14

Is the Universe Reasonable?

Often the following argument is attributed to the defender of the PSR: The PSR says that reality is rational. It is irrational to suppose reality to be irrational. Hence, it is irrational to deny the PSR. Typically, this argument is given only a straw man, quickly refuted, and the defender of the PSR is associated with an evidently unsound argument.

The argument as given is plainly valid, at least:

(122) The PSR says reality is rational.
(123) It is irrational to suppose reality to be irrational.
(124) Thus, it is irrational to deny the PSR.

Of course, one might be a skeptic about the PSR, neither denying nor affirming it, and escape the argument thus. Now while the argument is valid, acceptance of (123) may rest on a confusion between irrationality within a belief operator and outside it. To hold that reality is irrational need not prima facie be an irrational belief, just as for me to hold that Jones is irrational need not be irrational.

But there could be a little more to the argument than this. The PSR is one of our basic assumptions about how the world works; our belief in it increases our confidence and resolution in our search for truth and explanation. Prima facie, a stepmotherly nature might not support our scientific research. However, once we suppose nature to be thus stepmotherly vis-à-vis the PSR, recalcitrant in the face of our drive to seek explanations, then one might reasonably worry that our other intuitive expectations about the world, such as that it conform to our senses, might be frustrated. A world where the PSR fails is a world unfriendly to us, and if it is unfriendly in that way, who is to know how far its unfriendliness extends. Thus, denial of the PSR means that the world is irrational in the

sense of not conforming to our ways of thinking in one way, but if in one way, why not in more? And so the specter of skepticism looms ahead. Since skepticism *is* an irrational stance, this might be taken as support for (123).

However, the support is meager, since the universe plainly does disappoint some of our epistemic expectations. For instance, quantum mechanics shows that either there is an indeterminism of a sort that disappoints us in our scientific endeavors *or* there are hidden variables beyond empirical reach (or both).

But there is an argument not a far step from this one that has not been sufficiently explored. We have a *desire* to seek explanations. This makes it plausible that in fact there *are* explanations, since as a species we do not have desires for things that do not exist at all. Of course, it does not follow that there are explanations for *everything*.

However, one way of looking at our desires to seek explanations of various particular things is as merely symptomatic of a single human drive to understand it all, a basic human desire to explain everything there is, holistically but perhaps only sketchily. On this view, our piecemeal curiosities do not give rise to search for cosmic explanation, but it is the latter that gives rise to our piecemeal searches for explanation. Of course, even without the search for cosmic explanation we might have practically motivated and evolutionarily explicable desires for explanation. We might want to know why the lion runs the way it does, so that we might be better able to kill it. We might want to know why plants grow in one setting rather than another in order to be better agriculturists. However, these practically minded interests are not the disinterested desire to know for the sake of knowing that Aristotle evokes at the beginning of his *Metaphysics*, a desire born of wonder rather than of pragmatic exigencies.

It is quite compatible with our pragmatically motivated interests that we also have an overarching striving for an understanding and explanation "of it all," and our piecemeal interests derive from this. If so, if this is indeed one of our basic human desires, and if our basic human desires are all satisfiable, then it *is* possible to "explain it all," though no doubt we could only know the global explanation sketchily. Thus, the BCCF has an explanation, and hence so does everything else. Or at least, it is metaphysically possible that the BCCF has an explanation – but as we saw in Section 13.3, this implies that the BCCF in fact *does* have an explanation.

This argument obviously will not impress an existentialist sort of philosopher who is quite willing to admit that we are thrown into a cold and indifferent world, with desires that do not match it. But such a

story is its own counterargument, for why should we have a basic human desire that is so much out of step with reality? It is true that our disinterested wonder about "the reason for it all" has produced modern physics and has thus been an evolutionary benefit to us, but the wonder at the world as a whole is older than modern physics and in the past had much less in the way of practical application.

This is not the strongest of the arguments for the PSR, but it does provide some evidence, for that we desire something is indeed evidence, albeit defeasible, for its possibility.[1]

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1 Note, too, the resemblance between this argument and Thomas Aquinas's argument for the claim that knowledge of God is our ultimate end: we will not be happy until we know the causes of things, and thus we will not be happy until we know God, who is the first cause (*Summa Theologiae* I–II, 3, 8).

16

The Puzzle of the Everyday Applicability of the PSR

16.1. THE ARGUMENT

No one wants to deny the PSR wholesale. We all assume that airplane crashes have causes and consider it much more likely that an inspection team overlooked a cause that was there than that there was no cause. Generally, the person denying the PSR will still accept a restricted version, such as that, at least as a contingent matter of fact, every physical event in time has a prior cause, or perhaps that most macroscopic physical events have prior causes.

No one thinks that bricks pop into existence *ex nihilo* from time to time. The disagreement between the upholder of a robust form of the PSR and the PSR skeptic is over the status of this proposition. Is it simply a generalization contingently true, or true with high probability, or is it the result of a basic metaphysical *ex nihilo nihil fit* type of PSR? It is a common dialectical move that when the defender of the PSR appeals to homely cases, the opponent insists that the homely cases only support a contingent, and perhaps only true "for the most part" (to use an Aristotelian phrase), version of the PSR. But it is a mistake for the PSR's opponent to think that victory has been achieved in this way.

Let it be granted that the PSR is not metaphysically necessary and may not even hold for all events. It is still a mystery as to why it holds to the great extent that it does. After all, if the PSR is not metaphysically necessary, then there presumably are possible worlds where bricks pop into existence out of nothing for no reason at all. Why is our world not like that? Philosophy starts in wonder and the great extent to which the PSR at least contingently holds is surely worthy of wonder. Call this the "puzzle of the PSR's everyday applicability."

Of course the opponent of the PSR, precisely because she is such, can refuse to answer the question. She can just insist that the everyday applicability of the PSR is simply a brute fact lacking any explanation. This is a perfectly consistent move. On a Humean metaphysics on which any kind of a rearrangement of objects is logically possible, it is indeed true that there are possible worlds in which the PSR has everyday applicability, and it could thus just be a brute fact that our world happens to be one of those.

But claiming something to be a brute fact should be a last resort. It would undercut the practice of science were things claimed to be brute facts where not implausible putative explanations, propositions that would be explanations were they true, can be formulated. And in this case there is available to us a putative explanation, namely, that it is a basic metaphysical principle that the PSR holds of metaphysical necessity. We can conclude the metaphysical necessity of a fuller PSR by inference to best explanation from the everyday applicability of the PSR.

16.2. AN ABUNDANCE OF OBJECTIONS

16.2.1. This Is Not Explanatory

Saying that the PSR is metaphysically necessary simply transfers a mystery from a puzzle about everyday events to a mystery about why the PSR is metaphysically true. It is replacing a mystery about the physical world with a mysterious metaphysical "principle."

A coherent ontological system in which the PSR falls out of lower-level assumptions, say, about the nature of being, such as in our Thomistic arguments, would be a response to this. If such an approach works, we will have subsumed the metaphysical principle into a wider ontological system and thereby made it less mysterious. And indeed the possibility of doing so is itself evidence for any system that allows this to be done: the explanatory value of a metaphysical system is evidence for the system.

Moreover, we generally consider the subsumption of events under general physical laws of nature to be a paradigmatically good form of explanation. For exactly the same reason, subsumption under a metaphysical principle should be a good form of explanation.

16.2.2. The PSR Is Irrefutable

In a good use of inference to best explanation, the laws or principles inferred are refutable: one can conceive of a situation in which they

could be observationally falsified. But the PSR is irrefutable, since for any observable event for which we have not found a cause, we can always suppose an *unobservable* cause beyond our ken.

In response, one might well admit that the PSR is, strictly construed, irrefutable. The cause predicted by the PSR could always be unobservable. But not being strictly refutable is something the PSR has in common with most scientific inferences. A scientist can always give up some auxiliary hypothesis to defend a proposition. We know the difficulties facing the person wishing to defend Darwinian evolution from irrefutability.[1] One can imagine pieces of evidence that would make evolution highly unlikely, but one could always suppose a more convoluted evolutionary story to get around the difficulty. Likewise, there are pieces of evidence that would make the PSR, insofar as it is inferred from experience and not on the basis of some metaphysical argument, epistemically untenable: say, if bricks haphazardly started popping into existence.

The objection that causes entirely beyond our ken could always be posited to save the PSR from empirical refutation should in fact not worry one. First of all, any ceteris paribus law could be saved from empirical refutation by positing causes beyond our ken. However, the evidence that inference to best explanation bestows on a proposition is defeated in cases in which the proposition can only be saved from refutation by positing causes entirely beyond our ken, that is, causes that can only be justifiably characterized as "entities sufficient to cause *this*," such as the *virtus dormitiva*. Second, consider the parallel of neo-Darwinian evolution. Any conceivable fossil finding could be made to fit with evolution if we allowed for causes beyond our ken. It is not a part of the theory of evolution, as such, that there are no supernatural unknowable beings redistributing fossils in strata and perhaps doctoring them. Any fossil that appeared to refute evolution could be supposed to be produced by such a supernatural cause, just as any event that appeared to have no cause could be thought to have some supernatural cause. This in no way harms the theory of evolution, and likewise it does not harm this inference to the PSR.

One response that the critic can make here is that in fact there *are* cases in which the defender of the PSR will have to advert to causes beyond our ken. For instance, quantum mechanics presents us with indeterministic events whose causes we could not know. Likewise, there was a Big Bang.

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1   For a simple discussion, see Kitcher (1998, chap. 3).

There is very good reason to think the Big Bang could not have had a physical cause, because any physical cause would have been in time and prior to the Big Bang, whereas time starts with the Big Bang.

The quantum mechanical case was already considered in Chapter 8 and can be responded to by either the Bohmian approach or the insistence that explanations need not be deterministic.

The case of the Big Bang is more interesting. Let us suppose that the physicists who think that there can be a physical theory explaining why the Big Bang occurred are wrong – for if they are right, then the Big Bang is no objection here. If so, then any explanation of the Big Bang will involve something nonphysical. But it does not follow from this that the explanation will be beyond our ken. There might well, for instance, be some independent evidence for the existence of a deity of a certain nature, such as evidence found in fine-tuning anthropic arguments, and if so then the intentional action of this deity might be supposed to be an explanation of the Big Bang. But then because there would be independent evidence for this deity's existence, the deity would not be beyond our ken, since the independent evidence would provide for some characterization of the deity, for example, as a deity that desires organic life-forms to exist. Moreover, it might be that the supernatural being would have to be a person (see Chapter 5) and we *do* know some things about all persons: they are beings that, say, have a capability for intelligence, intentionality, and responsiveness to reasons.

16.2.3. This Inference Is Not Predictive

One way to distinguish a genuine use of inference to best explanation from a misuse of it is that good explanations are *predictive*, in the sense that they make use of laws or principles that yield further observable predictions beyond the explanandum itself. But the PSR does not yield any further observable predictions because the PSR does not say that the explanation of a proposition will always be one that can be observed.

Observe, however, that although evolutionary theory provides us with a general account of how organisms evolved, it does not *by itself* lead to further observable predictions. After all, while the theory insists that generally organisms evolved in a way that adapts to environmental conditions that harm or promote the genetic transmission of an organism exhibiting such and such a phenotype, that the environmental conditions are always observable is not part of the theory as such. Rather, that the sources of adaptive pressures appealed to are supposed to be physical and hence

ideally at least indirectly observable is something that is superadded to evolutionary theory by the general edifice of scientific practice. Likewise, that the causes the PSR bids us to search for are *physical*, unless the context demands otherwise (e.g., because we have a conceptual argument that a physical cause cannot be found, as in the case of the cause of the physical universe as a whole), is an additional hypothesis.

Another example of a nonpredictive explanation would be the following. Suppose that all over the world the sky started glowing in a mysterious and beautiful way, all amputees noticed that their limbs instantly regrew, and simultaneously everyone's computer screen flashed up the message, in the person's native language: "Know that I am God and I do exist. Live your life virtuously." And then the messages disappear, the sky goes back to its normal color, but the regrown limbs stay. The simplest explanation is surely that God did all that in order to testify to his existence. But there do not seem to be any predictions that can be made on the basis of this. One cannot, for instance, make any justified predictions about whether this will happen again or not, since given that this sort of universal phenomenon does not appear to have happened earlier in history, we cannot infer that God habitually does these things.

Finally, perhaps some probabilistic predictions could be made when the PSR is applied in arguments for an intelligent first cause of the universe (see Chapter 5), since it seems we can say *something* about what an intelligent person is likely to do: an intelligent person has a nonnegligible likelihood of acting on objective reasons, and thus it is perhaps made more likely than on a naturalistic hypothesis that there should be things in the universe that such a being would have reason to make, such as orderly or beautiful or complex beings.

16.2.4. The PSR Is Metaphysically Necessary, Whereas Inference to Best Explanation Involves Only Nomic Necessities

Laws of nature are metaphysically contingent and hence are genuine subjects of inference on the basis of empirical facts. It is unacceptable to use empirical data to infer a *metaphysically* necessary truth. Hence, the argument to the PSR, it seems, fails.

However, people use empirical data to infer metaphysical necessities all the time these days. Whenever we use a calculator, we infer a metaphysically necessary truth from empirical facts. We can infer that $5 + 7 = 12$, from the empirical fact that pressing the buttons $\boxed{5}$, $\boxed{+}$, $\boxed{7}$, and $\boxed{=}$ causes the display to show 12. It might be thought that this is

different from the earlier case, however, in that when we use a calculator, we do not use inference to best explanation. Perhaps, we use inductive reasoning ("calculators have usually shown correct answers") or base ourselves on manufacturer's testimony, which in turn is based on inductive reasoning about semiconductor physics. So the example of a calculator, while showing that we can derive metaphysically necessary truths from empirical data, does not show that we can do so by means of inference to best explanation. Nor does the example show that we can derive the metaphysical necessity of a true claim from empirical data. In the case of a calculator, the immediate inference might be argued to be just that $5 + 7 = 12$. The further inference that this is metaphysically necessary follows not from empirical observation but from the general metaphysical principle that all arithmetical truths are necessary.

There is thus a significant disanalogy between scientific employment of inference to best explanation and our inference of the PSR. However, this disanalogy need not be fatal, because inference to best explanation is also used outside science. Philosophers often argue that some claim is probably true from the fact that its truth would neatly solve some philosophical puzzle. Positing the existence of propositions, for instance, would help explain how beliefs are individuated. Positing possible worlds, Lewis thinks, helps solve a number of different puzzles.

However, in those cases more than one phenomenon is explained. The PSR only explains the everyday applicability of the PSR, it seems. But this is not obvious. The metaphysical truth of the PSR might also enter into an explanation of why, say, mere epiphenomenalistic property dualism is an unacceptable theory – for it fails to give the reason why physical properties are correlated with mental properties. And what further applications of the PSR could be given depends only on the ingenuity of philosophers: a number of issues were, however, already mentioned in the Introduction.

16.2.5. The PSR Inferred Is Too Broad

The empirical data at hand support only the claim that the PSR has everyday applicability, not that the PSR is true in general. Therefore, we should infer that there is a metaphysical principle that, necessarily, the PSR has everyday applicability, not that the PSR is true.

First, as a matter of general principle, in an inference to best explanation one seeks a principle that is not gerrymandered to fit the data, but has simplicity and generality. Otherwise, one could count as having explained everything by positing that, as a matter of metaphysical or nomic necessity,

everything is exactly as it is. Inferring only that the PSR has everyday applicability would be like inferring from the fact that every hitherto observed raven is black that, as a matter of law, every observed raven is black when observed. But the latter law does not sufficiently simply generalize from the observed data. There is a simpler and hence preferable, though stronger, law here: every raven is black all the time. The hypothesis that the PSR is just metaphysically necessary in full, rather than that the everyday applicability of the PSR is metaphysically necessary, is simpler and hence preferable.

The proposed restriction of the PSR was ad hoc. The same could be said about a restriction to physical phenomena. There is no reason to think the PSR to be *metaphysically* necessary for physical phenomena without being metaphysically necessary for all contingent phenomena. Why should contingent physical phenomena be intrinsically different from nonphysical ones with respect to explainability? Of course it may be a necessary truth that all physical phenomena are themselves contingent.

Second, a metaphysically necessary proposition that something is *probable* or holds for *macroscopic* objects is an unprecedented kind of principle, in the absence of deeper metaphysical facts. While the PSR *simpliciter* is something that could not unreasonably be thought to be a basic metaphysical principle, the claim that every *macroscopic* object has a cause or that *most* physical events have causes seems much less likely to be a metaphysical principle. This is not to say that it could not be derived from propositions that look more like metaphysical principles. For instance, one might derive it from a claim about God's necessarily existing and from a claim about what kinds of things, namely, orderly universes, a God is most likely to create. But the onus would be on the opponent of the PSR to produce such a derivation and thus show the preferability of the narrower thesis as an explanation. Note that the theistic explanation will not do, for that God necessarily exists entails the PSR, since God's creative action grounds the explanation, not necessarily deterministic, of every contingent fact, except perhaps those explained by the free will of creatures.

16.2.6. The PSR Inferred Should Have Merely Nomic Necessity

Inference to best explanation gives us laws of nature, not laws of metaphysics. Thus, we should infer from the everyday applicability of the PSR that the PSR, at least as restricted to physical events, is physically necessary.

To respond, neither the PSR nor the CP looks quite like a law of nature. For instance, although the CP is a causal claim, basic causal laws

of nature tend to be of the form *every C causes a C** rather than of the form *every C* is caused by a C*, which is what the CP looks most like. The latter form is what evolutionary theory looks like – every animal evolved through such and such a general process – but evolutionary theory is not a basic law of nature.

Therefore, the form that this objection should take is not that the PSR or the CP is a basic law of nature, but rather that it can be derived from some basic law or laws of nature. One promising prospect here is the law of conservation of mass-energy, which already implies a very weak form of the *ex nihil nihilo* principle: a state of the universe with positive mass-energy is preceded in time by another state of positive, and in fact equal, mass-energy.

By itself, conservation of mass-energy will not yield a CP, since conservation of mass-energy is consistent with a piece of matter of mass-energy's being annihilated in one place for no reason at all and a piece of matter of the same mass-energy's simultaneously popping into existence elsewhere also for no reason at all. However, a localized mass-energy conservation principle, that says that the amount of mass-energy entering any region of space from an adjoining region during an interval of time is equal to the amount of mass-energy leaving it to an adjoining region, may do better.

However, no conservation-type law will yield a *causal* principle, for conservation-type laws say nothing about causation, as conservation laws are compatible with the hypothesis that there are no causal interconnections between events on different time slices, or that there is a time slice at, say, t_0 across which all dynamical quantities are conserved but no causal influences reach.

But conservation laws together with enough causal laws of the form *every C causes a C** could quite conceivably ground a causal principle about mass-energy configurations. For instance, if we had enough deterministic causal laws of the form *every C causes a C**, then given a mass-energy configuration at time t_0, we could predict the mass-energy configuration at a later time t_1, and the conservation laws might imply that no new mass-energy subconfiguration at t_1 came into existence beyond those that were predicted by the causal laws, and hence no subconfiguration at t_1 is without cause.

Thus, the objector to the PSR might be able to use laws of nature to give a coherent account of the everyday applicability of the PSR. In doing so, she will be taking it that an appropriate version of the CP is nomically necessary but not metaphysically necessary. However, we will soon see that this response does not work on all views of laws of nature.

It fails, for instance, on a plausible Aristotelian understanding of laws of nature as grounded in the powers and capacities of objects. We will in fact see that, on the Aristotelian view of laws, not only is this objection to the argument for the PSR refuted, but a fuller argument for the PSR is made available.

But first we need a general digression about laws of nature.

16.3. LAWS OF NATURE

16.3.1. Humeanism

The most basic dichotomy between views of laws of nature is that between Humean views, on which the laws of nature are merely descriptions of actual states of affairs that obtain, and anti-Humean views, according to which the laws of nature have modal import and describe something over and beyond correlations between actual states of affairs. The best argument against the Humean approach may well be the very one that Aristotle levies against Platonic Forms: Humean laws of nature do not have any causal power and fail to explain anything. That all ravens are black is only explanatorily relevant to the claim that my raven Smitty is black if its force goes beyond the mere description of the color of the ravens in existence. If it is a mere coincidence that all ravens are black, then this accidental generalization fails to explain Smitty's blackness. Indeed, explaining the blackness of Smitty by the blackness of all ravens, when the latter is a mere coincidence, is explaining the obscure by the more obscure – the coincidence of all ravens' being black is more surprising and calls out for explanation more than Smitty's happening to be black.

Admittedly, there are more complex versions of Hume's approach. Thus, David Lewis proposed that laws of nature are the propositions that figure in an account of nature that has the optimal balance of simplicity and informativeness (i.e., deductive strength). A detailed discussion is beyond the scope of this section. However, a quick objection is not out of place. It seems to be a conceptual truth that it is *physically* impossible that the basic laws of nature could have been other than they in fact are, though this may of course be logically possible. Consider now a simple, conceptually possible case. Suppose there is a basic physical law that states that a particular kind of interaction indeterministically has a 50 percent chance of producing an electron with spin up and a 50 percent chance of producing an electron with spin down. It is then *physically* possible that, by coincidence,

this interaction should have *always* produced an electron with spin up: let the event of this coincidence be E. But were that to have occurred, then the assertion that the interaction always produces an electron with spin up would be no more complex than the preceding indeterministic law but would clearly be more informative. Consequently, this assertion would have been a law. But it cannot be that there are *both* a physical law that says that an interaction produces a result with 50 percent probability *and* another physical law that says it always produces that result. Hence, had E occurred, the laws of physics would have been different from what they are. But E is physically possible assuming that the law governing these interactions is indeterministic. This violates the principle that the laws of nature could not physically have been otherwise.

16.3.2. Anti-Humeanism

Let us then part company with Hume on the laws of nature. There is more to something's being a law of nature than its being true of the actual universe. We must, of course, be careful here. Suppose it is indeed a law of nature that all ravens are black. It is reasonable to say then that the law of nature is a proposition, namely, the proposition that all ravens are black. But then, it seems, we are no further ahead than the Humean, because qua proposition, it asserts nothing more than that all ravens happen to be black. However, while the proposition B that all ravens are black merely predicates blackness of the actually existent ravens, the *further* proposition that B is a law of nature says something more than just that B is true.

We can thus partially characterize dissent from the Humean position by saying that there is more to a proposition p's being a law of nature than p's being true and p's having certain *formal* features (such as being universally quantified and involving concepts that are not gerrymandered in some "grue"-some way). There are propositions p that are laws of nature in some possible worlds and yet that are not laws of nature in all possible worlds in which they are true.[2] For instance, in our world that objects fall when dropped is a law of nature, but there is a world where the laws

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2 This need not be true of *all* laws of nature. For instance, some laws of nature might be necessary truths, if they predicate essential properties of their objects. Also, arguably, the proposition that p is a law of nature is itself a law of nature if and only if p is a law of nature, so that the proposition that affirms nomicity of the proposition that all ravens are black is a proposition that is a law of nature in every possible world in which it is true.

of nature do not constrain the movement of falling objects but where the objects *happen* to move just as they do in our world.

Now, recall the truthmaker theory. Every true proposition is true in virtue of its accurately reflecting some aspect of reality, and that aspect of reality is the proposition's "truthmaker." Now, if *p* is a purely categorical proposition that is a law of nature, then we can ask not just what the truthmaker of *p* is, but also what the truthmaker of the proposition *that p is a law of nature* is. This truthmaker must be some aspect of reality. It must thus exist, since the nonexistent cannot be a truthmaker by Parmenides' principle that one cannot talk of what is not.

We need a name for the truthmaker of a true proposition of the form *that p is a law of nature*. The name should not be an abstract noun, because this truthmaker is not an abstract entity or concept, but an actual aspect of our existent universe, whose existence has explanatory prowess. I shall call such a truthmaker a *lawmaker* of *p*, that which makes the true proposition *p* into a law. Of course, just as the "truthmaker" of a proposition need not be a person that makes the proposition true (except in special cases: the truthmaker of "Socrates exists" is a person, namely, Socrates), so too one should not read personhood into the term lawmaker.[3]

The preceding assumes the truthmaker theory, the Parmenidean claim that every truth is true in virtue of what is. However, the argument also works if we assume the Aristotelian or Lewisian theory that true propositions can be made true either by the presence of a positive reality or by the absence of one. For it is implausible to suppose that what makes the proposition *that p is a law* be true is its lacking a falsemaker, or its being logically composed of propositions some of which lack a falsemaker, since the claim that *p* is a law seems clearly positive. Thus, still, I maintain that there will have to be some positive reality.

It is generally accepted that laws of nature are not causes, because laws are mere propositions and propositions have no causal efficacy. However, there are contexts in which one wants to use causal language about laws of nature. One may want to say, "The law of gravitation made this apple fall." Since the law of gravitation is a mere proposition, it cannot make anything

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3 On certain views of laws of nature, some or all lawmakers will turn out to be persons or aspects of persons. For instance, a Richard Swinburne (1968) might allow that a proposition's being a law of nature is constituted by God's directly willing it to be such, so that the lawmaker of the proposition is the will of God. Or if one thinks that ultimately all natural lawfulness supervenes on dispositional properties of substances, and if persons are substances, then the dispositional properties of persons will be lawmakers, though there will also be lawmakers that are the dispositional properties of nonpersons.

fall. But what *does* make apples fall, given appropriate initial conditions, is the lawmaker of the proposition that the law of gravitation holds. For, the explanatory relation among the proposition that $F = Gm_1m_2/r^2$ (the formula, of course, abbreviates a more complicated statement that gives the definitions of all the symbols), the proposition reporting the initial conditions, and the proposition reporting the fall of an apple mirrors a logically contingent, objective, ternary relation in nature among the lawmaker of the proposition that $F = Gm_1m_2/r^2$, the dropping of the apple, and the falling of the apple. Otherwise the law will not be objectively explanatory.

If the explanatory relation among a law-reporting proposition, an initial fact-reporting proposition, and a final fact-reporting proposition failed to mirror some kind of extramental relation in nature between the lawmaker and truthmakers, respectively, of the respective propositions, then explanatory relations would lack objectivity. But the search for explanations is a search for objective truths. Given that generally speaking we are willing to say that a relation of *causality* between events *A* and *B* is parallel to a relation of *explanation* among the propositions reporting that *A* and that *B* happened, the relation between the lawmaker of the law of gravitation, the initial conditions, and the fall of the apple is one that we can also call "causal" in an extended sense. Thus, nomological explanatory relations can be said to parallel causal relations between lawmakers and truthmakers.

So the laws of nature are not causes, but their lawmakers can be meaningfully said to have causal efficacy or causal relevance. And there must *be* lawmakers if the laws of nature are not to be Humean and if every true proposition must have a truthmaker or if Lewis's more general truthmaker/falsemaker theory holds. What I have said so far is, however, neutral between various concrete anti-Humean accounts of laws of nature. Indeed, these accounts can be seen as being nothing else than different substantive accounts of what the lawmakers are. If one thinks that the laws of nature can be reduced ontologically to the dispositional properties of substances, as an Aristotelian does, then the lawmakers will ultimately be nothing but the possession of these dispositional properties. If one thinks that a theory of physics is true on which ultimately it is space-time that moves particles around, then space-time or its properties will be the lawmaker or lawmakers. If one thinks that the idea of a law of nature is primitive, then there will be no reductive account of a lawmaker beyond saying that it is "the truthmaker of a proposition reporting that some other proposition is a law of nature."

Admittedly, this is not the only way of looking at the matter. One might instead make the concept of *natural necessity*[4] be primitive. If one accepts the truthmaker (or truthmaker/falsemaker) theory, then the natural necessity will have to be grounded in something, a lawmaker. However, one might be hesitant in saying that this lawmaker *causes* things to obey the natural necessities. But if the lawmaker does not cause things to obey the natural necessities, then it is not clear *why* things obey them. This may seem to be a question-begging objection in the middle of an argument for the PSR, but it is not. The main reason for positing laws of nature is to explain why things behave as they do. If it is completely obscure why things obey the laws of nature, if we have not been able to say anything about the connection between the lawmakers and the lawful events, then by stating the laws of nature we have not explained the events. It would be as if we said Jones's death is explained by Smith's pressing the trigger without anything's being said about any causal or other connection between the pressing of the trigger and Jones's death.

The defender of the natural necessity approach can say that natural necessity should be understood as analogous to metaphysical necessity. It is a category mistake to think there is some entity that causes it to be the case that $2 + 2 = 4$, and likewise it is a category mistake to think there is some entity that causes stones to fall toward the massive Earth when dropped. Both happen because of a necessity, a different necessity in the two cases, and yet their happening does not require any explanation of causal type.

However, the analogy here is mistaken. We know that the falling of a stone indeed can be explained scientifically. Were this not so, then inference to best explanation could never get off the ground since the case of invoking gravity to explain the falling of stones is as clear a case of explanation as anything in science, and one might very plausibly think that inference to best explanation is at least a *part* of the epistemology of science. Moreover, the primary nonpractical motivator for science is precisely the search for explanation. On the other hand, the notion of the explanation of metaphysically necessary truths is one that we do not have a good handle on. Is the proposition that $2 + 2 = 4$ to be explained by showing via associativity that $(1 + 1) + (1 + 1) = (1 + 1) + 1) + 1$, with 2 being defined as $1 + 1$ and 4 as $((1 + 1) + 1) + 1$? Or is it

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4   E.g., Leckey and Bigelow (1995).

perhaps a self-evident arithmetical claim? Or should we choose some other set of foundations for arithmetic? In general, are all mathematical proofs explanatory? Are only some, and if so, which ones? These are all questions to which we do not have answers, but they suggest that explanation in the sphere of the metaphysically necessary might be a very different thing from explanation in the sphere of the physically necessary, and hence provide a disanalogy between the two cases. One might even say that in the case of the physically necessary we seek *explanations* while in the case of the metaphysically necessary we seek *elucidations* and *understanding*.

It is a criterion of adequacy on a theory of laws of nature that it should make comprehensible why subsumption of a physically necessary connection of events, say, a stone's being dropped and its falling, under a law *explains* that connection. Unless one were willing to erase the distinction between the metaphysically and nomically necessary – and doing so would undercut the current objection to the metaphysical necessity of the PSR – and unless one is willing to be a Humean, it seems that some causal connection needs to be posited between lawmakers and events. Otherwise, it is quite unclear how the nomicity of the laws, that is, the existence of lawmakers, is supposed to be explanatory of the events.

16.4. LAWS OF NATURE AND THE CP

16.4.1. Why Are There No Everyday Violations?

Let us return to the question of why everyday violations of the PSR or CP do not happen. Suppose we grant that the CP is not metaphysically necessary. Then why do violations of the CP not happen? Presumably, since ex hypothesi they metaphysically could happen, the answer has to have something to do either with its being objectively unlikely that they should happen or with the contingent laws of nature or perhaps boundary conditions operative in our world. The objective unlikelihood, unless it is grounded in the laws of nature the way quantum probabilities are, is most obscure. For any one decently behaved possible world at which laws of nature just like those of our world hold and the CP holds in everyday contexts, there are infinitely many possible worlds where the CP does not hold. A universe is a maximal aggregate of physical entities. Call a universe that obeys our laws of physics and has the CP holding in everyday contexts a *regular universe.*

In fact, there are infinitely many more irregular universes. To see this, let S be the set of regular universes. The set S is infinite. But it is

nonetheless a *set* of some fixed cardinality. This point is not trivial, since the collection of all possible universes is not a set.[5] However, *S is* a set, because the rules or laws in accordance with which the good physical behavior of the world is defined specify the *set* of all possible continuants for any given world at any given time, for these rules specify what kinds of possible entities can come to be present in the world and how many of them can come in and when. The possibility of such specification is, I take it, analytically contained in the notion of a *regular universe*.

To make this point clearer, suppose that the kind of regularity that the world has is that which some kind of quantum field theory posits. Then, the field theory posits that the basic entities in a regular continuant will be several kinds of fields governed by certain equations. Now, a field can be represented as a function from some fixed set A to some fixed set B (e.g., a scalar field on a four-dimensional Euclidean space-time can be represented as a function from $\mathbf{R}^4$ to $\mathbf{R}$, where $\mathbf{R}$ is the set of all real numbers). The collection of *all* functions from A to B is a set denoted by B^A whose cardinality can be computed if the cardinalities of A and B are known (in the case of scalar fields on a four-dimensional Euclidean space-time, the cardinality of the set of functions from $\mathbf{R}^4$ to $\mathbf{R}$ is a cardinality known as $\mathfrak{f}$ that is bigger than the cardinality $\mathfrak{c}$ of the continuum). Or suppose that the kind of regularity that the universe enjoys is such as to imply, among other things, that the universe is composed of up to n (a finite or infinite number) particles, which arise from k (a finite or infinite number) different kinds, each of which kinds of particles has at most p (a finite or infinite number) different properties that can each be described by real numbers (the properties might be, e.g., charge or coordinate components of the position). Then, the set of regular universes will have cardinality at most $\mathfrak{c}^{n \times k \times p}$, where $\mathfrak{c}$ is as before the cardinality of the continuum. And even if a universe is only regular *in some aspect* or *in some region*, we will still be able to run the argument I am about to give, but this time concerning not universes as wholes, but those aspects or regions of universes in which there is regularity. Instead of kinds of *universes*, we will then be talking of kinds of *aspects or regions of universes* and counting these. Working out the details in this extension of the argument is left as an exercise to the reader.

Now, assume the Axiom of Choice. Let a denote the cardinality of S. Let n be any infinite cardinality greater than a, for example, 2^a (the

5   This is shown in Pruss (2001) for possible worlds, but the same argument applies to possible universes.

cardinality of the set of all subsets of S, which Cantor's diagonal argument has shown to be greater than the cardinality of S). We will let U be a set of possible universes in which tomorrow the Earth and Sun disappear counternomically for a day* and are replaced, for no cause at all, by a big cloud of photons all dancing the polka, with the number of these photons having some value between $\aleph_0$ (the cardinality of the set of integers), inclusive, and the $(n + 1)$st infinite cardinal number[6] $\aleph_n$, exclusive, which photons then disappear, the Earth and Sun return, and everything returns to normal nomic order the day after. The number of different cardinalities m satisfying $\aleph_0 \leq m < \aleph_n$ is equal to n, and so we can choose the worlds in U so that U will have cardinality at least n and hence greater than a. Moreover, since n is an *infinite* cardinality, it must be that n is *infinitely many times greater* than a.

Thus, indeed, there are a lot more of the everyday-CP-violating universes that otherwise obey the laws of physics than there are everyday-CP-obeying universes, if the violation of the CP is metaphysically possible.[7] Thus, we are unlikely to be able to say that everyday obedience to the CP is objectively probable, unless this probability can in some way be grounded in the laws.

So we are back to where we were. If the everyday violation of the CP is metaphysically possible, then it must be the laws that explain why it is not in fact violated. Should it be countered that this lack of violation is just a brute fact, one that is not itself explained, and that it is question begging to assume otherwise in an argument for the PSR, the following response can be made. The preceding argument shows that there is a presumption that the high degree of everyday obedience to the CP we observe is a very unlikely state of affairs. Even if one were willing to tolerate brute facts, a theory's positing of a very unlikely brute fact that can be specified a priori in a concise way ("the CP is satisfied") is a strong consideration against

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6   The existence of such a cardinal follows from the Axiom of Choice. For the technically minded reader, we prove this in the nomenclature of Kuratowski and Mostowski (1976): The number n is the cardinality of a set S. Then as S is well-orderable by the Axiom of Choice (p. 254, Theorem 1), we can find an initial ordinal ω_n (often also denoted $\aleph_n$) with index equal to the cardinality n of W (p. 273, Theorem 5). By definition of the index, it follows that there are precisely n infinite initial ordinals less than ω_n (p. 273, Definition 1); that is, there are precisely n cardinalities between $\aleph_0$ (inclusive) and ω_n (exclusive). We can then let $n^* = \omega_n$. (*Note:* Throughout their p. 273, Kuratowski and Mostowki talk of "initial ordinals," where, to be strictly precise, they mean "infinite initial ordinals.")

7   For arguments of this sort in the related context of Lewis's extreme modal realism, see Forrest and Armstrong (1984), Lewis (1986, Section 2.5), Pruss (2001), and Section 19.3.2.

that theory.[8] We should in fact say that on the theory that it is just a brute fact whether the CP holds in everyday contexts, the observed high degree to which the CP holds of macroscopic events is a most surprising fact, whereas on the theory that the CP is metaphysically necessary, this fact is much less surprising (though we might reasonably still be surprised that the causes are so often observable). Thus, we have very strong evidence against the brute-fact theory of the CP's holding in everyday contexts, and should opt for the alternative.

The brute-fact and unlikely-but-random accounts dismissed, we now need to consider whether the CP, even in a restricted form, could in fact be grounded in the contingent laws of nature. As we shall see, on the preceding lawmaker account of laws the answer is negative.

16.4.2. Ceteris Paribus Laws and the CP

On a lawmaker account, as long as there is more than one lawmaker influencing, say, motion, it is very natural to think of the laws of nature as all holding ceteris paribus. Perhaps one lawmaker brings it about, ceteris paribus, that items dropped fall, while another brings it about that items magnetically repelled from the ground, ceteris paribus, move upward. Now, if we follow the Humean denial of the metaphysical necessity of the CP, then we will have to admit that whatever a lawmaker can do can also happen in a brute manner, without any cause. A rock can fall under

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8   The notion of a fact that can be specified a priori in a concise way is an intuitive notion. For instance, we will use this notion when we say, upon hearing of a run of a thousand heads in a coin-tossing experiment, that surely there was something fishy. Even though the run of a thousand heads has exactly the same probability as any other sequence of a thousand outcomes, namely, probability 2^{-1000}, the run of a thousand heads could be concisely specified ahead of time, unlike most of the alternatives. There is no successful way of making this notion precise right now, though Dembski (1998, 2002) has made valiant attempts. A basic difficulty, for instance, is that the notion of a specification is language relative, and we need to avoid languages that are gerrymandered to specify precisely the description we are after. Thus, supposing that a given seemingly random run of a thousand tosses of a coin has occurred, a language might in fact be gerrymandered to include the adjective *jabberwockian*, which describes precisely *that* sequence of coin toss results, so that the run could be specified briefly: "A jabberwockian run has occurred." One needs to rule out such gerrymandering. This is most difficult in the case in which the phenomena to be specified (Dembski [2002] is concerned with things like life) are ones that were observed prior to and during the development of our language. Unfortunately, the CP is also this kind of a phenomenon, and this means that the argument must be run on an intuitive level only, at least right now. (Note, however, that we would just as much think fishy a run of a thousand heads that occurred when the English language was being formed: we *can* perhaps proceed intuitively in these matters with the help of such counterfactuals.)

the influence of gravity *or* it can just move this way or that for no reason. Now, just as the gravitational impulse can be countered by an opposed magnetic impulse, it is plausible that the gravitational impulse could be countered by a brute uncaused "impulse" in a direction opposite to that of the gravitational impulse. If we say that the lawmaker of the law of gravity is by itself sufficient to bring about the downward movement, and hence when the lawmaker is present the movement cannot fail to occur, then we have contradicted the fact that the law of gravitation holds merely ceteris paribus.

Of course, we might say that when we claim that we have a ceteris paribus law, we do not mean that the law operates "in the absence of a countervailing brute impulse" but "in the absence of a countervailing cause." Moreover, one might wonder about the very conceptual possibility of a brute "impulse," since an impulse is by definition that which a force produces, and hence is caused by the force, and since furthermore one might worry that there just is no concept of an "impulse" in present-day physics.

But these objections miss the point. The point is: What is it that makes it be the case that when the lawmaker is present and no other forces or laws are relevant, the lawlike behavior must occur, on the assumption that (at least in everyday contexts) it is at least nomically necessary that the behavior occur then? If we say that the lawmaker *necessitates* this behavior to occur, then we no longer have a ceteris paribus law. The metaphysical necessity of the CP would allow, however, for this question to be answered as follows: The nonoccurrence of the behavior, in the presence of the lawmaker and the absence of other causes, would itself be a causeless event and hence a violation of the CP. If we have the CP's being metaphysically necessary, then indeed the issue is clear: Events can only occur for causes, and so the causeless event of the lawlike behavior's nonoccurrence cannot occur.

The preceding argument relies on the idea that there is more than one lawmaker influencing, say, the motion of a particle – that there is not one unified law, with a single lawmaker, that governs all the motion of our particle. Moreover, it is assumed that we cannot consider the conjunction of all the laws to be something that itself does not hold mere ceteris paribus. But even if there were a unified law or conjunction of laws, it might well be conceptually possible to think of this law as ceteris paribus. Were there other influences, other lawmakers – ex hypothesi, there are not – quite possibly this lawmaker would not suffice to produce the effects. If we accept this, the argument becomes more general.

A different way to run the argument is to focus on the version of the CP that talks of the impossibility of object's coming into existence for no cause. Consider a large vacuum container. Why is it that we will not observe a brick or a stone or some other massive object's popping into existence in this container? One might start to answer this question by saying that quantum mechanics, while allowing for objects to pop into existence, makes it a very unlikely event when the object is massive. However, this, again, misses the point of the question. The lawmakers of the laws of quantum mechanics provide causes for object's popping into existence – though not *ex nihilo*, because in the presence of those lawmakers, which are not nothing. But in what way can something cause it to be the case that something does *not* brutely pop into existence? How can an *ex nihilo* popping into existence be causally prevented? We cannot prevent it in our usual way by preventing the cause from occurring or succeeding, since there is supposed to be no cause.

16.4.3. Essence and Existence

Here is yet another form of the argument. A brick has both essence and existence. On a Fregean analysis of this, the existence is a property of the essence, in the sense that for the brick to exist is for its essence to have the property of *being instantiated*. Consider the essence of a possible brick that could exist in a vacuum container. How do the lawmakers of the laws of quantum mechanics, or any other lawmakers, prevent this essence from, for no reason at all, gaining the property of *being instantiated*? After all, presumably, these lawmakers do not act on uninstantiated essences: they act, instead, on concrete existing things, transforming some into others.

One possible answer to the question is to say that the way the popping into existence of the brick is prevented is by the law-enforced presence in that place of something incompatible with the brick's presence. Vacuum is, on this view, not the complete absence of stuff. Perhaps, at least, empty space-time is there, and the presence of empty space-time is incompatible with the brick's presence there, while the lawmakers of the laws of nature continually bring it about that the empty space-time persists as it is. This answer, however, will not work if all laws are unavoidably ceteris paribus, because then the laws will not be sufficient to bring it about that empty space-time remains as it is, and so it will be incomprehensible how they guard against brute poppings-into-existence.

And there are arguments to be made in favor of all laws' being ceteris paribus. Besides the well-known arguments of Nancy Cartwright (1999),

one might add another one, at least for someone who thinks that something like theism is logically possible, for, arguably, it is logically possible that, whatever lawmakers actually exist, there might coexist with them a very powerful supernatural being capable of overriding them. If so, then the laws are ceteris paribus: they function in the absence of the influence of a logically possible supernatural being.

16.4.4. The Probability of Violations of the PSR

A useful intermediate conclusion result that I will argue for now is this:

(125) If the PSR is not metaphysically necessary, then either it is objectively highly probable that the PSR is violated in many ways, or there are no objective, nonepistemic, nonfrequentist probabilities of specific events that would be violations of the PSR.

For now I will assume all objective probabilities are nonepistemic and so drop the "nonepistemic" qualifier. An "objective" Bayesian approach will be discussed in Section 17.4.2.g.

Now, frequentism is not a viable option because after all it *is* possible for coins to have come up heads in all the finitely many tosses that have in fact occurred, even though the probability of coming up heads is not 1. By an event with a *nonexistent objective probability*, I do not mean an event that has 0 objective probability. Rather, I mean an event about whose objective likelihood it makes no sense to talk. There may well be contingent events that have no objective probabilities. For instance, if there is a God, then it might be that God's freedom is so radical that there are no objective probabilities to be, even in principle, assigned to different possible cosmoi that God could create, and if there is no God, then it might well be that no objective probability could be assigned even in principle to the Big Bang.

We might convince ourselves on the grounds of there being more possible worlds with lots of violations of the PSR than those with no violations of the PSR that violations of the PSR are objectively *probable*, if we take probability in terms of world- or universe-counting in some intuitive sense, albeit it is known that this is a sense that is very difficult to quantify. Otherwise, we have to say that there is no objective probability of any possible violation of the PSR, for the only other way there could be such an objective probability would be if these probabilities would be generated by the laws of nature and this would make specific violations of the PSR be law-governed events. But if we understand law-governed

events as ones arising from the causality of substances and/or lawmakers, and if we accept the thesis at the heart of the rejection of the free-will and quantum objections to the PSR, namely, that causation always gives rise to an explanation, we have to conclude that specific events violating the PSR cannot arise from any kind of causality and hence cannot have objective probabilities assignable nomically.

We can in fact reject the first disjunct in the conclusion of (125), since we do not in fact observe lots of widespread violations of the PSR, and hence that disjunct is empirically disproved. Given the implausibility of frequentist accounts of probability, it follows that

(126) If the PSR is not metaphysically necessary, then there are no objective probabilities of specific events that would be violations of the PSR.

This undercuts *all* objective nomic probability assignments if the preceding arguments are correct about there always being possibilities of violations of laws given the negation of the metaphysical necessity of the PSR. For suppose that we have an objective probability of some event E's occurring in a law-governed way given the laws. Then

(127) P(E occurs) = P(E occurs in a law-governed way | laws are obeyed)P(laws are obeyed) + P(E occurs for no reason at all or for some anomic reason | laws are not obeyed)P(laws are not obeyed).

Of course, we must understand the laws that are not obeyed here as ceteris paribus ones, rather than as universally true propositions. The preceding sum then involves two terms, the first of which presumably has an objective value, while the second does not. Hence the sum also does not have an objective value.[9]

The preceding arguments become particularly clear if we understand the laws in an Aristotelian way. We have a plurality of finite substances in the universe, each with its own dispositions, capacities, powers, and characteristic forms of behavior. The substances interact in various ways, for instance, through gravitational attraction or electrical repulsion. No finite substance is sufficiently powerful to be able to overcome all actual

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9 The sum $A = B + C$ where B has objective value and C does not cannot itself have objective value, for if it did have it, then so would C as $C = A - B$. On the other hand, it is possible to imagine a sum in which neither summand has objective value but the sum does. For instance, suppose D has no objective value. Then, neither does $-D$. But the *sum* of D and $-D$ might count as having objective value 0.

and possible opposition. Now on this view, it is indeed incomprehensible how a finite substance or set of finite substances is capable of preventing the popping into existence of something new.

Moreover, one might think that anything that can pop into existence for no cause can also causelessly pop out of existence. If substances can pop into existence causelessly, then the fact that finite substances do not in fact willy-nilly pop out of existence cannot be grounded in the powers, capacities, and characteristic behaviors of finite substances.

16.4.5. Would a "Deity" Help?

The Aristotelian can, however, posit a more powerful substance that sustains in existence all existing substances and holds sway over empty regions of space to ensure that they are empty in the absence of causes. Such a substance would be a sort of deity. It is not clear whether any substance could do this if it were not itself sufficiently similar to the God of Western monotheism. Plausibly, the only way a substance could sustain in existence other substances and prevent the causeless popping into existence of new substances is if it were such as to be itself the source of being, that by virtue of participation in which all the other substances exist and apart from which no substance can exist or pop into existence. It is plausible, further, that any such substance, since it would be the source of being, would have to exist either necessarily or at least quasi-necessarily, where a being exists *quasi-necessarily* provided it exists in every nonempty world: it would be strange if the fount of being did not have quasi-necessity, at least, since that would mean that it is a mere accident that it, rather than something else, is the fount of being. This would be sufficient to guarantee the truth of the version of the CP that says that substances cannot come into existence *ex nihilo*, for in every nonempty world, then, substances would come into existence only under the influence or sway of that deiform substance.

More generally, an Aristotelian system of ceteris paribus laws arising out of the dispositions, powers, and characteristic behaviors of finite substances can only work if the CP is assumed, for only if one could rule out the possibility of lawless brute behavior not grounded in these dispositions, powers, and characteristic behaviors could any concrete predictions be made even if one knew all of the ceteris paribus laws. The lawmakers, that is, the dispositions, powers, and characteristic behaviors of substances, are such that each is incapable on its own of logically necessitating any one result. Taken all together, they also are incapable of logically necessitating

a result. After all, were a new substance to pop into existence, it could override their activity. This makes it plausible that the only way behavior not arising from the activities of the substances, that is, unlawful behavior, could be ruled out would be either through the efficacy of a deiform substance or through an appropriate CP's being metaphysically necessary – or both, since one might take the CP to imply the existence of a God.

16.4.6. Causelessly Ceasing to Be

Finally, observe a simple way in which a failure of the cosmic CP might lead to scientifically unacceptable results. Suppose we accept the parity thesis that a contingent being that can causelessly come to be can also causelessly cease to be. If we think that the universe as a whole causelessly came to be, say, in the Big Bang, then we must likewise suppose it can causelessly cease to be. Now, the coming-to-be of the universe was on this view a causeless event not governed by laws of nature, for if it were governed by laws of nature, then we could say that the universe was caused by the lawmakers of the laws, even if the causal connection here were indeterministic (cf. the discussion of quantum mechanics in Chapter 8). Understanding the causelessness in the parity thesis in the same way, we will have to allow that the universe as a whole can also cease to exist, in a way that is not governed by scientific laws.

But this yields a defeater to scientific predictions of the future fate of the universe: notwithstanding whatever the scientific theories say, the universe could cease to exist, in a way not governed by law. The possibility of the universe's just popping out of existence is a possibility that needs to be taken seriously, because it is a possibility precisely parallel to something that, on the theory under consideration, has in fact happened – the universe has popped into existence. While not just any logical possibility of an outré event needs to be considered, when an event of the same sort *has* occurred and one has no justified way to attribute a low probability to the event's recurring, then the canons of reason – even of inductive reason – require one to take the possibility seriously. And indeed nothing can be said of the probability of the universe's popping out of existence, since this popping out of existence is not supposed to happen in concert with the laws of nature.

Observe that this argument can be run apart from the Aristotelian account of laws of nature or the more general lawmaker account. It can be run even from a Humean point of view. But once one uses an account of laws other than that considered earlier, then the following response

becomes available: "The parity thesis is false, for the universe's popping into existence at the beginning of time is, while not governed by law, not contrary to any law of nature. But the universe's popping out of existence would in fact be contrary to the laws of nature." The point is that on the more Aristotelian view, laws are of a ceteris paribus sort. But on other views, exceptions might be impossible and there might be no ceteris paribus clauses. However, let us consider the whole of the evidence available to us before we decide what counts as a law. Part of our evidence is that, ex hypothesi, the universe has popped into existence. Let us suppose that this is an event to which no available well-confirmed scientific theory can assign objective probabilities. Nonetheless, it is something we should work into our views. If we accept an intuitive parity between popping into existence and popping out of existence, then by the same token we should leave room in our laws for the universe to cease to exist. Thus, our causal laws should be of the form, *State A at t is followed by state B at* $t + \Delta t$ *provided that the universe still exists at* $t + \Delta t$. We have no reason to dismiss the possibility of the universe's causelessly ceasing to exist if we do not accept a CP.

16.4.7. Induction

Consider a final objection. We know *inductively* that there are causes of macroscopic phenomena, simply by virtue of having found causes in the cases of many macroscopic phenomena. There are at least three problems with this answer.

The first is the worry that many of the inductive data may be neutral with respect to the PSR or may presuppose it. For instance, yes, we have an explanation of the patterns shown on cathode-ray tubes: an explanation in terms of electrons. But we have not actually seen the electrons. We infer their existence as the best *explanation* of this and other phenomena, arguably only because we *assume* that there is an explanation – or so it shall be argued in the next chapter. Now, consider the following two hypotheses:

(128) The PSR is true of macroscopic phenomena, and
(129) There are always good *putative* explanations of macroscopic phe-
       nomena, that is, propositions compatible with the phenomena that
       would explain them well were they true.

Cases like those of electrons only support (128) by supporting (129). However, there will be cases of inductive data that *do* support the PSR.

Sometimes we will in fact be in a position to see that in fact there is an explanation.

But this takes us to the second objection. We do not in fact *always* find explanations for phenomena. We may never know why Sextus Empiricus died or why the San Francisco earthquake of 1906 occurred in 1906 rather than 1905, however hard we might search for the explanation – though no one wants to claim, at least in the case of Sextus Empiricus's death, that there was no cause. It might be optimistically claimed that in the case of phenomena that we collectively put our mind to and that do not slip further and further from what is epistemically accessible to us, as particular historical events do, we do eventually come up with an explanation.

But it is not clear that such confidence is in fact justified historically. For instance, we have searched for centuries for the origins of life. We do have accounts of abiogenesis, but these are mere theories, for none of which do we have independent evidence. The most that can be said for these accounts is that *if* the origin of life has an explanation and *if* the explanation is naturalistic, then likely some account like one of these is true. And we do have theistic accounts, but of course theism entails a form of the PSR, since if there is a God, his activity together with that of any free creatures explains everything, at least as long as God's existence counts as self-explanatory because it is necessary. Likewise, we have a number of theories of what triggers rain, but none of the theories is sufficiently dominant for us to say with any confidence why rain happens when it does.

Of course, one might come up with a story about why these kinds of unsolved problems are particularly hard ones, concerning the distant past or very complex phenomena. And one might in fact claim, confidently, that any cases in which our concerted efforts at finding an explanation have been thwarted will turn out not to be disconfirmatory of the PSR understood as inductively supported, but will turn out to be cases in which we can explain why our doxastic faculties are simply too limited for us to be able to handle the problem or why the problem is very complex. This confidence is highly plausible, but its justification rests on a priori considerations rather than induction.

A third but most controversial consideration against the inductive justification of the PSR is that violations of the PSR would not be law-governed phenomena. Inductive reasoning, however, presupposes that we are operating within a law–governed realm, and hence cannot itself justify this presupposition. A thought experiment: Suppose you came upon a bunch of one hundred oysters and found after opening thirty of

the oysters that each contained a pearl. You might justifiably conclude that they *all* contain pearls. However, suppose you further learned that in fact whether a given oyster produces a pearl is an anomic phenomenon, one with no explanation and one to which objectively no probabilities can be assigned. I would suggest that such information would make one conclude that in fact it was just a coincidence that the thirty oysters contained pearls, and hence that one cannot justifiably claim that the others would as well.

In fact one might even hold, with Bede Rundle (1986), that induction itself depends on the PSR, and then that dependence would be an argument for the PSR.

> So long as relevant conditions match those when our actions have had such results [say, as the door opening when the key is turned] previously, we anticipate them following yet again. . . .
>
> [P]art of what is at work here is a principle of sufficient reason: a departure from an observed regularity means that conditions were different on this occasion. (Rundle, 1986, p. 120, 121)

One difficulty with this argument is that we have seen that if the PSR is not to lead to fatalism, we must accept cases in which the same conditions end up with different results – for instances, cases of libertarian free will or quantum indeterminism. However, the basic point here stands. It is quite plausible to see the pattern in simple induction as starting with a claim that there is an explanation for the inductive data. Then, we try to fill out the explanation, though perhaps only to a very vague extent, for instance, "There is something *deterministic* in virtue of which all *A*s are *B*s." And then from this explanation we conclude that the next *A* will be a *B*, unless the conditions differ in that that "something" is no longer present. This suggestion leads us into our next topic.