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ORDER: GOD'S, MAN'S AND NATURE'S

Free Will and Two Accounts of Natural Laws[i]

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Is a commitment to scientific laws compatible with a commitment to libertarian free will? Since Early Modernity, there has been a substantial movement towards assuming that the answer is "no", in spite of the fact that some of the most influential early proponents of the idea that there are laws of nature (such as Descartes and Newton) were also staunch proponents of free will. I shall argue that Descartes and Newton had it right: properly understood, natural laws are completely consistent with libertarian freedom, and advocates of free will have nothing to fear from scientific laws. The *illusion* of incompatibility, I shall argue, is due to the influence of a particular philosophical account of the nature of scientific laws – the Empiricist account. But the Empiricist account of laws is neither the *only*, nor the *best*, account available. Indeed, I shall argue that it is utterly untenable, and that alternative accounts that claim that laws express causal powers, dispositions or propensities are clearly compatible with libertarian freedom. I shall introduce a cognitivist version of such an account as the most attractive account of laws.

Caveats

Because the philosophical literatures on free will and on natural laws are already truly immense, it is important to stress at the beginning just what issues will be considered in this paper, and which will not.

1) Of the many philosophical notions of "freedom", I am concerned specifically with the notion sometimes called libertarian freedom.
2) I shall assume (what I take to be a mainline but not universal view) that libertarian freedom is incompatible with determinism.
3) I shall not attempt to argue that one *ought* to be committed either to libertarian freedom or to scientific laws. I shall simply argue that one can be committed to both, simultaneously, without inconsistency.
4) In particular, I shall not attempt to comment on the myriad other topics on which philosophers have written concerning free will, (in)determinism, or (in)compatiblism.
5) I shall not attempt to untangle the issues surrounding Quantum Mechanics, indeterminism and freedom. When I speak of "laws" here, I shall not be speaking of probabilistic laws, but of the kind sometimes characterized as "strict" or "deterministic" (though for reasons that will become apparent, I do not favor these characterizations of non-probablistic laws).
6) Some scientific laws are concerned with relations between variables at a single moment (static laws). I shall not be concerned with these, which are not directly relevant to freedom and determinism, but with those concerned with change and causation (kinematic and dynamic laws).

What Do Laws Have to do with Freedom?

At least since the 18th century, many philosophers and scientists have believed the proposition that the universe is governed by natural laws to be in conflict (or at least in tension) with the proposition that humans possess libertarian free will. The tension between these two claims played a memorable role in Kant's philosophy, and the theme has been repeated by more recent philosophers. A.J. Ayer locates the problem of free will squarely within the context of the assumption that our actions are governed by natural laws:

> WHEN I am said to have done something of my own free will it is implied that I could have acted otherwise; and it is only when it is believed that I could have acted otherwise that 1 am held to be morally responsible for what I have done. For a man is not thought to be morally responsible for an action that it was not in his power to avoid. But if human behaviour is entirely governed by causal laws, it is not clear how any action that is done could ever have been avoided. It may be said

> of the agent that he would have acted otherwise if the causes of his action had been different, but they being what they were, it seems to follow that he was bound to act as he did. Now it is commonly assumed both that men are capable of acting freely, in the sense that is required to make them morally responsible, and that human behaviour is entirely governed by causal laws: and it is the apparent conflict between these two assumptions that gives rise to the philosophical problem of the freedom of the will. (From Ayer (1954), p 271.)

According to this formulation, human actions are determined because they fall under the scope of natural laws. And if they are determined, they are not free.

Timothy O'Connor likewise characterizes determinism in terms of natural laws, as "the thesis that there are comprehensive natural laws that entail that there is but *one* possible path for the world's evolution through time consistent with its total state (characterized by an appropriate set of variables) at any arbitrary time." (O'Connor 2000, p. 3)

Peter van Inwagen gives a characterization of determinism that is similarly framed in terms of natural laws. He defines determinism as the thesis that,

> For every instant of time, there is a proposition that expresses the state of the world at that instant;
>
> If p and q are any propositions that express the state of the world at some instants [and q describes a state later than that described by p], then the conjunction of p with the laws of nature entails q. (1983, p. 65, gloss in square brackets added)

A few pages later, van Inwagen puts forward an argument for incompatiblism. Consider the question of whether some person J could have raised his hand at time T. Let L be the set of laws, P a complete actual state of affairs at T that includes J's *not* raising his hand at T, and To be a complete actual state of affairs at some earlier time. Van Inwagen then argues,

> (1) If determinism is true, then the conjunction of Po and L entails P.
> (2) It is not possible that J have raised his hand at T and P be true.
> (3) If (2) is true, then if J could have raised his hand at T, J could have rendered P false.

(4) If J could have rendered P false, and if the conjunction of Po and L entails P, then J could have rendered the conjunction Po and L false.

(5) If J could have rendered the conjunction of Po and L false, then J could have rendered L false.

(6) J could not have rendered L false.

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So (7) If determinism is true, J could not have raised his hand at T. (p.70)

I would draw attention in particular to the fact that Van Inwagen frames the argument in such a way as to highlight the ideas that, according to the determinist, (a) laws and complete state-descriptions together imply unique future state descriptions for each subsequent time, and that acting in a fashion incompatible with that future state description would (*per impossibile*) "render [the laws] false", and (b) we are incapable of rendering laws false. The view of laws suggested here is one on which *exceptions* to the laws are equivalent to *falsifications* of them.

The basic line of argument can be summed up as follows:

1) *Nomic Determinism:* A commitment to scientific laws implies a commitment to determinism
2) *Incompatiblism:* Determinism is incompatible with libertarian freedom
   Therefore,
3) A commitment to scientific laws implies a rejection of libertarian freedom.

As stated above, I shall accept incompatiblism for purposes of this paper, and hence shall concentrate on the rationale leading to Nomic Determinism.

Classical Mechanics was generally regarded as employing laws that are deterministic. The use of stochastic equations in Quantum Mechanics has spawned a cottage industry of discussions of (a) whether these are best interpreted as implying that some or all of the most basic dynamical processes are in fact non-deterministic and (b) whether quantum indeterminacy would provide room for free will (Kane 1996) or perhaps actually render it incoherent (Pereboom 2001). Given the variety of interpretations of Quantum Mechanics (some, but not all, of which imply objective indeterminacy), I shall avoid these issues here. My concern, rather, is with the implications of non-probablistic laws, such as gravitation. My claim is that these, properly understood, do not imply determinism. But before arguing this claim, I wish first to turn to the question of why anyone would ever have thought that they did so.

Nomic Determinism and the Empiricist Account of Laws

There is a very familiar account of the nature of laws on which there *is* a straightforward connection between laws and determinism. This is the account of laws made popular by the Logical Positivisits and Logical Empiricists, which I shall refer to as the "Empiricist account (of laws)". The core commitment of this account is that scientific laws express universally quantified claims about the real-world behavior of objects and events found in nature. In its original form, framed in quantified predicate calculus, this involved a commitment to the material truth of such claims. In subsequent formulations, the material claims have generally been understood to be modally strengthened to cover counterfactuals. As the modally-strengthened versions of the Empiricist account entail the non-modal version, refuting the non-modal version will suffice as a refutation of the modal versions as well.

It is an unfortunate curiosity of the history of philosophy of science that the "paradigm" examples used to elucidate the Empiricist account of laws – e.g., "all swans are white" – bear little resemblance to the laws one actually finds in the sciences. However, the account was clearly intended to apply to *real* laws, like classical gravitation, as well, even if attempts to actually spell out how such laws would look if rendered as quantified claims are the exception rather than the rule. Informally, they would be such claims as that any two bodies with mass will behave (that is, move) in a fashion described by the inverse square law. (And similarly, n bodies will behave in a fashion described by the versions of the gravitation law formulated for n-body problems. These are computationally intractable where $n > 2$, but are nonetheless "deterministic" in the sense to be understood for Newtonian mechanics.) In other words, laws (thus interpreted) express materially true universal claims about the real-world behaviors of objects. In cases where the "behaviors" in question are *motions*, the laws are thus interpreted as making universal claims about *kinematics*.

Interpreted as true universal claims about real-world kinematics, natural laws *would* pose problems for free will. Because of the universally quantified nature of the claims, any object to which at least one true law applies would have to always behave as the law describes it in order for the law to be materially true. This would not, in itself, entail full-scale determinism, as there might also be objects to which no laws apply. It would, in particular, be compatible with a dualism that allowed for spontaneous (that is, causally undetermined) *thoughts*. But it would not allow for free *actions*, as actions involve the body, which is composed of a very large number of particles to which physical laws apply. Even if one wished to insist on free *thoughts*, the requisite notion of freedom would be debarred from any useful role in explaining moral responsibility. In short, on the Empiricist interpretation, a commitment to laws entails a rejection of any meaningful version of the libertarian thesis.

The trouble is that, interpreted in this way, laws like classical gravitation (or Relativistic gravitation, for that matter) turn out to be false. Indeed, worse than that, they have no true substitution instances. A simple example should illustrate this. Take two pieces of paper with identical mass. Fold one into a tight ball and the other into a paper airplane. Drop them from the same height above the Earth. Lo and behold, they do *not* fall at the same rate. Or take the paper ball and a piece of metal of equal weight and drop them from the same height close to a magnet. Again, they do not fall at the same rate. (Indeed, if the magnet is sufficiently strong, the metal does not fall at all, but sticks to the magnet.)

Now, *if* the inverse square law made universal claims about how objects always fall, these experiments would suffice to disprove the law. But of course they do no such thing. And we all know *why* they do not: *other* forces, such as wind resistance and magnetism, also play a role in many real-world kinematic situations. And given that most objects include charged particles, this includes just about *all* the real-world situations; so if laws claimed what the Empiricist account claims, they would not just need amendment with a few *ceteris paribus* clauses to account for exceptions, they would have few if any true substitution instances. You can't get much falser than that!

Nancy Cartwright (1983) has in a similar vein claimed that the laws of physics "lie" – that is, state falsehoods. But perhaps it would be better to say that, *if the laws meant what the Empiricist account claims them to mean*, they *would* be false. This, however, suggests a better way of characterizing the situation: namely, that the laws are *true* (or whatever alethetic honorific one prefers to apply to "good" laws), but the Empiricist account is mistaken about what they express.

The Empiricist account of laws does entail a rejection of libertarian freedom, but the very feature that causes it to do so – that is, the fact that it treats laws as materially-true universally-quantified claims about real-world kinematics – also entails that Empiricist laws would turn out to be quite radically false. There are, however, several familiar alternatives to the original, “pure” Empiricist view. These differ in the degree to which they differ from the Empiricist account and in their plausibility. However, as I shall argue, each of them is either compatible with libertarian freedom, or else faces insuperable obstacles as an account of laws, or both.

Ceteris Paribus Laws

The most familiar adjustment to the Empiricist account is one proposed by Logical Empiricists themselves: hedging quantified claims within *ceteris paribus* clauses. While this adjustment has often been applied only to the laws of the special sciences and in contrast with the purportedly “strict” laws of fundamental physics, it is nonetheless available as a strategy for handling the problems encountered above. This proposal, however, has two problems: it does not yield a satisfying account of laws, and (unlike the strict Empiricist account) does not entail determinism or preclude freedom.

The basic form of *ceteris paribus* laws is this: instead of simply asserting a law as a universal claim *L*, one embeds it in a *ceteris paribus* construction: “other things being equal, *L*”. The phrase “other things being equal” is a kind of stand-in for an unspecified list of conditions that separate the cases in which the embedded claim holds good from those in which it does not. Unfortunately, with the kinds of cases we have been discussing, “other things” are seldom, if ever, “equal”. The reason the quantified interpretation of the gravitation law turned out to be false was that other forces independent of gravity also make a contribution to real-world kinematics. And this is not just a fact about some exceptional cases at the margins. It is true of any interaction of bodies that possess both mass and charge, or any body which is subject to aerodynamic forces, or any of a long and open-ended list of additional causal factors. Interpreted in this way, most physical laws would turn out either to be completely vacuous or at best to apply to rare and specialized situations. And, perhaps worse, this would make the scope of the laws quite different from the scope accorded them by the scientist. Interpreted as a universal claim embedded in a *ceteris paribus* clause that excluded cases where non-gravitational forces were at work, the gravitation law would say nothing at all about cases in which additional forces contributed to real-world kinematics. But in fact the gravitation law *does* say something – and says something *true* – about cases where there are multiple forces at work. (Just *what* it says will need to be developed below.)

Moreover, once one introduces *ceteris paribus* clauses in this way, laws no longer entail determinism or even the denial of free action. The content of *ceteris paribus* clauses is generally left indeterminate. (And for good reason, as there may be yet-unknown situations in which a generalization fails to hold good.) But this opens the possibility that, among the factors that might make "other things unequal", one might find cases of anomic causation in the form of libertarian free will.

Laws and Ideal Worlds

A second familiar variant upon the Empiricist account is the claim that laws do not make true universal claims about the behavior of objects in the real world, but rather make true universal claims about some "ideal world". (Suppe 1989, Horgan and Tienson 1996, Giere 1999) And perhaps, if this "ideal world" is sufficiently "nearby" the actual world, the laws may be good enough to license predictions that are "approximately true" of the actual world.

This suggestion strikes me as wrong-headed for two reasons. First, it does not capture what the scientist understands laws to provide. The gravitation law does not merely make claims about some possible but non-actual world. It says things – *true* things – about the actual world as well. For example, it makes true claims about the gravitational *force* between two bodies as a function of their masses and the distance between them.

Second, the "ideal world" in question would have to be one in which the kinematics of particles with mass is a function *only* of mass and distance (and perhaps momentum). But this would be a world with a very different ontological inventory than that of the actual world, as such a world would not contain any particles susceptible to electromagnetism, strong or weak force. The claims of such a law would be about objects that are of little scientific interest, and it would say nothing about the majority of objects to which the gravitation law actually applies.

Moreover, interpreted as claims about ideal worlds, laws would imply nothing at all on the question of whether the actual world is deterministic. This is because such laws say nothing at all – or at least nothing exact – about the actual world. It is just too easy to stipulate conditions for a possible world that will turn out to be deterministic because one has stripped away so many features of the actual world. One cannot then look at the possible world in question and reason from the fact that *it* is deterministic that the actual world is deterministic as well.

Still, the idea of treating laws as in some sense “ideal” has something to be said for it. In what follows, I shall explore the possibility that laws are not exact claims about “ideal worlds”, but ideal*ized* claims about the actual world.

Summation of Forces

It might be objected that the Empiricist account (or my reconstruction of it) overlooks something very important that has been a part of mechanics at least since Newton: namely, the idea of *summation of forces*. In classical mechanics, when laws were said to be “deterministic”, this did *not* mean that *each* law, taken *individually*, determined the real-world behavior of objects. Rather, scientists understood the global summation of *all* the forces acting upon objects in a system to determine the evolving kinematics of the system. Newton himself supplied the basic machinery for expressing and computing summation of forces through the application of vector algebra, and foresaw that subsequent generations might well discover forces in addition to gravity and mechanical force. In the majority of real-world situations, such a function is not exactly and finitely computable, and in cases of classical chaos is not even good for approximate prediction. But even classical chaos is, by *fiat*, deterministic nonetheless.

Note that this variant upon the Empiricist account of laws adds something to the standard logical reformulation of laws. The true quantified claims, if they are to be claims about real-world behavior (e.g., kinematics), must not be statements of individual laws, but of composition-of-force functions. What is “deterministic” here is *not* the individual laws, taken singly, but something on the order of a global force equation. One reason this is interesting is that the deterministic character of the system can no longer directly be read off of the logical (i.e., universally quantified) form of the laws. The laws may be “universal” in the sense that they apply to all objects with mass, or charge, etc. But this does not itself entail that the kinematics of the system will be deterministic. Determinism is a *separate* claim from that of the universal *applicability* of laws specifying the contributions of individual forces.

Indeed, adding a summation function would likely also require us to abandon the original Empiricist assumption that laws are, individually, quantified claims ranging over real-world objects and their motions. A summation of forces implies that objects do not behave as the individual force functions describe. And so the domain of laws must be reconstrued in another fashion – say, as claims about *forces*. (See dynamic interpretation below.)

There are, no doubt, possible worlds that are exactly described by laws expressing the contributions of individual forces plus deterministic composition functions. The question of whether the actual world answers to this description, however, is complicated by several factors. First, given the limitations upon computability, we are faced with uncertainty in cases where real-world behavior deviates from our best finite calculations. These may be cases of experimental error (say, failing to adequately screen off exogenous variables). They may be the work of yet-unknown additional laws. They may be manifestations of classical chaos. Or they may be intrusions of true randomness or anomic forces, including but not limited to free will. Further experimentation may reveal the first two types of causes, but it is incapable of definitively distinguishing classical chaos from brute randomness or anomic causal factors.

A more serious problem, to my mind, stems from the fact that there are cases in which there are roadblocks to the summation of forces. Cartwright (1983) has suggested that there are many instances in which we do not know how to evaluate a summation of forces. Some of these may be mere instances of present-day ignorance, but others seem to be more principled. Mark Wilson, for example, has argued that the different models used for different situations in fluid dynamics in fact have contradictory assumptions. (Wilson 2006) And indeed, our two best-supported scientific theories – Relativistic gravitation and Quantum Mechanics – are notoriously inconsistent or incommensurable. That is, in some physical situations, the two theories yield incompatible descriptions and predictions of how objects behave. Any logical reconstruction of science that attempts to incorporate them, in their present form, will thus have the unwelcome trait of generating contradictions. And such an account would not be truly "deterministic", as it would entail multiple incompatible outcomes.

Of course, this problem is well known to physicists, and indeed motivates a very active search for a "Unified Field Theory". It is possible that such a theory will be discovered, and will remove this particular roadblock. However, our present commitment to the claim that General Relativity and Quantum Mechanics each have laws that express truths does not depend upon the viability of the search for a Unified Field Theory. One can *believe* that there is (or will be) a means of expressing truths about gravitation, electromagnetism, strong and weak force that will be both consistent and deterministic, and thus rule out free will, or at least free action. But such a belief is by no means forced upon us by our acceptance of the laws we actually have. It is a kind of philosophical leap of faith, either in what will be revealed in the future, or else in something that is true but can never be known. (There may, additionally, be a *regulative principle* to the effect that we should *look for* such a unification. But it would be an error to mistake a regulative ideal for a knowledge claim.)

Dynamic Claims

Another possibility for saving the Empiricist account would be to retain the thesis that laws express universally quantified claims, but to treat these as claims about *forces* (that is, as *dynamic* rather than *kinematic* claims). It is, indeed, possible to view alternative accounts of laws in terms of "causal powers(/capacities/dispositions)", offered by Cartwright (1983, 1989, 1999) and others (Harré and Madden 1975, Hacking 1983) and described below, in this fashion. (Though Cartwright herself disavows the reality of "component forces".)

This view might serve us well in the case of laws of fundamental physics, where it is commonplace to speak of "forces". However, when we try to apply the notion of "force" to laws of the special sciences – say, to psychophysical laws – the usage seems a bit strained. This, I think, partially explains the fact that causal accounts of laws tend to employ more ecumenical terms like 'power', 'capacity' or 'disposition'.

Causal Accounts

A major alternative to the Empiricist account of laws that has been offered in the past several decades is the view that what laws express are "causal powers" (alternatively "causal capacities", "causal dispositions"). The gravitation law expresses the capacity of two masses to attract one another. Laws of chemical reaction express the dispositions of particular types of chemical structures to react and produce new structures. Often, a capacity will be manifest only in particular situations. (For example, a reaction between two compounds may take place only in the presence of a catalyst.) Likewise, the capacity for reaction expressed by a chemical law may be prevented by other conditions. Cartwright gives a simple illustration involving an acid and a base and their known reactive tendencies with a third compound. Suppose you know what happens if you mix a given substance with an acid and know what happens when you mix it with a base. You cannot tell what will happen when you mix it with an acid *and* a base just by doing some sort of vector algebra on the models for mixing with acids and mixing with bases, because the acid and base interact with one another in a way that negates their individual abilities to react with the third substance. The fact that you *can* do so in mechanics is in fact a special feature of mechanics.

> When two forces in mechanics are present together, each retains its original capacity. They operate side by side, independently of one another. The resulting effect is a pure combination of the effect that each is trying to produce by itself. The law of vector addition gives precise content to this idea of pure combination. In chemistry, things are different. The acid and the base neutralize each other. Each destroys the chemical powers of the other, and the peculiar chemical effects of both are eliminated. This is not like the stationary particle, held in place by the tug of forces in opposite directions. When an acid and a base mix, their effects do not combine: neither can operate to produce any effects at all. (Cartwright 1989, p. 163)

This example illustrates two important points. First, treating laws as expressing causal capacities does not directly license predictions of real-world behavior, because in the real world, the exercise of the capacity may require (or be prevented by) factors not mentioned in the law. Second, the dynamic potentialities expressed by some types of laws are not suitable for composition of forces through vector algebra. This is a point that Cartwright argues at length in various publications, and it strikes me as quite significant: we may be committed to whatever it is that various laws express, piecemeal, but whatever this "something" is, it does not directly imply determinism. (Though neither is it incompatible with it, except insofar as some laws may themselves be indeterministic.)

Laws, taken individually, do not entail determinism because (a) the capacities expressed in a law may or not be exercised in a given instance because of factors left unspecified by the law and (b) real-world behavior will also be influenced by other causal capacities, including those expressed by other laws, but an individual law does not say anything about what kinds of additional influences (nomic or anomic) there might be. Laws, taken together, do not license determinism either. On the one hand, in many cases there is not a well-defined way of framing a composition of forces. On the other hand, having any set of laws in hand still leaves us essentially agnostic about whether the world is causally closed under that set of laws, or whether there are additional causal powers, whether nomic or anomic, that have yet to be specified.

On this view, our scientific understanding of the world comes *piecemeal*, through a "patchwork of laws", each of which expresses one causal capacity, or perhaps a small number of such capacities. Science presents us with a "dappled world", not a unified world. (Cartwright 1999) Nothing in the laws themselves specifies all of the conditions under which the capacities they express will be active, nor do the laws themselves tell us how they act in combination. Sometimes we *do* know many of the relevant conditions and interactions, but this knowledge itself comes in the form of a myriad rules of thumb and not something like the single axiomatic system hoped for by Positivists like Carnap. Moreover, the list of such conditions and interactions is essentially open-ended, as experimentation and discovery continually reveal new ways in which processes *in vivo* do not work as described by the laws.

On such a view, our scientific knowledge leaves us agnostic about what remains to be discovered. The gravitation law says nothing about what other causal capacities, nomic or anomic, might be at work in a given situation, and likewise for every other law. One may still be free to opine, as a matter of philosophical taste, that all causes are nomic, or that the behavior of the universe is fully determined by the complete set of causal capacities and the complete state description at a time. But such a view is in no way implied by the laws themselves. Discovery of the law of gravitation in no way implied that there were not other, yet undiscovered laws, such as those of electromagnetism. And our contemporary list of laws does not imply that there are no undiscovered laws today. Nor does it imply that there are no *anomic* causal factors, including whatever sort would be required for free action. Laws do not imply that the world is causally closed under those laws, and laws do not imply a rejection of freedom *because each law speaks only to a single causal capacity*.

I view this causal account of laws as a great improvement over the original Empiricist account and those variations on the account that add *ceteris paribus* clauses and composition functions or take laws to make true claims only about ideal worlds. Most prominently, it allows the laws to count as *true* as expressions of causal capacities and to contribute something to our understanding of real-world kinematics in the face of the ubiquitous failure of laws to generate exactly correct descriptions or predictions of real-world behavior.

At the same time, I have some misgivings about Cartwright's causal account. The first misgiving is about the status that is to be accorded to talk of "capacities", "powers" or "dispositions". Part of this misgiving is semantic and part is metaphysical. The grammar of such words almost compels us to treat their referents as properties inherent in individual objects. Often, however, what laws express are regularities in how a dynamical situation involving *multiple* objects unfolds. We can say “this compound has a disposition to interact with an acid in such-and-such a way”, but such a disposition is ultimately a relational disposition. That is, interactive dispositions do not lie entirely within an individual thing that is said to possess them. The metaphysical qualm stems from a concern that Cartwright’s account, if read in a realist fashion, might commit us to a fundamental ontology of capacities, powers or dispositions. It is possible that such a commitment might turn out to be an acceptable option, but my own prejudice is to treat it as a less than desirable outcome.

The other realist interpretation of the causal account would be to take talk about “capacities” to really be talk about *forces*. This, in fact, seems like a reasonable interpretation in the case of fundamental physical laws, though Cartwright herself resists it due to a disavowal of the reality of component forces. (My intuitions on this go in the opposite direction: component forces are often real, but resultant forces are mere mathematical constructions, even though they are the better predictors of kinematics.) Some readers may find a commitment to an ontology of forces as hard to swallow as I find an ontology of dispositions. But the interpretation of capacity-talk in terms of forces really cannot serve for a general interpretation of laws. Even if one is inclined to find real forces behind the gravitation law, many laws in special sciences like psychology or economics do not seem to involve special forces of their own. We need a way of cashing out capacity-talk that applies to laws in various sciences.

Much of Cartwright’s corpus, however, suggests a non-realist reading, with a tension between an endorsement of a kind of Pragmatism and residual traces of a Realist Empiricism. In the next section, I shall develop an alternative account that shares many features with the causal account, but is based upon a Cognitivist rather than a Pragmatist or Empiricist approach to science.

Cognitivism and Idealization

Earlier we considered the proposal that laws provide express exact descriptions of the kinematics of “ideal worlds”. Instead, let us consider the proposal that laws express *idealized* descriptions of the *real* world that highlight the *dynamic* principles that underlie real-world kinematics. Any observable situation in the real world is incredibly complex, far more complex than human minds are suited to understanding in its entirety.

In order to find order in complexity, the human mind needs to filter its understanding through mental models that capture some abstract features at work in real-world situations while screening others out. Scientific theories, models and laws are particularly regimented forms of such mental modeling that aim at capturing real dynamic invariants in the world. Such models are *abstract* in that they are formulated around general principles. They are also *idealized* in that the world-as-understood-through-the-model will often fail to capture features at work *in vivo*. In particular, they involve at least the following three sorts of idealization:

> *Bracketing Idealization:* A model of, say, gravity deals only with gravity, and brackets or screens off other dynamic principles at work in the real world. Bracketing idealizations thus create a gap between the application of the model to kinematic problems and the actual evolution of kinematics in the real world. However, this is simply the price that is paid for theoretical insight into individual dynamic principles. It does not *decrease* our capacity for prediction, as the road to any more accurate understanding of complexity must first pass through the formulation of models of the individual principles at work.
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> *Distorting Idealization*: Many scientific models describe their subject matter in ways that distort it. For example, familiar models in mechanics treat extended objects as point-masses or inelastic collisions as elastic, economic models treat individuals as ideally-rational decision theorists, etc. Distorting idealizations are often cognitively necessary to gain initial traction on theoretical problems, and models that contain them often remain the most elegant solutions of particular subclasses of problems. However, more complex models formulated to handle other cases (say, turbulent as opposed to laminar flow) often end up bending theoretical terminology in directions that make them formally incompatible with one another. (Cf. Wilson 2006.)
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> *Finite Approximation*: When working in a purely theoretical context, it is often possible to express natural constants (the speed of light, the gravitational constant) with constant letters. However, to apply those models to calculations about real-world situations, those constants must be represented with a finite degree of accuracy. Often, the real values of the constants involve infinite

decimal sequences, and so any finite value that stands in is an approximation. The degree of exactitude can matter in real-world predictions, and in cases of chaos, there is no finite approximation that is sufficient to assure an accurate simulation of the real-world evolution of kinematics.

Laws are not simply algebraic equations. They are framed against a background of a theory or model. For example, the equations of classical and relativistic gravitation require a background understanding of models of the geometry of space and time characterized by Euclidean and Lorentzian metrics, respectively. This, in turn, points to another characteristic of such models: *any model must employ a particular representational system*.

Scientific understanding *starts out* as a kind of pastiche of separate models because we need to understand dynamic contributions individually to gain explanatory traction. But the fact that the models are idealized and employ proprietary representational systems can produce barriers to integrating this pastiche into a single super-theory. The ways different models are idealized may, for example, result in incompatible definitions of theoretical terms (Wilson 2006), and the different representational systems that are appropriate for different problems may be formally incommensurable. When we recognize such a situation, as in the present situation with General Relativity and Quantum Mechanics, we look for a unified theory, but whether we can find one depends not only on how the world is, but on how the human mind is capable of representing the world. There may turn out to be the case here, or elsewhere, that we cannot formulate a single consistent theory that captures all of the explanatory and predictive power that two incommensurable models afford us individually. At any rate, actual science often proceeds without such a super-model, even though the *search* for one may be viewed as a regulative ideal in scientific practice.

The view I have described is *cognitivist*, in that it treats laws (theories, models) not simply as features of the world itself, but as ways of *representing* the world. It is not, however, an anything-goes relativism. A law (theory, model) is *apt* for particular theoretical or practical purposes to the extent that it gets real-world invariants *right*.[ii] The cognitivism consists merely in the claim that "getting it right" involves, in part, in *representing* it in a fashion that is useful for theory, prediction, or intervention. The view is also *pluralist*, in that (a) it highlights the fact that particular laws (theories, models) are to a large extent *independent* of one another in how they provide explanatory traction, and (b) it presents the *possibility* that an comprehensive super-theory may be beyond our grasp, not because of “how the world is” but because of how the mind goes about understanding the world. I thus call this view Cognitive Pluralism. (Cf. Horst 2007, 2011.)

Individually, dynamic laws express *potential partial causal contributors to real-world kinematics*. They express only *partial* contributors because their bracketing idealizations leave open the question of what additional causal contributors there might be. They express only *potential* contributors because their bracketing idealizations may also include the fact that there are necessary background conditions for those causal contributions to be made.

This Cognitive Pluralist account of laws has much in common with the causal account. On both accounts, each law speaks only to a single factor (or a small set of factors) that can contribute to real-world behavior. As a result, a commitment to any particular law, or any set of laws, leaves us absolutely agnostic as to whatever other sources might produce additional causal contributions: additional nomic causes, brute randomness, or anomic causal factors. This last class, of course, includes whatever sort of causation is needed for free will to operate. And thus, like the causal powers account, Cognitive Pluralism understands laws in a fashion that is compatible with free will.

Assessment

In this paper, I have discussed several accounts of laws – variations on the Empiricist account that treat laws as making universal claims about real-world behavior, an Empiricist variation that treats laws as making universal claims about forces, the causal powers account, and my Cognitive Pluralist account.

1. Empiricist accounts – threat laws as making materially true universally-quantified claims:
    a. Original version: true universal claims about real-world behavior of objects
    b. Ceteris Paribus version: true universal claims about real-world behavior within specified conditions
    c. Ideal Worlds version: true universal claims about the behavior of objects in a non-real ideal world
    d. Dynamic version: true universal claims about forces exerted
        i. Without summation function

ii. With well-defined summation function

2. Causal capacities account
3. Cognitive Pluralist account

Two of these accounts (1a and 1d.ii) would, if correct, entail a denial of free will, or at least of free action. The original Empiricist account (1a), however, would have the consequence that scientific laws turn out to be quite radically false, and Cartwright and I (among others) have provided reasons to suspect that a single "master summation function" (1d.ii) might be unavailable in principle. The addition of *ceteris paribus* clauses (1b) and the Ideal Worlds version did not meet the test of having the resulting laws correspond with what laws do in scientific practice. But even if this criticism is incorrect, they also do not exclude free will. The Ideal Worlds version says *nothing* directly about real world behavior, and the *ceteris paribus* version opens the door to *ceteris paribus* clauses precisely involving free will. The simple quantified dynamic account (1d.ii), the causal capacities account and the Cognitive Pluralist account do not exclude free will, because on those accounts, each law speaks only to its own domain, and leaves open the question of what other factors may contribute to the entire causal mix, be they nomic or anomic.

In short, the widespread assumption that a commitment to scientific laws entails a commitment to determinism and a denial of libertarian freedom is an artifact of the influence of the Empiricist account of laws. On the original Empiricist account, such an entailment actually follows. But that account is untenable in its own right, and its major alternatives present no obstacles to free will.

Notes

[i] Much of the research for this paper was undertaken with the help of a National Endowment for the Humanities Fellowship for College Teachers and Independent Scholars.

[ii] I prefer not to use the descriptions 'true' or 'false' for models, as models are not propositions, but rather serve to define a possibility space for propositions. 'Aptness' is my preferred felicity term for models.

Works Cited

Ayer, A.J. 1954. *Philosophical Essays*. London and Basingstoke: Macmillan.

Cartwright, Nancy. 1983. *How the Laws of Physics Lie.*: Oxford University Press.
———. 1989. *Nature's Capacities and their Measurement*. Oxford: Clarendon.
———. 1999. *The Dappled World: A Study of the Boundaries of Science*. New York: Cambridge University Press.

Giere, Ronald. 1999. *Science Without Laws*. Chicago, IL: University of Chicago Press.

Hacking, Ian. 1983. *Representing and Intervening*. Cambridge: Cambridge University Press.

Harré, Rom, and Edward H Madden. 1975. *Causal Powers*. Oxford: Blackwell.

Horgan, Terrence, and John Tienson. 1996. *Connectionism and the Philosophy of Psychology*. Cambridge, MA and London: MIT Press/Bradford Books.

Horst, Steven. 2007. *Beyond Reduction: Philosophy of Mind and Post-Reductionist Philosophy of Science*. New York: Oxford University Press.
———. 2011. *Laws, Mind, and Free Will*. Cambridge, MA: MIT Press.

Kane, Robert. 1996. *The Significance of Free Will*. New York: Oxford University Press.

O'Connor, Timothy. 2000. *Persons and Causes: The Metaphysics of Free Will*. New York: Oxford University Press.

Pereboom, Derek. 2001. *Living Without Free Will*. Cambridge: Cambridge University Press.

Suppe, Frederick. 1989. *The Semantic Conception of Theories and Scientific Realism*. Urbana, IL: University of Illinois Press.

van Inwagen, Peter. 1983. *An Essay on Free Will*. Oxford: Clarendon Press.

Wilson, Mark. 2006. *Wandering Significance*. New York: Oxford University Press.