Time, Chance, and the Necessity of Everything

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Abstract

There is no contingency in the world. This chapter shows how premises that all have some plausibility in metaphysics and physics lead to this conclusion, that every true proposition is necessarily true (for example, the proposition that there is thought). The argument turns on the necessity of laws of nature, the claim that there is no absolute distinction between laws and initial conditions, and the EverettĐ-De Witt 'many worlds' hypothesis.

Keywords: contingency; necessitarianism; laws of nature; no-boundary condition; many worlds hypothesis

1 Introduction

Is there any contingency in the world? Surely it is possible that there might not have been any *thought*. That is, it is a contingent fact that there are creatures that can think. Had the history of the world been different—and it could have been different—then such creatures might never have existed. In this paper I present an argument to the contrary, whose conclusion is that whatever is true necessarily:

$$p \rightarrow \Box p \tag{NEC}$$

Let us call a fact about the way the world is, such as the fact that there is thought, a *worldly* fact. These are the facts that answer to the laws of nature. Strictly, this paper's argument is confined to worldly facts. What counts as a worldly fact may be vague; but that may not matter for the purpose of this paper, for if any facts are contingent, then clearly worldly facts will be among them.

The premises of the argument include empirical hypotheses that are speculative and far from sufficiently well established to be known, but are nonetheless plausible. Here I use 'plausible' in a fairly weak sense: a proposition is plausible if it is epistemically possible, i.e. logically consistent with what we know to be the case, and it is, given what we know, a *reasonable* speculation, one that is worth taking fairly seriously. A proposition can be plausible in this sense without being credible (i.e. worthy of belief). I shall take it as evidence that a proposition is plausible that it does not obviously conflict with well-established theories and that it has been conjectured and discussed by well-respected scientists. *Mutatis mutandis* we may say something similar about the plausibility of proposals in metaphysics (arguably plausibility is a rather weaker constraint in philosophy than in science).

And so the aim of this paper is to show that (NEC) is supported by an argument starting from plausible premises. Note that such an argument, even if valid, does not automatically guarantee the plausibility of (NEC) itself. For a pair of inconsistent propositions may each be plausible. Nonetheless, where the premises of such an argument do not obviously relate to one another in such a way that evidence for one premise is evidence against another premise, then if the premises are plausible, a valid argument from those premises establishes the *prima facie* plausibility of is conclusion. I start with a simple argument for (NEC) that is probably unsound since one of its premises (determinism) is widely believed to be false. I then argue for the plausibility of the other key premises of that argument. I then consider an alteration to the simple argument that does not depend on determinism.

2 A simple, but unsound, argument for the necessity of everything

Let us imagine that the laws of nature were deterministic. Then any actual worldly truth is entailed by the laws of nature, L, plus all facts about the universe at any specific time. That is, the way the world is at t plus the laws of nature, will fix everything about the want the world is at any other time, t' (t' can be later or earlier than t). In particular, if there is an earliest time, all later facts are fixed by the facts at that earliest time, the initial conditions, I, along with the laws of nature. Ie. under the assumption of determinism:

$$p \to \Box(L \land I \to p) \qquad \text{(DET) [assumption]}$$

Let us make two further assumptions. First, let us assume that the laws of nature are themselves necessary, as has been argued for by a number of necessitarians:

$$\Box L \qquad \text{(L-NEC) [assumption]}$$

And, secondly, let us assume that the initial conditions of the universe are not distinct from the laws of nature but must be included among them or are fixed by them:

$$L \to I \qquad \text{(INIT) [assumption]}$$

Hence:

$$\Box(L \land I) \qquad \text{(*) [from (L-NEC) and (INIT)]}$$

from which we may conclude:

$$p \to \Box p \qquad \text{(NEC) [from (DET) and (*)]}$$

If this argument were sound it would be telling us this. Assume the laws of nature are necessary; so if the initial conditions of the universe are to be regarded as laws or are uniquely constrained by the laws, then they would be necessary also. It follows that any consequence of the laws and initial conditions is also necessary. Under the assumption of determinism, all worldly facts are consequences of the laws and initial conditions, and hence are necessary also. And that includes the existence of thought: since the existence of thought is a consequence of the necessary laws and initial conditions, despite its appearance of contingency, it too is necessary.

My task then is to justify the claim that assumptions (L-NEC) and (INIT) are plausible. On the other hand, we have good reason to think that (DET) is false. So I shall consider whether we can reach the same conclusion, (NEC), or similar with a weaker assumption in place of (DET).

3 The laws of nature are necessary

In this section I establish the plausibility of (L-NEC), which I do by explaining why some philosophers hold views of laws that make (L-NEC) true. While I favour such a view myself, I do not suggest that the arguments of this section are sufficient to convince the reader of the truth of (L-NEC). But they should give some idea why it is reasonable to propose the philosophical hypothesis that the laws of nature are necessary. That establishes the plausibility of (L-NEC). I note that as far as (L-NEC) and the argument in Section 2 are concerned we need to consider only genuinely universal and fundamental laws. Universal non-fundamental laws will supervene on the fundamental ones, so if the latter are necessary so are the former. Some non-universal truths are called laws that may better be thought of as 'frozen accidents', to use Crick's phrase, results of the combination of laws and certain contingent conditions that are fixed as far as the field of study are concerned. So the chirality of life has the status of a law regarding the handedness that all biomolecules share; but this 'law' is probably the outcome of random events close to the origin of life. (L-NEC) does not hold that such truths are necessary. Nor does it need to in order for the argument from (L-NEC), (INIT), and (DET) to (NEC) to be valid. (Of course, if (NEC) is true, then frozen accidents will turn out to be necessary after all—but we ought not assume that, nor need we do so.)

Most accounts of the metaphysics of laws respect the intuition that the laws of nature are contingent. They reject (L-NEC). Humean accounts hold that the laws are just a certain species of regularity among the particular facts (Lewis 1973: 72–7). According to that metaphysics, the particular facts could have been otherwise and so could the regularities they exhibit. Hence the laws could have been otherwise. David Armstrong rejects the regularity view because then laws cannot explain the regularities there are in the world—they just *are* those regularities. Correlation does not suffice for explanation. So, given that laws do explain the particular facts, the laws do not supervene on them.

Armstrong (1983) proposes that laws are relations of necessitation between universals: N(F,G). Necessitation is a contingent relation, so such laws are contingent. But where the relation does hold, in this case between universals F and G, the laws necessitate that some entity possesses F that entity also possesses G (to describe a simple case). On this view N(F,G) entails $\forall x(\mathrm{F}x \to \mathrm{G}x)$ but the converse does not hold. According to Armstrong this necessitation allows laws to explain their instances.

Let's abbreviate $\forall x(Fx \rightarrow Gx)$ as R(F,G). So according to Armstrong, So N(F,G) entails R(F,G). However, in virtue of what does N achieve this? (Not, Lewis reminds us, in virtue of being called 'necessitation'.) Perhaps it is the case that necessarily (or even essentially) N entails R. Now Armstrong denies that any property *necessarily* has any interesting feature such as this. (By 'interesting' I mean to exclude features such as self-identity.) All such interesting features are contingent—because they are imposed on properties by the contingent laws of nature. So perhaps we should instead say that N merely implies R. But just as Armstrong complains in rejecting the regularity theory, mere implication is not sufficient for explanation. The remaining option is that N contingently necessitates R. In which case there is some higher level N', relating N and R. Now we see that a regress looms (Bird 2005).

To avoid the regress without falling back on a mere correlation between N and R (or the analogue at a higher level), at least one property/relation has a feature necessarily. But if one property can have a feature necessarily, why not all? Why not say that all properties have such features necessarily? For example, it might be a necessary feature of F and G that they relate in a regular way. In which case we can do without N. The *powers* (or *potencies*) view of properties takes this approach (Swoyer 1982; Ellis and Lierse 1994; Mumford 2004; Bird 2007a). It is the essence of (at least fundamental) natural properties that they relate in certain ways; these ways can be described *dispositionally*. So, for any natural and fundamental property P there is some specific way of being disposed (say to produce manifestation M in response to stimulus S), such that in all possible worlds whenever an object has P, that object will be disposed in that way. For example, if positive change is such a property, then in all possible worlds things that are positively charged are disposed to attract things that are negatively charged. Now think of all those things in all those possible worlds that have P and which also receive the stimulus S. Each one will (normally) produce manifestation M; for example, each positively charged object will normally attract negatively charged objects towards it. Since we are talking about all things that are P (and S) in all possible worlds the claim that each (normally) will be M is not just a universal truth, but a necessary universal truth. Now, I have said 'normally'; this is because dispositions are typically subject to *interferers* (such as finks and antidotes).

These intervene to stop a disposition producing its manifestation, even though it is suitably triggered/stimulated. So the universal truth is one with a 'ceteris paribus' rider (which says that the interferers are absent). Be that as it may, it must be noted that while this rider may limit the perfect universality of the truth, it does not limit its necessity. So although some entities within a world are exceptions to the claim 'everything that is P and S is also M', there are no worlds that are exceptions to the claim 'every world is such that anything in it that is P and S is (ceteris paribus) also M'. (I note in passing that it is not obvious that there are interferers at the fundamental level. If there are not, then the adjustments concerning ceteris paribus conditions can be put aside for fundamental laws.)

The powers (or potency) theorist can now claim to have an explanation of what the laws are. Facts of the form 'everything that is P and S is (ceteris paribus) also M' are the laws. Laws are ceteris paribus laws where the ceteris paribus rider is required and are strict laws when it can be dropped. Either way the laws are necessary for the reasons just given. We can formalise the argument as follows:

> It is the essence of some property P that things with P are disposed to produce manifestation M in response to stimulus S (for certain, specific S and M):
>
> $$\Box\forall x(\mathrm{P}x \rightarrow x \text{ is disposed to produce manifestation M in response to stimulus S}) \qquad \text{(POWERS)}$$
>
> When something is so disposed, it would (interferers being absent) produce the manifestation on receiving the stimulus:
>
> $$x \text{ is disposed to produce manifestation M in response to stimulus S} \rightarrow (\text{interferers being absent, } \mathrm{S}x \mathrel{\Box\!\!\rightarrow} \mathrm{M}x) \qquad \text{(DISP)}$$
>
> (POWERS) and (DISP) (which is necessary) together give us:
>
> $$\Box\forall x(\mathrm{P}x \rightarrow (\text{interferers being absent, } \mathrm{S}x \mathrel{\Box\!\!\rightarrow} \mathrm{M}x)) \qquad \text{(SUBJ)}$$
>
> Assuming weak centerting (*viz.* A$\mathrel{\Box\!\!\rightarrow}$B entails A$\rightarrow$B), (SUBJ) entails:
>
> $$\Box\forall x(\text{interferers being absent, } \mathrm{P}x \wedge \mathrm{S}x \rightarrow \mathrm{M}x) \qquad \text{(LAW)}$$

We may regard (LAW) as providing the basic form of a ceteris paribus law; furthermore we see that the law is necessary. So this approach accepts that laws necessitate (consequents of their) instances (the second intuition), but correspondingly says that laws are themselves necessary. To the extent that there is an intuition that the laws are contingent, this approach regards that intuition as faulty, in all probability a consequence of conflating conceivability and possibility.

Note that in (LAW), in addition to P, two further properties are mentioned, S and M. According to the powers view, these properties also have dispositional essences, which will relate them to further properties, also with dispositional essences. This does raise a question of whether there is some kind of undesirable regress or circularity, but I believe these worries can be assuaged (Bird 2007b). What it does mean is that the laws form a network of nomically related properties. And the identity of each property is fixed by its place in the network.

If this is the correct account of laws, then laws are necessary. But note that the laws hold only where the properties exist. So it looks as if the necessity of laws is like the necessity of identity: necessarily, Mark Twain is Samuel Clemens, but that is understood in a way that is consistent with there being worlds where Twain/Clemens does not exist.[1] This is *weak necessitarianism* about laws. If it is correct, then the argument in section 2 will fail, since there may then be worlds without our properties and so without our laws.

One response to this is to argue that we should think of properties as themselves being necessary existents, as would be appropriate on the Platonic (*ante rem*) conception of universals that I prefer.[2] If that is the case then the objection in the preceding paragraph can be dismissed. For then every possible property exists in every possible world, and so every possible law holds in every possible world. This is

[1]Of course, the conclusion of this paper is that it may be an illusion that there are worlds without Twain/Clemens; but I am here referring to a standard philosophical view, that in some worlds Mark Twain does not exist, but in al worlds where he does exist he is identical to Sam Clemens.

[2]Properties are also necessary existents on Lewis's view of them as natural classes of actual and possible entities. But Lewis's view doesn't really help here, since his view does not accommodate the earlier claim that fundamental natural properties have dispositional essences, and this claim is key to the argument that laws are necessary.

strong necessitarianism about laws.[3] It would mean that there are (in every possible world) *multiple* networks of laws; such networks would be fully independent of one another. It would be as if the world contains multiple universes, although we should understand 'universe' here in a loose sense, for the notion of a universe as a maximal spatio-temporally connected entity is tied to a particular set of laws—space and time, as I emphasize below, are not independent of the laws.

David Lewis regards possible worlds as being distinct from one another in virtue of being spatio-temporally disconnected: each world is a region of space-time that is closed under spatio-temporal connection. However, if the next section is correct, worlds with different laws will not have space-time at all. Since space-time is itself a product of our laws, worlds with different laws will had different fundamental structures. So Lewis's spatio-temporal criterion of identity and difference of possible worlds will only distinguish between different worlds sharing the same laws as the actual world. So how do we accommodate the possibility of different sets of laws? Different responses are possible, but one would be to maintain strong necessitarianism; there are not any possible but non-actual laws.

In conclusion, the view that laws are necessary has a well-supported basis in the metaphysics of properties. The weak necessitarian view is insufficient for the simple argument presented above, but the strong necessitarian view, which does the trick, is also plausible, either from the point of view of Platonism about properties, or from considerations relating to the identity of possible worlds.

4 The initial conditions are laws—the nature of time

Consider a logically possible world governed by Newtonian laws. The universe of such a world comes into existence with a certain quantity of matter distributed and set in motion in absolute space and time. It is intuitively compelling that if there is one such possible world, then there are other possible worlds where the universe comes into existence with different distributions of matter or different motions of that matter. If the actual world were such a world, then it would follow that the ini-

[3] For a full exposition and defence of strong necessitarianism see Bird (2004).

tial conditions of the universe are contingent. Our world happens to have this set of initial conditions, but it could have had some different distribution of matter and motion. Now we know that the actual world is not such a world because we know that the world's laws are not Newtonian. Nonetheless, we are tempted to believe that the basic metaphysics is right: there is a distinction between the laws and the initial conditions. So even if our laws are not Newtonian, the basic idea that the laws (whatever they are) operate on a set of initial conditions remains correct. And those initial conditions are contingent. Hence there is contingency both in those conditions and at least some (perhaps all) subsequent events. In particular it is plausible that there might not have been any thought if those initial conditions had been different.

Call the metaphysical picture articulated in the previous paragraph the 'simple' picture. The simple picture is independent of one's metaphysics of laws. It includes a radical distinction between initial conditions and the laws. And so one might accept a necessitarian metaphysics of laws while also accepting the contingency of the initial conditions. The contingency of the initial conditions does not guarantee the contingency of every particular matter of fact; it is nonetheless plausible that many things would be different now had the initial conditions been different 14 billion years ago. And the existence of sentient, thinking beings would seem to be one of those facts.

Nonetheless, the views of contemporary physicists are at odds with the simple picture. To begin with, the simple picture most naturally sees space and time as a *background* structure, that is as akin to a stage upon which the events of the universe are acted out; the actors are given their positions at the beginning of scene 1, and then interact according to the rules they have been given.[4] We could adopt a Euclidean background structure for space and time, so that space and time are infinite, even though the universe itself might have begun at a particular point in time and have only a finite extent. Space and time are the stage, not part of the action;

[4]According to Abhay Ashtekar (2012), there is a 'deep conceptual difference between the description of gravity in general relativity and that of non-gravitational forces in other fundamental theories. In those theories, space-time is given a priori, serving as an inert background, a stage on which the drama of evolution unfolds.' The latter conception exemplifies the simple picture I am articulating (and will reject). See also Baez (2000).

they are not created by nor subject to any of the rules/laws. While the simple picture need not adopt Newton's absolutism about time and place, it does nonetheless regard the basic structure of space and time as independent of the events that unfold within space and time.

Contemporary physics rejects the simple picture. Space and time are not a fixed background, but are themselves subject to the laws of nature. The general theory of relativity tells us that the metrical structure of space-time interacts with the matter in space-time. This does not of itself tell use that we cannot distinguish between the initial conditions and the laws of nature is based. But by undermining the simple picture's view of space and time as a background, developments such as special and general relativity weaken our basis for making that distinction. For example, the idea of initial conditions is a special case of the idea of the totality of particular facts at a particular time. But thanks to Einstein's special theory of relativity, we know that there are no observer-independent facts about simultaneity, and therefore no observer-independent set of facts about the way things are at a particular time. So it is far from trivial that we can think of initial conditions in the way that the picture articulated above enjoins us to.

Contemporary cosmology tells us that the universe came into existence about 14 billion years ago. This is not just the coming into existence of matter within space-time; it is the coming into existence of space-time itself. It is not as if there was nothing at all 16 billion years ago—as the simple picture would suggest. There just was no time that was 16 billion years ago. (Consider this analogy: it is potentially misleading to say that nothing is −300 °C, i.e. 27 degrees celsius below absolute zero; rather there just is no temperature that is −300 °C.) Many models of the origin of the universe take it to have originated in a singularity, a state where the spatial dimensions of the universe are zero and which constitutes the absolute zero of time (the initial state of the big bang). Thus the 'initial conditions' of the universe concern the nature of this singularity. Now imagine that the laws of nature themselves constrain the possible nature of the singularity so tightly that only one kind of singularity—only one set of possible initial conditions—is consistent with those laws. Thus if this world is to exist at all then, thanks to the laws, the initial conditions can only be what they are and not otherwise. This is one way in which (INIT) might be true according to some approaches in contemporary cosmology. Another is due to James Hartle and Stephen Hawking (1983), who speculate that there may be no initial or boundary conditions at all. This is because in their quantum approach to time at the earliest moments of the universe, time just becomes another dimension of space; in John Barrow's words (1994: 106) '... as one goes back towards the beginning, the distinct character of time melts away and time becomes indistinguishable from space.' Because space-time develops out of a state with no time, there is no initial or boundary condition (for which reason their hypothesis has become known as 'the No-Boundary Condition'). Thus the laws of nature themselves determine that the universe comes into being.[5] I note also that Laweance Sklar (1984) has argued that consideration of Gödel's closed time-like loops also gives us reason to be sceptical about the laws-initial conditions distinction: the laws may constrain what initial conditions are consistent with them (see also Sklar 1990 and Frisch 2004). The constraints might be sufficient to determine a single set of compatible with the laws, in which case (INIT) it true.

Both the view that the initial conditions (e.g. the nature of the singularity) are fixed by the laws and the view that there are no initial conditions (the no boundary condition) are speculative. But they appear to be consistent with all that we so far know, and are proposed by scientists with respectable track-records. And so those views are at least plausible; it is (epistemically) quite possible that the nature of the initial conditions (including that there are none) is entailed by the laws. That being so, assumption (INIT) of the argument of section 2, though not known to be true is a plausible empirical assumption.

[5]This consequence of Hawking–Hartle speculation has been called 'Creation out of Nothing'. While this may seem bizarre and offends against the idea that there is no such thing as a free lunch, there is nothing in physics to rule out such a hypothesis. In particular the No-Boundary Condition/Creation out of Nothing hypothesis is entirely consistent with the conservation laws (the physicists' equivalent of the economist's principle concerning free lunches). Creation out of Nothing obeys the law of conservation of charge, since all the evidence is that the universe has zero net charge. Similarly the universe has zero net angular momentum. And because of the existence of negative energy, the total mass-energy of the universe is also believed to be zero.

Lawrence Krauss (2012) has argued that the physics referred to above explains how 'there is something rather than nothing'. My argument is in sympathy with Krauss's, for my argument says that the laws of nature explain why there is thought rather than its absence. The existence of thought it not dependent on some unexplained set of initial conditions wholly distinct from the laws. Yet David Albert (2012) has quite reasonably criticised Krauss's argument on the ground that Krauss does not explain why we have the laws that we do have. Sean Carroll (2012) summarises the debate thus:

> Very roughly, there are two different kinds of questions lurking around the issue of 'Why is there something rather than nothing?' One question is, within some framework of physical laws that is flexible enough to allow for the possible existence of either 'stuff' or 'no stuff' (where 'stuff' might include space and time itself), why does the actual manifestation of reality seem to feature all this stuff? The other is, why do we have this particular framework of physical law, or even something called 'physical law' at all? Lawrence [Krauss] (again, roughly) addresses the first question, and David [Albert] cares about the second, and both sides expend a lot of energy insisting that their question is the 'right' one rather than just admitting they are different questions. Nothing about modern physics explains why we have these laws rather than some totally different laws . . .

This paper, in effect, adds to Krauss's argument by giving a philosophical answer to the question 'why *these* laws?', viz. the answer of the preceding section, 'because they are necessary—every possible law is actual'.

I note in conclusion that our seemingly metaphysical distinction between the laws and the initial conditions of the universe is founded on our experience of middle-sized entities. We can set a pendulum swinging from different heights and with different bobs; we can lengthen and shorten the pendulum; but we cannot change the law of gravity. By analogy, the positions and velocities of the planets around the Sun are initial or boundary conditions, since we can imagine them differing for reasons of a kind that could not change the laws. But given determinism, the distinction between laws and initial conditions as applied to middle-sized things depends on there being such a distinction at the very beginning of the universe.[6] So we should not rely on supposed metaphysical insights tutored by middle-sized things unless we know about how things are in basic physics and cosmology. Michael Strevens (2008) and others argue that even some laws do not have physical necessity because they are in fact dependent on highly contingent occurrences in history. These are frozen accidents such as *all (normal) ravens are black* or *all DNA nucleotides are right-handed* (the chirality of life mentioned above). This might be taken to show that there is more contingency in nature than one supposed. But I take it to show that out intuitions about necessity and contingency are not especially reliable and are very much dependent on what we know. In some cases, such as those Strevens discusses, additional knowledge make some propositions look more contingent; in other cases the additional knowledge makes contingency recede. For example, given that there are many sibling pairs where one has blue eyes and the other has brown eyes, it might seem an accident that both children in a particular sibling pair have blue eyes. And it often is. But when one knows in addition that both parents have blue eyes and that the blue eye allele is recessive, then it looks rather less an accident that both have blue eyes: both children *had* to have blue eyes. Given the dependence of our judgments of necessity and contingency on what we know, we ought not be surprised by the suggestion that our judgments concerning the contingency of the initial conditions of the universe might be radically revised in the light of knowledge of the relevant cosmology and physics.

5 From determinism to indeterminism

The argument for (NEC) assumed that determinism is true. The weight of scientific opinion is that this view is false, although there remain some influential views, notably David Bohm's, that retain something like the hidden variables, deterministic view of quantum mechanics associated with Einstein and Schrödinger. Without determinism the argument as first presented is invalid, since even if we start with fixed

[6]Which is not to say that the distinction at the middle-sized level is not a useful one—it just isn't one founded in the metaphysics of laws.

initial conditions, subsequent history may turn out in more than one way, thanks to the play of chance. Two worlds might have the same laws and initial history so that a particular time the worlds are in the very same state involving a fissile nucleus that has a 0.5 probability of decaying and an equal probability of not decaying. The laws and that state permit in one world the nucleus to decay while allowing that in the other it does not decay. Thereafter the histories of the two worlds differ and facts (such as the decaying of the nucleus) that exist in the one may not exist in the other and vice-versa.

This indeterminism comes about in the following way. The central component of quantum mechanics is the wave-function. The wave-function describes how the quantum-state of a system (such as a sub-atomic particle) develops (deterministically) over time. The wave-function can be interpreted as a superposition of waves each corresponding to a specific (classical) state of the system. The amplitude of each wave fixes the probability of system's being found to be in the corresponding state (the probability is proportional to the square of the amplitude), when the system interacts with a measuring device. Quantum mechanics is the best-confirmed scientific theory of all time. But of course testing the theory involves using measuring devices. Since the theory as sketched tells us about the precise state of an entity, such as decayed or not decayed (or rather the probabilities attached to such states of the entity) only when measured, the theory is at a loss to say what state things are in when they are not being measured. The orthodox, Copenhagen interpretation says that there is no state of things independently of their being measured; the wave-function itself says all that there is to say. But if we believe that the macroscopic supervenes on the microscopic, then the same goes not just for the atomic nucleus but for middle-sized dry goods, and so it would seem that à la Berkeley the tree in the quad is not in one state or the other until perceived to be so; the difficulties of this view are vividly captured in the tale of Schrödinger's cat.[7] A question is similarly raised about the Universe as a whole. Since it contains all the measuring devices that there are, there is nothing external to it that can measure it. In which case the

[7] Eugene Wigner tells the tale known as 'Wigner's friend' to suggest that consciousness plays a special role in measurement. But that is in effect to deny that the macroscopic supervenes on the microscopic.

Universe as a whole, and so all that it contains including us, is in a superposition of all its possible states rather than in any one determinate state.

A response to this, the measurement problem, is Hugh Everett's relative-state formulation of quantum mechanics (Everett 1957). Quite how Everett himself intended his approach to be understood is unclear. However, the most popular version of his theory is the *many worlds* hypothesis (DeWitt 1971) (although we ought to prefer DeWitt's original name, the 'many universes' interpretation, since this emphasises that the many worlds/universes under discussion all occur within one metaphysical world). Simplified, this view proposes that instead of a system existing in a superposition of states which collapse into a single determinate state on measurement, there are many parallel determinate states, each corresponding to one element in the superposition. And so, instead of some particle being in a superposition of spin-up and spin-down states, there are two particles in separate worlds/universes, one with spin-up and one with spin-down. Every physical interaction leads to the universe splitting into distinct universes, so every possible outcome of an interaction (such as a measurement) is found in some resulting universe.

The many worlds interpretation leads to metaphysical problems, most obviously concerning identity, as well as facing its own problems, such as accounting for the precise values of the various probabilities involved (see Albert and Loewer 1988; Saunders 1998; Tappenden 2000 for discussion of theses issues). Nonetheless, the popularity of the view among both philosophers and physicists suggests that it should be taken seriously. Let us assume then that it is consistent and is not ruled out by anything we know. We are now in a position to see how the original flawed argument for the claim that all actual facts are necessary can be replaced by one which may (for all we know) be sound. Let 'p' represent the proposition that there is thought. If determinism were true the probability p conditional on the laws and initial conditions is 1. Our original argument then added that the laws (plus initial conditions) are metaphysically necessary; consequently the probability of p is 1 in all possible worlds. However, if the laws are not deterministic, then although the probability p conditional on the laws and initial conditions is greater than 0, it may well be less than 1. And so, even if the laws and initial conditions are necessary, since the non-occurrence of p is consistent with the laws and initial conditions, there will be a possible world where p does not hold. Here is where the DeWitt many-universes interpretation becomes important. Consider how matters stand according to the standard von Neumann–Dirac interpretation of quantum mechanics. The wave-function of the universe evolves deterministically until at the relevant time a measurement is made and the universe chancily jumps either to a determinate state where p or to a determinate state where $\neg p$. However, according to the DeWitt interpretation, *both* outcomes occur in distinct universes—both of which are parts of the actual world. So in the actual world it is inevitable that there is a universe within it where p. In that case the occurrence of thought is inevitable, even though there is another *part* of the world where no thought occurs (or at least that occurrence of thought does not occur). The picture just sketched is a simplification in that it assumes that the first 'measurement' occurs at a time when the universe is in a state where p has non-zero probability. Perhaps some earlier measurement has taken place, and the outcome of that measurement is a state that precludes the possibility of p. For example, assuming that thought requires life, then if an earlier measurement were (according to the von Neumann–Dirac interpretation) to collapse the wave-function to a state where there is no life, then the probability of thought is now zero. However, according to the DeWitt interpretation, that measurement leads to a branching of the universe, with life in one branch and no life in the other, so in the former, the probability of thought remains greater than zero. Consider an episode of current actual thought, and consider the history of branching of the universe from its initial state until the the occurrence of that episode. That history is a sequence of occurrences each of which has a non-zero probability at the preceding branch point. Consequently, any world that has the same laws and initial conditions must have this history as one of the branching patterns in its tree. So in any such world there will be a branch in which that episode of thought occurs.[8] Further add, as the original argument does, that the laws are necessary and so are the initial conditions

[8] Knobe et al. (2006) reach an analogous conclusion regarding the actual occurrence of every physical possibility, but by another route. They argue that quantum mechanics implies that there are only finitely many possible histories in an infinite region of space-time. Cosmological inflation means that the universe is infinite and contains an infinite number of inflating regions, thereby giving every one of the finite

(or the initial conditions are also laws), then we may conclude that this episode of thought occurs in all possible worlds.

6 Conclusion

The purpose of this paper is not to persuade anyone that it is in fact the case that there is no real contingency in the world. The argument cannot be persuasive because the various premises are contentious and speculative. Nonetheless, the various premises have proponents and supporters among philosophers and physicists. The necessity of laws is a consequence of one of the principal accounts of the metaphysics of laws and properties. The no-boundary condition that eliminates initial conditions (or reduces them to laws, if you prefer), is a proposal from a renowned contemporary physicist, and the many worlds/universes interpretation of quantum mechanics is perhaps the most popular interpretation of QM among both physicists and philosophers. So each of these premises must be taken seriously. What is intriguing is that together they rule out contingency. Contingency is an illusion.

Some might regard that as a reductio of the combination of premises, one at least of which must be false. I have given a weak definition of 'plausible' such that it is clearly possible for two propositions to be plausible that are inconsistent with one another—competing scientific theories may both be plausible, for example. We learn something when we discover that propositions that are all independently plausible turn out to lead to an absurd conclusion.

On the other hand, perhaps we should not dismiss the conclusion as absurd quite so quickly. It tells us that contingency is an illusion. How confident should be we be that our intuitions of contingency are reliable? I am inclined to think that they are not especially reliable, being largely informed by our epistemic limitations. The more we learn, the more we discover could not have been otherwise. Lois Lane might wonder what would happen if Superman and Clark Kent were to meet—she imagines them having a conversation. Once she learns Superman's identity, she realises that what she thought was possible was in fact impossible. Moreover, one

number of possible histories an infinite number of opportunities to occur. Hence, with probability equal to one, every such possible history will occur, and indeed infinitely often.

already has to accept the illusory nature of reality if one accepts the many worlds interpretation of QM (indeed, arguably one has to accept the illusory nature of reality on any interpretation of QM—the interpretations differ on where they locate the illusion). We like to think that when we perceive something to occur, where some alternative outcome might have occurred, then that alternative did *not* occur. But the many worlds interpretation tells us that this is wrong: every possible outcome in fact occurs on some branch of the universe. So if the many worlds interpretation can address this and other problems, as its supporters suppose they can, then this illusion is something we have to accept, and explaining that illusion will be part of explaining the illusion of contingency.

It might be possible to reintroduce contingency despite my argument. For if metaphysically possible worlds just are the Everett–DeWitt worlds/universes then the actual world does not contain all the Everett–DeWitt worlds, it is just one of them. This approach, discussed in detail by Alistair Wilson (2011), cannot be straightforwardly dismissed. For example, although it implies a form of modal realism, many of the objections to modal realism lose their bite because this is a naturalistic version of modal realism—the real (non-actual) possible worlds are ones that are mandated by a scientific theory. Some revision of Lewis's approach to modal realism may be required, for possible worlds will not be spatio-temporally and causally disconnected. One conclusion from this paper might be that we ought to take this modified, naturalistic modal realism seriously as a way of recovering contingency. Whether that is the right response remains to be seen.

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