Against Pluralistic and Inexact Ontologies

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Abstract: The ontologies of scientific theories include a variety of objects: point-mass particles, rigid rods, frictionless planes, flat and curved spacetimes, perfectly spherical planets, continuous fluids, ideal gases, nonidentical but indistinguishable electrons, atoms, quarks and gluons, strong and weak nuclear forces, ideally rational agents, and so on. But the scientific community currently regards only some of these objects as real. According to Paul Teller, a group sometimes can be justified in regarding competing ontologies as real and the ontologies we are justified in regarding as real are inexact, because the theories that give those ontologies characterize what things are *like* rather than what they *are*. In this paper, I argue that Teller's view is incomplete and suggest that one way to remove this incompleteness is to adopt a criterion for when we are justified in regarding a theory's ontology as real that is based upon a theory's comparative degree of confirmation. I argue that this criterion is *prima-facie* plausible and that Teller's view is false if this criterion is correct.

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The ontologies of scientific theories include a variety of objects: point-mass particles, rigid rods, frictionless planes, flat and curved spacetimes, perfectly spherical planets, continuous fluids, ideal gases, nonidentical but indistinguishable electrons, atoms, quarks and gluons, strong and weak nuclear forces, ideally rational agents, and so on. But the scientific community currently regards only some of these objects as real. For instance, phosphorus is composed of discrete atoms but not of phlogiston, and atoms themselves are composed of discrete nucleons and not incompressible continuous liquids.

Set aside worries about whether theories are linguistic systems or collections of models, and assume that whatever gives an ontology for at least one physical object is a theory (in some loose sense of 'theory'). Assume that there is a way to determine whether something is merely a mathematical artifact of a theory or, instead, part of the theory's ontology. Ignore the realist-antirealist debate over whether the appropriate way to regard an unobservable object as real is to believe that the object exists or merely to accept that the object exists. Also assume there is a way to overcome the instrumentalist worry that we never are justified in regarding the ontology of a scientific theory as real because theories are predictive tools with no ontological import. Even with all these (interesting and important) philosophical issues set aside or settled by fiat, there remains the issue of what justifies a scientific community in regarding the ontologies of some theories as real and the ontologies of others as unreal.

Consider, for example, Quantum Chromodynamics (QCD) and hydrodynamics. Whereas QCD gives an ontology for fluids that includes discrete quarks bound by gluons, hydrodynamics treats fluids as continuous incompressible substances. These are competing ontologies: no fluid can be both discrete and continuous in the same respect. Similarly, phlogiston and modern chemical theory give competing ontologies for flammable objects: phlogiston theory's ontology includes phlogiston, whereas modern chemistry's ontology includes discrete atoms and no phlogiston. For the most part, the current scientific community seems to regard the ontologies of QCD and modern chemistry as real and the ontologies of continuum hydrodynamics and phlogiston theory as unreal. But what justifies these attitudes?

According to Paul Teller, the attitude toward continuum hydrodynamics is not justified.[1] For Teller, the criterion for being justified in regarding a theory's ontology as real is context-sensitive. (More on this later.) And since there are some contexts in which attitudes toward continuum hydrodynamics satisfy that criterion, sometimes the scientific community is justified in regarding fluids as incompressible continuous substances. Teller's view, which he calls ontological pluralism, consists of two key theses. The first is that a group sometimes can be justified in regarding competing ontologies as real. The second is that the ontologies we are justified in regarding as real are inexact, because the theories that give those ontologies characterize what things are *like* rather than what they *are*.

My goal in this paper is to develop a rebuttal of the view that scientific ontologies are pluralistic and inexact. Teller's thesis about inexactness depends upon his thesis about pluralism, which in turn depends upon the purported context-sensitivity of the criterion for being justified in regarding a theory's ontology as real. After sketching Teller's view, I argue that it is incomplete and suggest that removing this incompleteness requires a context-invariant criterion for whether someone is justified in regarding a theory's ontology as real. Next, I show that a criterion based upon a theory's comparative degree of confirmation satisfies this demand, and I argue that this

[1] Paul Teller, "How We Dapple the World," *Philosophy of Science* (2004) 71: 425-447.

criterion is *prima-facie* plausible because it potentially explains attitudes from the history of the debate over the nature of light. I show that ontological pluralism is false if this criterion is correct, and that Teller's argument for inexactness fails if ontologies are exclusivist (rather than pluralist). Finally, I consider a potential objection to the view that the ontologies we are justified in regarding as real are both exclusivist and exact.

Before proceeding, an explanation of terminology is in order. When a theory characterizes the composition and/or structure of an entity, I say that the theory *gives an ontology* for that entity. When the theory characterizes an entity as having a certain element as part of its structure or composition and that element is not a mere mathematical artifact of the theory, I call the element *part of the theory's ontology* for the entity and say that the theory's ontology for that entity includes that element. I call a theory's ontology for an entity *correct* when every element included in that ontology is real. When the ontology of one theory includes one element, the ontology of a different theory includes another element, and an entity cannot include both elements at the same time in the same respect, I say that the two theories give *competing ontologies* for that entity. Finally, when a group is justified in provisionally regarding a theory as giving a correct ontology for an entity, I say that the theory is an *ontological guide* to the entity for that group. I take these definitions to clarify the way that others concerned with the ontological import of theories use these terms.

To illustrate this terminology, consider the liquid drop and shell models. Both give an ontology for nuclei. An incompressible continuous fluid is part of the liquid drop model's ontology for the nucleus, whereas discrete nucleons are part of the shell model's. These theories give competing ontologies for the nucleus, since nothing can be both a continuous fluid and a collection of discrete nucleons at the same time in the same respect. Insofar as one is justified in provisionally regarding the nucleus as composed of discrete nucleons, the shell model is one's ontological guide to the nucleus.

1 Ontological Pluralism

According to Paul Teller, sometimes there can be more than one ontological guide to the same entity. For instance, he argues that both QCD and continuum hydrodynamics are ontological guides to fluids, even though these theories give competing ontologies for water. Both theories provide accessible information about some aspects of the world: QCD, about the results of scattering experiments; continuum hydrodynamics, the flow of water and wave propagation. While QCD is closer to the truth than continuum hydrodynamics in some respects, continuum hydrodynamics is closer to the truth than QCD in other respects. Since we are unable to deduce from QCD equations about the large-scale properties of water (and since we would be unable to make sense of solutions to such equations), QCD gives little accessible information about water's fluid properties (p. 439). Whence Teller:

> Keeping this in mind, and when it is the fluid properties of water that are of interest, a hydrodynamic characterization of water may be fairly evaluated as much more 'truth-like' than a quantum mechanical description, let alone any humanly accessible characterization in terms of quantum field theory (p. 440).

Since nothing privileges some respects as more important (*qua* ontology) than others,[2] Teller concludes that nothing privileges QCD over continuum hydrodynamics as an ontological guide

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[2] "Some may want to maintain that certain respects are privileged in some way. If so, we are owed an argument why we should take any such privileging to be other than interest relative" (Teller, p. 435).

to water. Both are guides to the nature of water if either is. Since QCD clearly is, continuum hydrodynamics is too.

However, Teller does not conclude that water is both a collection of discrete quarks bound by gluons and a continuous incompressible medium. He argues that neither theory's ontology is exactly correct. Since quarks and gluons are represented as excitations of the positive and negative frequency solutions of a wave equation but there are no such solutions if (as General Relativity says) spacetime is irregularly curved, "States described by such solutions are idealizations every bit as much as the idealization of a liquid as a continuous medium" (p. 433). According to Teller, "There are no quanta any more than there are continuous fluids. Both are idealizations, known not to be realized in the real world" (p. 440). Since both QCD and continuum hydrodynamics are ontological guides to water, but neither is exactly correct, the most that justifiably can be said of water is that in some respects it is very much like a collection of discrete quanta and in other respects it is very much like a continuous fluid. These ontologies are compatible with each other, because each characterizes a different aspect of water. QCD is a guide to the composition of water with respect to the scattering properties of its small-scale constituents, and continuum hydrodynamics is a guide with respect to water's large-scale, aggregate properties.

Teller's argument generalizes. Of all our presently available scientific theories, both foundational theories--such as QCD and General Relativity--and phenomenological (nonfoundational) theories give competing ontologies for matter. Although foundational theories are closer to the truth than phenomenological theories in some respects, phenomenological theories are closer to the truth in other respects, because the foundational theories sometimes provide comparatively little accessible information about medium-sized systems. Since nothing privileges some respects as more important (*qua* ontology) than others, foundational theories are ontological guides to matter in some respects and phenomenological theories are ontological guides to matter in other respects. But the ontologies of these theories are not exactly correct, because "the 'ontologies' given by any of our actual theories are all idealizations, and so are, strictly speaking, false" (p. 446). So the most that a theory justifiably can say about what there is in the world is that, in some respects, the world contains objects that are very much like the objects in the theory's ontology.

To illustrate Teller's view with an example that does not invoke the contrast between foundational and phenomenological theories, consider two competing theories of the nucleus. The liquid drop model treats the nucleus as an incompressible continuous fluid and provides accessible information about nuclear deformation and fission, whereas the shell model treats the nucleus as a collection of discrete nucleons and provides accessible information about nuclear binding energies. Since we are interested in all of these phenomena, and since each model is limited in the information it provides, both the liquid drop and shell models can be ontological guides to the nucleus. However, this does not mean that the nucleus can be both a continuum and a collection of discrete nucleons. Instead, it means that there can be one aspect of the nucleus according to which it is continuum-like and a different aspect according to which the nucleus is very much like a collection of discrete nucleons. Since these are different aspects of the nucleus, this plurality of ontologies would be complementary rather than contradictory.

The basic motivation for Teller's view is that all currently available scientific theories that provide humanly accessible information about some question that interests us are not completely accurate because they are idealized in some way. According to Teller, this is true even of what are sometimes called "foundational" theories, such as QCD. Teller argues that "[since] our foundational theories can provide answers to questions about what there is in the world and what it is like, then non-foundational theories [e.g., continuum hydrodynamics] can do likewise …" (p. 440). Furthermore, since

> 'better' must always be evaluated in a complex multitude of ways including considerations of human accessibility, … it cannot be said that foundational theories uniformly provide better answers for questions of the form 'What is there in the world, and what is it like?' (p. 440).

That is: since there is no context-independent way to privilege some informative theories rather than others as ontological guides, multiple theories can be guides to the ontology of the same entity. Without the presumption that there can be only one ontological guide, "we see that we can embrace 'conflicting' ontologies, being careful … not to take them to represent the same aspects of the not completely accurately represented objects of our representations" (p. 441).

2 A Problem with Pluralism

The key to Teller's argument for pluralism is the claim that "'better' must always be evaluated in a complex multitude of ways including considerations of human accessibility." If this is so, then which theory counts as better in some respects can differ from which theory counts as better in other respects. If the ontological guide to a system is given by the best of the competing theories about that system, different theories can be ontological guides to the same system in different respects. Suppose, following Teller, that bestness is a matter of closeness to the truth, where the degree to which a theory approximates the truth is a matter of how similar the theory's theoretical model is to the real world. Then, since degree of similarity is context-sensitive, closeness to the truth is too: one theory can be closer to the truth than a second in one respect, while the second is closer to truth than the first in a different respect.

Ontological pluralism does not require that bestness be a matter of closeness to the truth. It might be a matter of explanatory power or explanatory coherence. According to Chris Eliasmith and Paul Thagard, one component of explanatory coherence is analogy: "Similar hypotheses that explain similar pieces of evidence cohere" (1997, p. 9).[3] According to Stathis Psillos' account of inference to the best explanation, one criterion of explanatory power is importance: theories that explain more salient data tend to give better explanations than those that do not.[4] Similarity and salience are context-sensitive notions: two pieces of evidence might be similar or salient in some respects but not in others. For instance, evidence about the behavior of certain springs and pendula is similar when one is interested in highly qualitative behavior (evidence shows that each kind of system can be very much like a harmonic oscillator); but evidence about the mechanisms that produce such behaviors is dissimilar. Since nothing privileges some respects as more important than others, different theories can be ontological guides to the same system in different respects if explanatory power or coherence determines which theories are ontological guides.

Nonetheless, ontological pluralism is unsatisfactory. It presumes that if two theories provide accessible information about some entity, and each theory is better (in some sense) than

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[3] Chris Eliasmith and Paul Thagard, "Waves, Particles, and Explanatory Coherence," *The British Journal for the Philosophy of Science* 48:1 (1997): 1-19.

[4] Stathis Psillos, "Simply the Best: A Case for Abduction," in *Computational Logic: From Logic Programming into the Future*, eds. Anthony Kakas and Fariba Sadri (Berlin: Springer-Verlag, 2002): 605-625, p. 615.

its competitors in some respect, then both theories simultaneously can be ontological guides to that entity for the respects in which each is the best. This is why Teller says that both QCD and continuum hydrodynamics can be guides to the nature of matter, and it is why both the shell model and the liquid drop model can be ontological guides to the nucleus. But the picture is not always this neat.

Consider modern chemical theory and phlogiston theory. Each gives an ontology for charcoal according to which charcoal is, respectively, a collection of discrete carbon atoms or a composition of earth, water, and phlogiston. Suppose our interest in charcoal is only with respect to its very general, qualitative, large-scale behavior of turning into ashes, water vapor, and fire when burnt. Modern chemical theory and phlogiston theory tie with respect to being the best theory for charcoal in this respect, because each theory predicts this behavior exactly. (If one disagrees, one is welcome to find some other respect relative to which the theories tie for bestness according to one's preferred criterion for bestness. Provided that one characterizes the respect of interest in a sufficiently generic manner, there should be at least one such respect, even if it differs for different criteria of bestness.) So both theories cannot be our ontological guides to charcoal for this respect, lest we regard charcoal as having contradictory properties. Yet we seem to be justified in provisionally regarding at least one theory--namely, modern chemical theory--as an ontological guide to charcoal for this respect. This suggests that being the best theory about some entity *in one respect* is not the only criterion for whether the theory is an ontological guide to that entity for that respect.

Being best-in-a-respect is insufficient for being an ontological guide in that respect, because it is possible for two theories to tie for being best regarding a given respect of an entity even though one of those theories clearly should be the ontological guide to that entity in that respect. This suggests that which theory is an ontological guide to an entity for a given respect depends upon how the theory compares to its competitors in other respects. For instance, modern chemical theory is the ontological guide to charcoal with respect to charcoal's qualitative behavior upon being burnt, not because it is the best theory for that respect of charcoal (it is not; phlogiston theory is equally good), but because modern chemical theory is better than phlogiston theory regarding other respects of charcoal. Assuming that Teller is right in holding that nothing privileges some respects as more important (*qua* ontology) than others, there must be some measure of bestness that does not vary when contexts change the comparative importance of different respects.

3 Context Invariance and Confirmation

When understood in Bayesian terms, degree of confirmation--unlike degree of approximation or explanatory power or coherence--is just such a measure.

According to Bayesianism, the degree to which a theory is confirmed is a function of the theory's prior probability, its posterior probability relative to the total available evidence, and/or the likelihood of the theory and its competitors on the total available evidence. Different measures of confirmation diverge on which of these elements determine degree of confirmation.[5] There is no need to adjudicate the dispute over which measure is correct. It suffices to proceed under the assumption that degree of confirmation is a function of all these elements. If degree of

[5] For a discussion of different Bayesian measures of confirmation, see Branden Fitelson, "The Plurality of Bayesian Measures of Confirmation and the Problem of Measure Sensitivity," *Philosophy of Science* 66:3 (1999): S362-S378.

confirmation is not context-sensitive as a function of all such elements, it is not context-sensitive as a function of a subset of those elements.

Consider each possible element for a measure of confirmation. The posterior probability of a theory is fixed by the likelihoods and prior probabilities of the theory and its competitors. Both likelihoods and priors are context-invariant: once assigned for a set of theories and a set of evidence in one context (such that the set includes evidence available from all contexts), they are invariant across contexts, no matter how those contexts influence the importance of various respects. For instance, if in one context a theory entails all the available evidence, the theory's likelihood in that context--and in every other context--is one, because entailment relations are context-independent. Consequently, if a particular theory has the highest degree of confirmation in one respect, the same theory has the highest degree of confirmation in any other respect, even if it provides no accessible information about that respect. For instance, relative to the totality of currently available evidence, QCD is better confirmed than continuum hydrodynamics and modern chemical theory is better confirmed than phlogiston theory. This is true even concerning those respects of matter for which QCD and modern chemical theory provide little or no humanly accessible information. So, if degree of confirmation determines which theories are ontological guides--that is, if a theory is an ontological guide just in case it is better confirmed than all of its competitors and otherwise sufficiently well confirmed--then QCD and modern chemical theory are guides to the nature of matter in all respects. And continuum hydrodynamics and phlogiston theory are not guides to the nature of matter in any respect, even when they are the only source of humanly accessible information about some aspect of matter. Admitting that degree of confirmation determines which theories are ontological guides nullifies the possibility of multiple, incompatible ontological guides for the same system: that is, it entails that ontological pluralism is false.

Motivation for the view that degree of confirmation determines which theories are ontological guides comes from the history of the debate over the nature of light. Consider a brief (and simplified) history of that debate.[6] Newton's corpuscular theory characterizes light as particulate. The explanatory and predictive superiority of this theory over Huygen's wave theory, with respect to phenomena like the diversity of colors, Newton's rings, and double refraction, privileges Newton's theory over Huygen's as a guide to the ontology of light until the late-eighteenth century. Then, early in the nineteenth century, the corpuscular theory of light falls into disfavor because of Fresnel's wave theory. For, in contrast to the corpuscular theory, Fresnel's theory explains and predicts many of the same phenomena as the corpuscular theory but without improbable auxiliary hypotheses. And Fresnel's theory predicts several surprising phenomena, such as the bright spot at the center of a disk's shadow and the results of Young's double-slit experiment. By the middle of the nineteenth century, it is Fresnel's wave theory (and elaborations of it), rather than the corpuscular theory, that is privileged as the guide to the nature of light.

Assuming that scientists were justified in eventually (provisionally) regarding light as a wave, their justificatory status can be explained by the view that degree of confirmation determines which theories are ontological guides. The initial predictive success of the

[6] This sketch borrows heavily from Peter Achinstein, *Particles and Waves: Historical Essays in the Philosophy of Science* (New York: Oxford University Press, 1991): 13-23. Also his "Waves and Scientific Method," *PSA: Proceedings of the Biennial Meeting of the Philosophy of Science Association* (1992): 193-204.

corpuscular theory in the eighteenth century initially made that theory the ontological guide to light, because it was the best confirmed of the extant hypotheses, relative to the available evidence (and it was otherwise sufficiently well confirmed to be an ontological guide). Since a mathematical refinement of the wave theory and new experimental results about light in the nineteenth century made the wave theory better confirmed than its competitor, the wave theory replaced the corpuscular theory as the ontological guide to light.

Moreover, there is a correlation between the comparative confirmation of corpuscular and wave theories of light and variations in the accepted ontology for light: the ontological guide to light at any given time is the best confirmed theory at that time. If a theory is an ontological guide in virtue of being better confirmed than all of its competitors (and otherwise sufficiently good), this correlation, as well as nineteenth century scientists' provisional acceptance of the wave theory as the ontological guide to light, is no mere coincidence.

This explanatory strategy generalizes. Whenever there are multiple theories available to a group such that each gives a competing ontology for some entity, the strategy says that the group is justified in privileging one of those theories as giving a correct ontology for the entity in question if that theory is better confirmed, relative to the group's available evidence, than any of its competitors (and otherwise sufficiently well confirmed); and it says that the group is justified in regarding the elements of a theory's ontology as unreal if there is some better confirmed theory with a competing ontology (or the theory itself is not confirmed enough). This strategy shows why the scientific community is justified in privileging the Standard Model, rather than more phenomenological theories such as continuum hydrodynamics, as giving a correct ontology for matter: physical matter is a collection of quarks bound by gluons, but not a continuous medium, because the Standard Model is better confirmed, relative to the totality of available evidence, than its phenomenological competitors. This strategy also shows why we are nowadays justified in regarding phlogiston and the ether as unreal: the theories that include these elements in their ontologies are less confirmed than theories that do not include such elements. The strategy does not entail that everything other than the elements in the Standard Model's ontology is unreal: we can be justified in regarding both atoms and quarks as real, because our current atomic theory is better confirmed than its competitors and, insofar as something can be both composed of atoms and composed of quarks at the same time in the same respect, modern atomic theory does not give an ontology that competes with the Standard Model's.

4 Ontological Exactness

If degree of confirmation determines which theories are ontological guides and if ontologies are exclusivist rather than pluralist, what becomes of Teller's point that the ontologies of foundational theories are not exactly correct? It is obvious that if QCD and General Relativity do not give competing ontologies, then each theory's ontology can be exactly correct: neither's exactness is threatened by the other theory's ontology. Suppose, however, that QCD and General Relativity *do* give competing ontologies. Then, if degree of confirmation determines which theories are ontological guides, only the best confirmed theory of the pair is the ontological guide. (If there is a tie, *neither* is an ontological guide: each theory undermines the justification for regarding the other's ontology as real.) Suppose the best theory is QCD. Then the scientific community would be justified in regarding General Relativity's ontology as incorrect. And this would mean that General Relativity poses no challenge to the exactness of QCD's ontology, because the scientific community would be justified in regarding an irregularly curved spacetime as unreal. So the existence of a (sufficiently well-confirmed) competitor to a theory's ontology does not entail that the theory's ontology must be inexact.

Teller, of course, does not merely deny that QCD's ontology is exact. He gives an argument. According to Teller, the quanta of QCD's ontology are excitations of normal modes that are positive and negative frequency solutions of a wave equation. However, "in any model that characterizes space-time as irregularly curved, as do our most accurate models of the structure of space-time, there are no positive and negative frequency solutions of the field equations." Hence, Teller concludes, the quanta of QCD's ontology are unreal, "idealizations every bit as much as the idealization of a liquid as a continuous medium" (p. 433). This suggests not only that QCD and General Relativity give competing ontologies (since General Relativity's ontology includes an irregularly curved spacetime) but also that General Relativity poses a challenge to the exactness of QCD's ontology. If this is correct, the existence of a (sufficiently well-confirmed) competitor to a theory's ontology *does* entail that the theory's ontology must be inexact.

The flaw in Teller's reasoning is the assumption that both QCD and General Relativity (or other models that characterize spacetime as irregularly curved) give correct ontologies. For if only General Relativity gives a correct ontology, then the (purported) incompatibility between quanta and irregularly curved spacetime is unproblematic, because the quanta are not real. If only QCD gives a correct ontology, then the (purported) incompatibility is unproblematic because spacetime is not irregularly curved. Teller's assumption is natural within the framework of ontological pluralism. It allows him to argue that since spacetime is irregularly curved, there are no positive and negative frequency solutions to certain equations within QCD, and that since QCD is an ontological guide despite this, QCD's ontology must be inexact. Yet the assumption is false if degree of confirmation determines which theories are ontological guides. For QCD and General Relativity give competing ontologies: for instance, the latter, but not the former, includes an irregularly curved spacetime as part of its ontology. Either QCD is better confirmed than General Relativity, General Relativity is better confirmed than QCD, or both theories are equally well confirmed. In the first case, QCD is an ontological guide and General Relativity is not; the situation is reversed in the second case; and in the third case, neither theory is an ontological guide. Hence, although ontological pluralism entails that the ontologies of foundational theories are not exactly correct, ontological exclusivism does not.

5 A Problem for Exclusivist and Exact Ontologies

Much of what motivates Teller's endorsement of pluralist, inexact ontologies stems from the fact that even our best theories are idealized in some way. As a quantum field theory, QCD is based upon the idealization that Newton's gravitational constant is negligible; General Relativity is based upon the idealization that Planck's constant is negligible.[7] These idealizations seem to be responsible for each theory apparently being inconsistent with evidence about phenomena for which, respectively, gravity and quantum effects matter: for instance, General Relativity apparently fails to accommodate certain uncertainty relations.[8]

Lavoisier's experiments with phosphorus led many to hold, eventually, that phlogiston is unreal. If degree of confirmation determines whether a theory is an ontological guide,

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[7] J.C. Baez, "Higher-Dimensional Algebra and Planck-Scale Physics," in C. Callender and N. Huggett (*eds*.), *Physics Meets Philosophy at the Planck Scale: Contemporary Debates in Quantum Gravity* (New York: Cambridge University Press, 2001): 177-95.

[8] Baez 2001.

consistency seems to demand that we also regard quarks and curved spacetimes as unreal. Because it seems that General Relativity and QCD, like phlogiston theory, are disconfirmed by the available evidence and, accordingly, not ontological guides.

I only have space to sketch the framework for a response to this objection. Elsewhere I argue that it is possible for Bayesianism to accommodate the attitude that neither General Relativity nor QCD are disconfirmed by our available evidence. I claim that it is possible to do this while retaining the result that phlogiston theory *is* disconfirmed by our available evidence. The basic strategy involves showing that there is a principled way to restrict the scope of a scientific theory so that it only makes claims about certain phenomena. If this strategy is viable, it removes the worry that QCD and General Relativity are not ontological guides in virtue of being disconfirmed.