporal part that consists of all the temporal parts of *A* that exist at *t* or later. Similarly, let *P** and *M** be the corresponding parts of the particle *A**.

The final assumption that the argument needs is that identity over time logically supervenes on causal relations between temporal parts. Given this assumption, it follows that *P* is causally related to *M* in a way that it is not to *M**. But *M* and *M** differ neither with respect to their non-causal properties, nor with regard to their non-causal relations to *P*, nor to anything that exists at intervening times. There is, therefore, no non-causal basis for *P*'s being causally related to *M* but not to *M**.

Finally, as in the case of the previous argument, the situation is not changed if one also brings in dispositions, propensities, and objective chances: they cannot serve to make it the case that *P* is causally related to *M* in a way that it is not to *M**. Causal relations do not, therefore, logically supervene upon non-causal states of affairs, nor upon such states of affairs combined with causal laws, together with dispositions, propensities, and objective chances, plus facts about the direction of causation.

3.3 Summing Up

We have seen that reductionist accounts, both of causal laws and of causal relations, are open to very serious objections. In the case of laws, there are the problems posed by cosmic, but accidental uniformities, by uninstantiated basic laws, and by probabilistic laws, together with the difficulty of showing that one is justified in believing that laws obtain, if one holds that laws are, basically, cosmic uniformities. In the case of causal relations, there are, first of all, the objections that turn upon the problem of explaining the direction of causation, as illustrated by the case of very simple universes, and the case of temporally 'inverted' universes. Secondly, there are the underdetermination objections, the thrust of which is that causal relations between events are not logically supervenient even upon the totality of all non-causal facts, together with all laws, both causal and non-causal, together with dispositions, propensities, and objective chances, plus the direction of causation in all potential causal processes.