

laws & lawmakers

Science,
Metaphysics,
and the
Laws of Nature

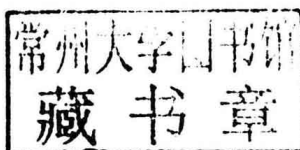
MARC LANGE



Laws and Lawmakers

Science, Metaphysics, and the Laws of Nature

Marc Lange



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Laws and Lawmakers

For Dina

The beauty of electricity, or of any other force,
is not that the power is mysterious and
unexpected, touching every sense at unawares
in turn, but that it is under *law* . . .

—Michael Faraday (1858: 560)

We need scarcely add that the contemplation
in natural science of a wider domain than
the actual leads to a far better understanding
of the actual.

—Arthur Eddington (1928: 266–67)

Preface

This book aims to answer two kinds of perennial philosophical questions about laws of nature:

1. *Questions about how laws differ from facts that do not qualify as laws*, such as the fact that the Andromeda galaxy is about 2.5 million light-years from Earth and the fact that each of the families living on my block has two children. Philosophers generally call these non-laws “accidents.” These questions, then, concern the various respects in which laws differ from accidents—not merely how the *actual* laws and accidents differ, but how the laws would differ from the accidents no matter what particular laws and accidents there were. The topic is *lawhood*: the status of being a law rather than an accident. In what ways must the facts possessing lawhood differ from the facts lacking it?
2. *Questions about how the various differences between laws and accidents are to be explained*. Which of these differences are responsible for which others? Is there a *fundamental* difference between laws and accidents that ultimately accounts for all of the other respects in which they differ? What are the *lawmakers*: the facts in virtue of which the laws *are* laws rather than accidents?

Here, in summary, are the answers I shall give.

It has long been recognized that laws of nature differ from accidents by standing in a more intimate relation to “subjunctive facts”: facts about what would happen under certain circumstances that may not actually come to pass. Appropriately, circumstances that do not arise are called “counterfactual” circumstances. A sentence concerning what would have happened under some counterfactual circumstance—such as “If I had gone shopping, then I would have bought a quart of milk”—is called a “counterfactual conditional” (or “counterfactual,” for short). To begin to see how laws differ from accidents in their relation to counterfactuals, consider this example: Had Jones missed his bus to work this

morning, then the actual laws of nature would all still have held, but some of the facts that are actually accidents (such as Jones's perfect on-time attendance record at work) would not still have held.

This approach to distinguishing laws from accidents, though illuminating, threatens to become disappointingly circular: the laws, unlike the accidents, would still have held under any counterfactual circumstance *that is logically consistent with the laws*. For instance, the laws are logically consistent with Jones's missing his bus to work this morning but not with Jones's accelerating to beyond the speed of light (since a law prohibits bodies from doing that). Accordingly, the laws would still have held even if Jones had missed his bus to work this morning, but not if Jones had accelerated to beyond the speed of light. Thus, to see how laws stand out from accidents by displaying greater persistence under counterfactual circumstances, we must begin by restricting our attention to those circumstances that are logically consistent with the laws. To make the laws stand out, we must first put the laws in!

This circularity may appear unavoidable. However, I will explain how to avoid it—and thus show how the subjunctive facts suffice to determine the laws. I will then bravely propose that the subjunctive facts *are* the lawmakers.

Instead of becoming entitled to offer this proposal by first critiquing every rival proposal that has been made, I will get right to the juicy part. In chapter 1, I will explain my solution to the circularity problem that I mentioned above. During the succeeding three chapters, I will occasionally look at the competing pictures of natural law offered by David Armstrong, Brian Ellis, and David Lewis—but mainly in the service of giving a crisp presentation of my own account and the arguments for it.

Here are some “coming attractions.”

Chapter 1: Laws Form Counterfactually Stable Sets

In the first chapter, I argue that a few sets of truths possess a remarkable kind of invariance under counterfactual circumstances—an invariance that I call “stability.” Roughly speaking, a set of truths is “stable” exactly when its members would all still have been true under any counterfactual

circumstance that is logically consistent with their all being true. The set containing all and only the laws is a stable set. For example, the set of laws is logically consistent with Jones's missing his bus to work this morning, so the laws' stability requires that the laws would all still have been true if Jones had missed his bus to work this morning. In contrast, no set containing accidents is stable (unless, perhaps, it contains all truths). For example, take the set containing just the logical consequences of the truth that Jones always arrives at work on time. It is "unstable": it is logically consistent with the supposition that Jones missed his bus to work this morning, but its members would not all still have been true under that supposition.

The rest of this book springs entirely from this proposal (so it had better be mostly right!). It suggests a way to capture the laws' hierarchical structure: that certain laws transcend the idiosyncrasies of others in that they would still have held even if those others had been different. (For example, in classical physics, perhaps the laws of momentum, mass, and energy conservation are more general than the laws governing specific forces: energy would still have been conserved even if there had been different forces instead of gravity, electromagnetism, and so forth.) This proposal regarding the laws' characteristic relation to counterfactuals also has the welcome consequence that had Jones missed his bus to work this morning, the actual laws would not only still have been true, but also still have been laws.

Chapter 2: Natural Necessity

In chapter 2, I use ideas from chapter 1 to explain what makes laws necessary (sharply setting them apart from accidents), but not as necessary as "broadly logical" truths (such as conceptual, mathematical, metaphysical, and [narrowly] logical truths). Laws of nature have traditionally been thought to possess a distinctive species of necessity (dubbed "natural" necessity). For example, take the fact that any two positive (or negative) electric charges repel each other. Because this regularity holds as a matter of natural law, it is inevitable, unavoidable—necessary. An exception to it is (naturally) impossible. Any two like charges not only as a matter of fact *do* repel each other—they *must*. Yet the laws are also thought to be contingent truths; unlike the broadly

logical truths, the laws of nature could have been different from the way they actually are.

The laws' apparent status as "contingent necessities" has often been considered paradoxical. Consequently, some philosophers ("scientific essentialists," such as Brian Ellis) have rejected the laws' contingency; they characterize laws as possessing the same strong variety of necessity as broadly logical truths do. Other philosophers ("Humeans," such as David Lewis), in contrast, have downplayed the laws' necessity, arguing that no profound metaphysical gap separates laws from accidents. In this chapter, I aim to do justice not only to the laws' necessity (by which they are distinguished from accidents), but also to their contingency (by which they are distinguished from broadly logical truths). I show how genuine varieties of necessity (such as logical necessity and natural necessity) are distinguished from mere "conversational" or "relative" necessities (as when Jones says, "I must be going now; I have to catch my bus to work"). By using the concept of "stability," I propose unpacking every genuine variety of necessity in terms of subjunctive facts. The varieties of necessity (logical, natural, and so forth) can then be understood as distinct species of the same genus. My proposal explains not only what makes natural necessity weaker than other genuine varieties of necessity, but also why all such necessities must stand in a definite ranking by strength in the first place.

Chapter 3: Three Payoffs of My Account

In chapter 3, I display three additional fruits of the account given in the previous chapters.

1. I explain what it would be for the laws to change (that is, for there to be temporary laws, as distinct from eternal but time-dependent laws). I argue that my account nicely explains why natural laws are immutable.
2. I consider how symmetry principles in physics may constitute "meta-laws"—that is, laws governing the laws governing what happens. I argue that the concept of "stability" can be used to elaborate the notion of a "meta-law" so that the meta-laws' relation to the laws they govern (the "first-order laws")

mirrors the first-order laws' relation to the facts they govern. This approach accounts for the meta-laws' modal status and the explanatory power commonly attributed to them, such as the capacity of symmetry principles to explain why various conservation laws hold.

3. I look at the special relation between laws and "objective chances"—as when an atom of the radioactive isotope polonium-210 is by law 50% likely to decay sometime during the next 138.39 days (the isotope's half-life). I argue that the laws' relation to objective chances falls naturally out of my account (whereas it must be inserted into Lewis's account by hand).

Chapter 4: A World of Subjunctives

In this final chapter, I aim to answer the question: Are the laws necessary by virtue of being laws, or are they laws by virtue of being necessary? It seems to me that their necessity is ultimately what makes them laws—what sets them apart from accidents. Since their necessity is constituted by subjunctive facts, I conclude that the lawmakers are subjunctive facts. However, subjunctive facts are widely regarded as very poor candidates for being ontologically prior to laws. Indeed, the way that counterfactual conditionals (which express subjunctive facts) manage to be true is notoriously murky. *My boldest suggestion in this book is that subjunctive facts are ontologically primitive and responsible for laws*, a view that is contrary to the traditional conception of laws as "underwriting" or "supporting" counterfactuals. I offer several additional arguments for my view.

1. A theory according to which essences, universals, or other heavy-duty metaphysics is responsible for both laws and subjunctive facts cannot account nicely for the laws' characteristic relation to counterfactuals. The laws' stability would have to be inserted into such an account in an ad hoc manner. The laws' relation to counterfactuals has a much more straightforward explanation if subjunctive facts are the lawmakers.

2. It has long been recognized that laws have a distinctive power to explain why various facts hold by rendering those facts (naturally) necessary. (For example, all like charges in fact mutually repel because

this regularity *must* hold.) Now take the facts (whatever they are) in virtue of which the fundamental laws are laws. If those lawmakers are not necessary, then they are unable to bestow necessity upon the laws, and so the laws lose their explanatory power. On the other hand, if the lawmakers are necessary, then what makes them so? If their necessity is constituted by other facts, then are those facts necessary or not? If they are necessary, then the regress continues, but if they are not necessary, then the laws' necessity is again compromised. On my picture, the various subjunctive facts that serve as lawmakers, unlike other subjunctive facts, are (naturally) necessary. Each of them has its necessity constituted by other subjunctive facts that also help to make the same laws. (Each of those other subjunctive facts is necessary by virtue of yet other subjunctive facts that help to make those same laws, and so forth.) That is why the laws are able to render certain regularities necessary without deriving their own necessity from anywhere else, much less from facts that are unnecessary.

3. Instantaneous rates of change (such as velocity, according to classical physics) figure in the universe's state at a given moment. Indeed, a quantity's instantaneous rate of change at time t traditionally plays various causal and explanatory roles. But its capacity to do so cannot be accounted for by the standard reductive analysis of this rate in terms of a mathematical function of the changing quantity's values at various times throughout t 's neighborhood. The best way to account for the causal and explanatory roles played by some quantity's instantaneous rate of change at t is to interpret that rate in terms of an irreducibly *subjunctive* fact. (For example, in classical physics, for a body at t to have an instantaneous speed of V centimeters per second is for it to be the case that *were* the body (existing at t) to remain in existence after t , the body's trajectory *would* have a time-derivative from above at t equal to V cm/s.) Thus, the universe's state at a given moment cannot be purged of irreducibly subjunctive facts. If such facts must be countenanced anyway, parsimony urges us to put them to work as the lawmakers.

★ ★ ★

In an earlier book, *Natural Laws in Scientific Practice* (Lange 2000), I remained steadfastly neutral about whether laws help to make counterfactual conditionals true, or the reverse, or whether some third kind

of fact is responsible for both laws and subjunctive facts. Now I am prepared to argue that subjunctive facts are the lawmakers—that this view best explains the laws' relation to counterfactuals. However, one could reject this proposal and still accept a considerable portion of what I have to say.

Although the central idea in chapter 1 was embedded (though not especially highlighted) in my earlier book, most of the present book is new—or, at least, lifted from articles I wrote after that book appeared:

“Must the Fundamental Laws of Physics Be Complete?” *Philosophy and Phenomenological Research* 78 (2009): 312–45.

“Why Do the Laws Explain Why?” in *Dispositions and Causes*, ed. Toby Handfield (286–321). Oxford: Oxford University Press, 2009.

“Why Contingent Facts Cannot Necessities Make,” *Analysis* 68 (2008): 120–28.

“Could the Laws of Nature Change?” *Philosophy of Science* 75 (2008): 69–92.

“Laws and Meta-Laws of Nature: Conservation Laws and Symmetries,” *Studies in History and Philosophy of Modern Physics* 38 (2007): 457–81.

“How to Account for the Relation between Chancy Facts and Deterministic Laws,” *Mind* 115 (2006): 917–46.

“Do Chances Receive Equal Treatment under the Laws? Or: Must Chances Be Probabilities?” *British Journal for the Philosophy of Science* 57 (2006): 383–403.

“How Can Instantaneous Velocity Fulfill Its Causal Role?” *Philosophical Review* 114 (2005): 433–68.

“Reply to Ellis and to Handfield on Essentialism, Laws, and Counterfactuals,” *Australasian Journal of Philosophy* 83 (2005): 581–88.

“A Note on Scientific Essentialism, Laws of Nature, and Counterfactual Conditionals,” *Australasian Journal of Philosophy* 82 (2004): 227–41.

Some important topics in my earlier book (such as lawhood's relation to inductive confirmation, laws as an elite class of natural necessities,

natural kinds, and “*ceteris-paribus*” laws of inexact sciences) make no appearance here.

Many thanks to my good friends John Roberts and John Carroll, who have supplied me with a wealth of valuable feedback during recent years. I am immensely grateful for their generous help and their friendship. Thanks also to Jamin Asay, Gabriele Contessa, Adam Cureton, Crawford Elder, Katie Elliott, Mathias Frisch, Alan Hajék, Chris Hauße, Chris Pearson, and Matthew Slater, who read some or all of the manuscript and helped me to improve it. My title is an affectionate nod to David Armstrong’s *Truth and Truthmakers* (2004).

The philosophy department at the University of North Carolina at Chapel Hill has given me an incredibly congenial and stimulating environment in which to work and to play. For that, I am especially grateful to the department chair (and my dear friend), Geoffrey Sayre-McCord. I also wish to record my gratitude to the anonymous referees for the journals in which the above papers appeared. The care that referees typically take to provide authors with worthwhile feedback makes me proud to belong to the philosophical community.

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