KITCHER'S PROBLEM WITH ASYMMETRY

A Thesis

by

JANNAI MICAH SHIELDS

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF ARTS

August 2012

Major Subject: Philosophy

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ABSTRACT

Kitcher's Problem with Asymmetry. (August 2012)

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The twentieth century was dominated by two rival views of scientific explanation. The first is the causal view in which causation is primitive. According to this view, the best explanations are the ones that tell us the cause of a phenomenon, organism, or state of affairs. The second is the unification view, which seeks to unify seemingly disparate bodies of knowledge. Philip Kitcher shook up the debate by synthesizing the two views. He developed a unification theory in which causation is derivative of explanation. The intuitive idea is that the best explanations are the ones that can draw the most conclusions from the fewest basic premises, and these premises just are the causal explanations. There is a problem though. Like any theory of scientific explanation, Kitcher must show that his respects explanatory asymmetry. For instance, we want our scientific theories to say that the height of a flagpole is explanatory of the length of the flagpole's shadow, and not vice versa.

Kitcher's view has come under serious attack from Eric Barnes, who claims that Kitcher's theory cannot respect the problem of asymmetry. He gives three examples in which he thinks Kitcher's view fails. Todd Jones tried to defend Kitcher in a paper, but there is still much left to be said. One of his arguments, involving a Newtonian particle

system, fails. The status of two of his other arguments is unclear. My goal is to step into the debate between Jones and Barnes and tip the scales in favor of the position that Jones defended. Additionally, I consider new potential cases of asymmetry and show how Kitcher's theory is equipped to accommodate these cases too.

ACKNOWLEDGEMENTS

I wish to express my indebtedness to those who have helped me complete this project. Just a little over a year ago, I knew next to nothing about the philosophy of science and scientific explanation. I certainly did not plan to write a thesis in this field of philosophy. However, Roger Sansom's seminar in the philosophy of science kindled an interest, and working with him has strengthened my interest as well as sharpened my insight into the topic I discuss in the following pages. I also am glad to have had the chance to work on this project with Hugh McCann and Kirk Winemiller, who have been both patient and supportive throughout the thesis process. Finally, I wish to thank Bhaskar Dutta, who was gracious enough to take time away from his work in the physics department to talk to a philosopher who knows too little about physics.

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1. INTRODUCTION AND LITERATURE REVIEW

The twentieth century was dominated by two views of scientific explanation. The first view is the causal view. As the name implies, causation is primary in the causal view. Since causation is primary, the best scientific explanations tell us the cause of a phenomenon, organism, or state of affairs. The second view is the unification view. According to this view, the best scientific explanations are the ones that best unify bodies of knowledge that seemed disparate without the explanation.

Toward the end of the century, Philip Kitcher dropped a bombshell in the middle of the debate between the unification proponents and the causal proponents. He adopted the unification position, but developed it in a new way. Not only did he claim that the best scientific explanations are the ones that best unify our knowledge, he claimed that unification is more primitive than causation. He plainly states that he is committed to, "If *F* is causally relevant to *P* then *F* is explanatorily relevant to *P*."[1] In another passage, he explains,

> The heart of the unification approach is that we cannot make sense of the notion of a basic mechanism apart from the idea of a systematization of the world in which as many consequences as possible are traced to the action of as small a number of basic mechanisms as possible. In short, on the unification approach, the basic mechanisms must be those picked out in the best unifying systematization of our best beliefs, for if they were not so picked out then they would not be basic.[2]

Clearly, Kitcher is claiming that, in any possible world, causation is the most unified

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This thesis follows the style of *The Chicago Manual of Style*.

1. Philip Kitcher, "Explanatory Unification and the Causal Structure of the World," *Scientific Explanation*, ed. Wesley Charles Salmon (Minneapolis, MN: University of Minnesota Press, 1989), http://site.ebrary.com.lib-ezproxy.tamu.edu:2048/lib/tamu/docDetail.action?docID=10159395, 495.
2. Ibid., 497.

theory. What is remarkable about Kitcher's theory is that it not only gives us a theory of explanation, it gives us a theory of causation too.

The problem of asymmetry is part of the testing ground that any theory of scientific explanation must overcome in order to be viable. In this introduction, my first goal is to introduce the reader to the problem of asymmetry and to give the reader a more detailed account of Kitcher's unification theory. My second goal is to present the reader with Eric Barnes' arguments that Kitcher's theory fails to overcome the problem of asymmetry.

In its contemporary form, the asymmetry problem was first used as a counterexample to Carl Hempel's Deductive Nomological theory of explanation. For Hempel, a good scientific explanation took the form of a sound deductive argument that made reference to at least one law of nature somewhere in its premises. For instance, when explaining the length of the shadow of a tower, Hempel would construct an argument with a premise about the height of the tower, another premise about the angle of the sun, and a third premise about some law of light. This model successfully explains the shadow's length.

However, it looks like the DN model allows for backwards explanations when there should not be any. We could make another argument in which the length of the shadow is explaining why the tower has height x. The DN model will count this backwards explanation as explanatory because it has true premises, uses the same laws, and is able to derive the conclusion about the tower's height. This is bad though, because the tower's shadow should not be explanatory of the tower's height. There should be an

explanatory asymmetry. We do not want our theories of scientific explanation to allow things like the length of the tower's shadow to explain the height of the tower, so Hempel's theory was rejected. After it was shown that Hempel's theory could not respect explanatory asymmetry in the tower case, the problem of asymmetry became a testing ground for any new theory of scientific explanation.

Kitcher thinks his theory can respect explanatory asymmetries. He says,

> What is distinctive about the unification view is that it proposes to ground causal claims in claims about explanatory dependency rather than vice versa. So, we account for the intuition that appeals to shadows do not explain the heights of towers because shadow lengths are causally dependent on tower heights, by suggesting that our view of causal dependency, in this and kindred cases, stems from an appreciation of the explanatory ordering of our beliefs.[3]

The primary aim of this thesis is to see if Kitcher can respect explanatory asymmetries. Eric Barnes, as we will see shortly, argues that Kitcher cannot respect explanatory asymmetry, but there is more work to be done before this issue can be put to rest.

Keeping the problem of asymmetry in mind, I now explain Kitcher's theory in more detail. The intuitive idea that Kitcher is trying to utilize is that scientific explanations should generate as many conclusions as possible by using as few patterns of inference as possible. In order to make this idea stick, Kitcher needs some machinery that will ensure that his theory picks out the most explanatory derivations. One piece of the machinery is the *explanatory store*. The explanatory store is a set of all successful explanations. Kitcher says, "…the fundamental task of a theory of explanation is to specify the conditions on the explanatory store. Intuitively, the explanatory store associated with science at a particular time contains those derivations which collectively

3. Ibid., 436.

provide the best systematization of our beliefs."[4]

Kitcher, similar to Hempel, utilizes arguments that are ordered pairs. The first member of the pair is a set of premises and the second member is a single statement that is the conclusion of the argument. Let *K* be the set of statements endorsed by the scientific community. In order for a particular argument, or derivation of statements from *K*, to count as a good explanation, the derivation must be a member of the explanatory store over *K*, *E(K)*. Kitcher explains, "*E(K)*, then, is the set of derivations that best unifies *K*."[5] More specifically, *E(K)* is the set of derivations that makes the best tradeoff between maximizing the number of conclusions that can be drawn and minimizing the number of patterns of derivations used in the process.[6]

A "pattern of derivation" provides the general structure of arguments, or derivations, that are very similar. Patterns of derivation are made up of schematic sentences in which some or all of the nonlogical expressions are replaced with variables. For example, the sentence "Organisms homozygous for the sickling allele develop sickle-cell anemia," is a particular instance of the argument pattern, "For all *x*, if *x* is *O* and *A* then *x* is *P*". Along with the argument patterns comes a set of filling instructions, which instructs us on how to fill in each variable in the schematic sentences. An argument, or derivation, consists of schematic sentences in a sequence, and a classification is provided which specifies details such as whether a sentence is a premise or a conclusion and the rules for drawing inferences. All of these together make up what

4. Ibid., 430.
5. Ibid., 431.
6. Ibid., 432.

Kitcher calls a general argument pattern, which comes packaged as an ordered triple—the first part is the schematic argument, the second is the set of sets of filling instructions, and the last part is the classification.[7]

Another significant part of Kitcher's theory is his notion of "stringency". Stringency is important because it is one of the factors used in determining which derivation is more unifying between two competing derivations. He says that a pattern is more stringent than another if the conditions upon instantiation of the pattern are more difficult to meet. Kitcher explains, "The stringency of an argument pattern is determined in part by the classification, which identifies a logical structure that instantiations must exhibit, and in part by the nature of the schematic sentences and the filling instructions, which jointly demand that instantiations should have common nonlogical vocabulary at certain places."[8] The purpose of this notion is to judge the similarity between patterns.

Let *D* be a set of derivations and *C(D)* be the set of statements that are conclusions of some member of *D*. *G*, the generating set, will be defined as "…a set of argument patterns such that each derivation [*D*] in the set instantiates some pattern in the generating set."[9] Kitcher brings all of these pieces together to explain how the theory's unifying power is judged. He says, "The unifying power of a complete generating set for *D* varies with the size of *C(D)*, directly with the stringency of the patterns in the set, and inversely with the number of patterns in the set."[10]

At this point, I have explained the basic, most important features of the

7. Ibid.
8. Ibid., 433.
9. Ibid., 434.
10. Ibid., 435.

unification theory. I now want to explain how Kitcher handles the tower's shadow case. Let *K* be the set of our current beliefs. We are going to compare the unifying power of a systematization *S* to *S**. *S* consists of premises about the height of the tower and the angle of the sun, and a conclusion about the length of the shadow. *S** consists of premises about the length of the tower's shadow and the angle of the sun, and a conclusion about the height of the tower. Which is more unifying? Kitcher argues that *S* is more unifying because of *origin-and-development explanations*. Origin and development explanations are used to explicate the current state of the object in which we are interested by tracing the object's history. So, in order to explain the present condition of an object, we use derivations that instantiate a pattern that traces the object to the conditions in which it originated.[11]

If *S** does not include origin and development explanations, then it is less unifying than *S* because it cannot derive as many conclusions as *S*. For instance, the pattern used in *S**, which reasons from the length of the shadow to the height of the tower, could not be used in instances where there was no shadow, but the origin and development explanations can be used. Thus, *S** cannot derive as many solutions.[12] Even if *S** includes origin an development explanations, it still loses. By including O and D explanations, *S** would be required to contain the pattern used for O and D explanations. However, *S** would include an additional pattern to enable the derivation from the shadow's length to the tower's height. Thus, *S** is burdened with an additional pattern,

11. Ibid., 485.
12. Ibid.

but incapable of deriving any more conclusions than *S*.[13] So, it looks as though Kitcher avoids the problem of asymmetry.

However, Eric Barnes presents three cases of asymmetry in which the O and D explanations do not seem to solve the problem of asymmetry. The first example involves a Newtonian particle system, *N*, which is a temporally symmetric closed system. We take the set of all statements in K of the form "Object *O* in *S* has position *P* and velocity *V* at some time *T*" as the class of our explananda *E*. Given a complete description *D* of the system at some time *t* in *K*, "*E* will contain a complete set of descriptions of the position and velocity of all objects in *N* for each moment in *N*'s history; these descriptions will be deductively inferred from *D* together with Newton's laws."[14] There is an argument pattern, Barnes calls it the *Newtonian Predictive Pattern*, which totally covers the statements in *E*. The explanation of any member of *E* will intuitively consist of the conjunction of Newton's laws and the premises from *K* describing the state of *N* before the occurrence of the explanandum. There is a second pattern, however, that Barnes calls the *Newtonian Retrodictive Pattern*. The new pattern derives its unifying power from the fact that Newton's laws are temporally symmetric. "Assuming a closed system, one may as easily retrodict some state of the system from a complete description of the system at some later time as one may predict future states from prior states".[15] These two patterns are identical in their ability to supply a unified account of the set of explananda. The unification theory does not rule out the asymmetrical *Newtonian Retrodictive Pattern* as

13. Ibid.
14. Eric Barnes, "Explanatory Unification and the Problem of Asymmetry," *Philosophy of Science* 59 (1992), 564.
15. Ibid., 565.

less explanatory, something a well-behaved theory should do.

The second and third examples involve evidentiary arguments, which explain "Why do we/should we believe that *p*." Such arguments are often incapable of answering "Why *p*?", however. They fail to explain the cause of *p*. A theory of explanation should respect the nonexplanatory nature of evidentiary arguments, but there are plausible cases in which it seems that Kitcher cannot.

This time, we take as our class of explananda *E* the set of all statements *K* describing causal processes in open physical systems. Such systems demonstrate a temporal asymmetry with respect to the prediction and retrodiction of their causal processes.[16] For example, we know when we see footprints in the sand that the beach is an open system on which walkers have strolled; the footprint did not evolve from a prior state of the beach. We know that the footprints did not evolve from a prior state of the beach because it is highly unlikely that a low entropy state, such as the footprint, would evolve; there must have been some outside causal force entering and affecting the open system. Thus, such causal processes are open to retrodiction, but not prediction, because the causal processes involved in an open system are unpredictable. Kitcher has a problem again.

There is a retrodictive pattern that can be used to derive that there must have been a stroller on the beach, but there is no competing predictive derivation.[17] Since there is no competing derivation, the retrodictive pattern is the most unifying by default. However, retrodictive patterns are inherently nonexplanatory, according to Barnes. This

16. Ibid., 567.
17. Ibid.

nonexplanatory character derives from a violation of the asymmetry of explanation because, "…what should intuitively count as the explanandum (the occurrence of the footprint) appears as a premise, and the intuitive explanans (the beach/stroller causal interaction) occurs as the conclusion."[18] Kitcher must affirm that the retrodictive pattern is explanatory because it is the most unificatory, when it is in fact nonexplanatory.

The last example is a another evidentiary argument that Barnes calls the paleontological example. Consider the following argument:

1. A fossil of type *F* indicates a dinosaur of skeletal type *S*.
2. A fossil of type *F* has been found.
3. Therefore, a dinosaur of skeletal type *S* existed.

Take as our class of explananda the class of all statements *K* of the same form as (3), i.e., the class of all statements that such and such dinosaurs existed. Suppose that paleontologists who accept such statements do so on the basis of an instantiation of the above argument pattern.[19] Lastly, suppose that paleontologists do not consider themselves to be in a position in which they can offer any explanation as to why these skeletal structures, rather than some other structures, or no skeletal structures, came to exist. Under these conditions, there is no argument pattern which scientists take to be explanatory of the broad class of hypotheses. Again, however, Kitcher must claim that the pattern is explanatory because there is no more unified pattern. But this seems absurd.[20]

These examples show that, in order to successfully defend his theory from

18. Ibid. 567-568.
19. Ibid., 569.
20. Ibid.

Barnes' arguments, Kitcher needs more than just the O and D explanations. Todd Jones has attempted a defense of Kitcher. In the next section, I evaluate his defense.

2. A STANDOFF BETWEEN JONES AND BARNES

As we saw in the introduction, Eric Barnes argued that Philip Kitcher's unification theory of explanation cannot account for the asymmetries of explanation. In this section, I consider Todd Jones' response to Barnes.[21] Jones tries to exploit the ambiguities found in unificationists' guiding principle, which says that we should try to use the same argument patterns repeatedly to derive as many conclusions as possible. His primary claim is that the unification theory possesses two features that allow it to avoid affirming Barnes' nonexplanatory backwards derivations as explanatory:

> 1) In cases where the only way to derive a precise description of some phenomena is to retrodict it from later information, there are other, more unifying, forward-looking patterns which can partially derive these conclusions and are preferred on unification grounds. 2) The forward-looking derivations of conclusions, even if only partial, help unify our knowledge because the patterns involved belong to related *families* of patterns. Membership in these larger families makes forward-looking patterns preferred on unification grounds.[22]

I think Jones' approach works well for the beach stroller case. However, I think he needs help in the paleontological case. Near the end of this section I offer a clearer picture of how Kitcher's notion of stringency and similarity might work with Jones' family of patterns concept. I think this will help clarify the status of the paleontological example.

Recall the paleontological example and the Fossil Pattern. The Fossil Pattern says,

1. A fossil of type *F* indicates a dinosaur of skeletal type *S*.
2. A fossil of type *F* has been found.

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21. Todd Jones, "How the Unification Theory of Explanation Escapes Asymmetry Problems," *Erkenntnis* 43 (1995), http://pao.chadwyck.com/PDF/1334205012660.pdf: 229-240.

22. Ibid., 231.

3. Therefore, a dinosaur of skeletal type *S* existed.[23]

The Fossil Pattern is obviously a nonexplanatory evidentiary pattern. Our class of explananda is the class of all statements in *K* of the same form as (3). Barnes asks us to suppose that the paleontologists are not in a position to give any explanations as to why these skeletal structures existed rather than not at all, or rather than some other structure. Since, according to Barnes, there is no account more unifying than the Fossil Pattern, Kitcher must affirm it as explanatory when it is clearly a nonexplanatory retrodictive pattern.[24]

Jones thinks that Kitcher's theory does not affirm the Fossil Pattern and similar retrodictive patterns as explanatory. Feature one is relevant here: "In cases where the only way to derive a precise description of some phenomena is to retrodict it from later information, there are other, more unifying, forward-looking patterns which can partially derive these conclusions and are preferred on unification grounds."[25] Jones calls these more unifying, forward-looking patterns "epistemologically intermediate" accounts. He identifies two kinds of epistemologically intermediate accounts. The first is a speculative explanation. In speculative explanations, detailed conclusions are generated from premises of which we are uncertain. The second epistemologically intermediate account is a partial explanation. In partial explanations, a less detailed conclusion is derived using premises that are well accepted.[26]

Let's consider whether or not a speculative explanation is preferred over the

23. Eric Barnes, "Explanatory Unification and the Problem of Asymmetry," 569.
24. Ibid.
25. Jones, "How the Unification Theory," 231.
26. Ibid., 234.

Fossil Pattern on unification grounds. For Barnes, the competition is between a slim set of derivation patterns that can derive no conclusion whatsoever and a somewhat fatter, less-unifying set of derivations that adds the evidentiary pattern. The fatter, nonexplanatory set wins on unification grounds because it has the virtue of being able to derive some conclusions. Jones thinks there is room for a speculative account here, and that a speculative account will allow the conclusion about the skeletal structure.

A speculative explanation might be derived using the "Darwinian Evolution of Skeletal Structure Pattern," a pattern contained in the slimmer set. This pattern utilizes selection pressures that existed at the time of the organism and at predecessor skeletal forms. Using this pattern over and over to account for why organisms have the forms they do would be unificatory. However, Barnes thinks that this Darwinian pattern is not available because scientists do not have the relevant historical facts in hand.[27] Jones responds by saying,

> But the problem we face here is *not* that we could not use this general Darwinian pattern and fill it in with detailed information about past conditions to generate the skeletal structure conclusion. (We could easily create a plausible just-so story.) Rather, the problem is that we really don't have enough access to the past to have complete confidence in the accuracy of the premises used in this derivation.[28]

So in the skeletal structure case, we can give a speculative explanation using the general Darwinian pattern. We do so by making educated guesses about the predecessor skeletal forms and the selective pressures that might have existed at the time that led to the formation of the skeletal structure in question.

There are good reasons to be skeptical of speculative patterns. Before I explain

27. Ibid., 233-234.
28. Ibid., 234.

these reasons, let's consider an example of a way we might construct the Darwinian Evolution of Skeletal Structure Pattern (henceforth called the Darwinian pattern):

1. The predecessors of dinosaurs with skeletal type φ had skeletal type ψ.
2. Dinosaurs with skeletal type ψ faced selective pressures $x_1,...,x_n$.
3. Dinosaurs with skeletal type ψ lived in environmental conditions $y_1,...,y_n$.
4. The evolution of dinosaurs of type ψ faced with selection pressures $x_1,...,x_n$ under environmental conditions $y_1,...,y_n$ caused dinosaurs of skeletal type φ.
5. Dinosaurs of skeletal type φ existed.
6. Under the right conditions, dinosaurs of skeletal type φ left fossils of type θ.
7. The right conditions for the preservation of type θ fossils occurred and some number of type θ fossils were preserved.
8. Paleontologists look for fossils of type θ.
9. A fossil of type θ has been found.

The following are the filling instructions for the pattern. Let skeletal type ψ be structurally similar to skeletal type φ such that it is conceivable that φ evolved from ψ. φ and ψ are placeholders for whatever kind of skeletal structure in which we are interested. $x_1,...,x_n$ will be all the selective pressures that play a role in the modification of a form, and $y_1,...,y_n$ will be all the environmental conditions that play a role in the modification of a form. Lastly, θ is a placeholder for whatever fossil type in which we are interested.

Concerning classification, clearly lines one through eight are all premises and nine is the conclusion. Additionally, it looks like the conclusion can only be derived if we have all nine premises, so if we have a premise that cannot be filled in, then the argument is not valid. Line eight might be an exception, here; perhaps it is not necessary because a fossil could be found even if no one was looking for it. Notice that the fifth premise in the Darwinian pattern is the conclusion of the Fossil Pattern. In evidentiary patterns, explanatory asymmetry is violated and what should be the explanandum (the fossil being discovered) occurs as a premise.

A speculative derivation of the Darwinian pattern will contain premises of which we are uncertain. I have replaced the variables in the pattern above with capital letters, which represent specific names and instances in this case. Here is an example:

1. It is possible that the predecessors of dinosaurs with skeletal type *S* had skeletal type *R*.
2. Dinosaurs with skeletal type *R* might have faced selective pressures $x_1,...,x_9$.
3. Dinosaurs with skeletal type *R* might have lived in environmental conditions $y_1,...,y_7$.
4. The evolution of dinosaurs of type *R* faced with selection pressures $x_1,...,x_9$ under environmental conditions $y_1,...,y_7$ possibly caused dinosaurs of skeletal type *S*.
5. Dinosaurs of skeletal type *S* existed.
6. Under the right conditions, dinosaurs of skeletal type *S* left fossils of type *F*.
7. The right conditions for the preservation of type *F* fossils occurred and some number of type *F* fossils were preserved.
8. Paleontologists look for fossils of type *F*.
9. A fossil of type *F* has been found.

Jones thinks that speculative accounts like the one I gave are preferable on unification grounds. In order to see if he is right, we need to know the criteria for deciding which derivations are the most unificatory. Kitcher says, "The unifying power of a complete generating set for *D* varies directly with the size of *C(D)*, directly with the stringency of the patterns in the set, and inversely with the number of patterns in the set."[29] So to determine whether the unification theory will count the Fossil Pattern or the Darwinian pattern as more unificatory, we must determine which pattern is most stringent, which can derive the most conclusions, and whether either pattern adds to the set of *C(D)* (where *D* is the set of derivations and *C(D)* is the conclusion set of *D*).

According to Kitcher, we say that a pattern is more stringent than another "If a pattern sets conditions on instantiations that are more difficult to satisfy than those set by

29. Philip Kitcher, "Explanatory Unification and the Causal," 435.

another pattern…"[30] This definition of stringency is general and not very helpful for determining between the Fossil Pattern and the Darwinian pattern. Kitcher gives no explanation as to how we are to determine "conditions on instantiations that are more difficult to satisfy than those set by another pattern." Perhaps one reason that he does not give this explanation is that it is very unclear how to give such an explanation.

One criterion for determining stringency might be the number of premises in a pattern. It is natural to think that it will be more difficult to satisfy a pattern with several premises, since the instantiations must align properly with each premise in order for the instantiation to fit the pattern. According to this criterion, the Darwinian pattern is more stringent since it has more premises. However, this criterion has limits. Perhaps the conditions set on the three premise Fossil Pattern are very difficult to satisfy and the conditions set on the eight premise Darwin pattern are comparably easy to satisfy. I have in mind here a case in which the conditions on one pattern make it such that it is harder to instantiate a premise. If this is the case, the Fossil Pattern might be more stringent. I conclude from this that we are not in a position to determine which pattern is more stringent, so we will have to determine which pattern can derive the most conclusions in order to ascertain which one is more unificatory.

However, both patterns appear capable of deriving many conclusions. The evidentiary Fossil Pattern could be used on almost any dinosaur fossil found. The speculative Darwinian pattern can be used repeatedly to derive conclusions, with one exception. It is conceivable that paleontologists could find a fossil that they know so

30. Ibid., 433.

little about that they are unable to provide educated guesses that allow them to fill in the Darwinian pattern. Imagine the paleontologist finding a fossil of a form that does not fit any of our paradigms and is, therefore, mysterious to her. Because of this possibility, it might be that the Fossil Pattern can derive a few more conclusions than the Darwinian Pattern.

In finalizing our evaluation of each pattern, it is important to note that the Fossil Pattern adds to the set *D*, while the Darwinian pattern does not. Presumably something like the Darwinian pattern is already part of our set *D* and is being used by scientists today. So a small edge goes to the speculative Darwinian pattern, since it is does not expand *D* at all. This might not be much of an advantage though, since adding the Fossil Pattern only adds one pattern, and since the Fossil Pattern can likely derive a few more conclusions for *C(D)*.

I conclude from this discussion that we cannot affirm that the speculative explanation is chosen over the evidentiary pattern on unification grounds. We are not in a position to determine which pattern is more stringent. Additionally, we know that the evidentiary pattern might be able to draw a few more conclusions than the speculative pattern, but that the evidentiary pattern adds to our set *D*. At this point we can say that the speculative explanations do not eliminate the possibility of the unification theory affirming evidentiary patterns as the most unificatory and, thus, explanatory. Though the Darwinian pattern might compete with the Fossil Pattern, we cannot conclude that it is preferred.

Now we turn to Jones' notion of a partial explanation. Recall that in a partial

explanation a less detailed conclusion is derived using premises that are well accepted. Jones says, "Here, one may only be able to derive a more schematic "outline" of the conclusion—or one may only be able to derive various parts of the situation described in the conclusion."[31] He thinks partial explanations will be counted as the truly explanatory accounts rather than evidentiary arguments because "A partial account tells us a great deal about numerous features of the conclusion, without having to add any new patterns to our special maximally unifying set."[32] Another reason that the partial explanations are better is that they help unify our knowledge because they use premises with placeholder terms. Placeholder terms stand in place of more detailed descriptions and guide us in searching for new information that will allow us to generate more precise conclusions.[33]

First I will give a partial explanation that ends in a schematic outline of the conclusion. It is important to be aware of why we might only be able to derive a schematic outline of the conclusion. I see only two reasons for this situation. The first is that our information is so incomplete that we cannot fill in some premises of the Darwinian pattern. This results in missing premises. The second reason is that, although we are able to fill in all the premises, our information is so incomplete that many of the details in the premises are unknown, or we only have an approximation of those details. The premises, therefore, lack detailed information.

If our information is so incomplete that we have missing premises, these premises must be filled in with speculative premises. To see this, note that missing premises result

31. Jones, "How the Unification Theory," 234.
32. Ibid., 235.
33. Ibid.

in invalid arguments, and the unificationists do not want their theory to affirm invalid arguments. But if they turn to speculative premises to fill in the missing premises, then the argument pattern is subject to the concerns already discussed above.

Since Jones seems to want the partial explanations to be different than the speculative explanations, he must have in mind the second reason I mentioned; that is, cases in which our information is so incomplete that we can fill in the details of premises with fuzzy approximations at best. The following is a partial explanation pattern where we are only able to derive a schematic outline of the conclusion:

1. Predecessors of dinosaurs with skeletal type *S* had a skeletal type approximately like skeletal type *R*.
2. Dinosaurs with a skeletal type approximately like *R* faced selective pressures $x_1,...,x_n$ (though we are unable to say what $x_1,...,x_n$ are).
3. Dinosaurs with a skeletal type approximately like *R* lived in environmental conditions $y_1,...,y_n$ (though we are unable to say what $y_1,...,y_n$ are).
4. The evolution of dinosaurs of approximate skeletal type *R* faced with selection pressures $x_1,...,x_n$ under environmental conditions $y_1,...,y_n$ caused dinosaurs of skeletal type *S*.
5. Dinosaurs of approximate skeletal type *S* existed.
6. Under the right conditions, dinosaurs of approximate skeletal type *S* left fossils of approximate type *F*.
7. The right conditions for the preservation of type *F* fossils occurred and some number of type *F* fossils were preserved.
8. Paleontologists look for fossils of type *F*.
9. A fossil of approximate type *F* has been found.

Again, I have filled the variables with specific names. The primary difference between this partial Darwinian pattern and the standard Darwinian pattern is that this one has placeholder terms.

Now we must determine if this pattern is more explanatory on unification grounds than the Fossil Pattern. So we must determine which pattern is more stringent and which allows us to derive the most conclusions. Like the speculative pattern, the

partial pattern has the quality of not expanding our set of patterns *D*. Also like the speculative pattern, we cannot determine if this pattern is more stringent than the Fossil Pattern. In fact, this one might be less stringent than the speculative Darwinian pattern because the less precise premises might make it easier to satisfy the conditions on instantiation. Concerning which pattern can derive the most conclusions, the results are again like the speculative case. Both patterns are capable of deriving many conclusions, but the evidentiary pattern might be able to derive a few more. This is because there likely are cases in which we will know so little about a fossil that we cannot fill in the partial Darwinian pattern.

There is another reason for concern. Recall that Jones says, "…one may only be able to derive a more schematic "outline" of the conclusion—or one may only be able to derive various parts of the situation described in the conclusion."[34] I wonder how Jones would have us compare the conclusions of the Fossil pattern with the conclusions of the partial Darwinian pattern. Notice that they do not derive the same conclusions. The partial Darwinian pattern can only derive an approximation as a conclusion. The Fossil pattern does a better job at deriving the conclusions that we want, and it seems like this should count in favor of the Fossil pattern being more unificatory.

So far, Jones' claim that the partial explanations are preferred to the evidentiary explanations on unification grounds seems wrong. When we compare the two kinds of patterns on unification grounds, we have not been able to determine a clear winner, and the unificationists need these evidentiary patterns beaten if they are to avoid the

34. Ibid., 234

asymmetry problem.

For the remainder of the section, I will focus on the notion of a family of patterns. Recall Jones' second claim—that "…the forward-looking derivations of conclusions, even if only partial, help unify our knowledge because the patterns involved belong to related *families* of patterns. Membership in these larger families make[s] forward-looking patterns preferred on unification grounds."[35] Jones thinks this because in a 1981 paper, Kitcher says that it is important not only to use as few patterns as possible, but also to use similar patterns.[36]

I think Jones might be on to something, but he is mistaken about Kitcher's position. In his 1989, the reason Kitcher introduces stringency is "To capture the notion that one pair of arguments is more similar than another pair…"[37] So determining stringency *is* how we determine similarity for Kitcher, or family membership for Jones. Jones thinks that he has added another category to assess the unificatory power of patterns, but there is no other category for Kitcher. By his 1989 paper, Kitcher developed what he meant by "similarity" in earlier work into this notion of stringency. So when Jones talks about similarity, we should think of stringency.

Neither Jones nor Kitcher says much about families of patterns, but perhaps this notion was motivating their talk of stringency and similarity. Maybe we can think of stringency as being measured on a continuum. On the most stringent side of the spectrum, there is identity. The only patterns that are perfectly stringent are identical to

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35. Ibid., 231.

36. Philip Kitcher, "Explanatory Unification," *Philosophy of Science* 48 (1981), http://www.jstor.org.lib-ezproxy.tamu.edu:2048/stable/pdfplus/186834.pdf?acceptTC=true: 505-531.

37. Kitcher, "Explanatory Unification and the Causal," 433.

each other. At the other end of the continuum, any argument pattern can be said to have similarity with another. Recall that Kitcher said, "If a pattern sets conditions on instantiations that are more difficult to satisfy than those set by another pattern, then I shall say that the former pattern is more *stringent* than the latter."[38] Let's say that there is particular pattern *A*, and this pattern is considered the most unified explanation for something *y*. We could have two competing patterns that have something similar to *y* as their conclusion. Which one is more unifying? Well, all other factors being equal, I think Kitcher had in mind, with his notion of stringency, that the most unified account between our competing explanations is the one that is most similar in structure to *A*.

It is time to figure out where this leaves us with respect to the Fossil Pattern example. Before, I concluded that we were unable to tell whether the Fossil Pattern or the Darwinian pattern were more stringent. Moreover, I concluded that the Fossil Pattern could probably derive more conclusions, but that this meant adding a pattern to *E(K)*. Even Barnes admits that the Darwinian pattern would be the most explanatory if we had all the pertinent facts. So let's take the Darwinian pattern and put it on *A*'s position on the continuum. In this case, I think it is likely that both speculative and partial explanations will be more stringent than the Fossil Pattern. This is because the speculative and partial patterns are closer to the Darwinian pattern on the continuum. We want the pattern that is more closely related to the Darwinian pattern because it seems that science is committed to something like it being the most unified. This would suggest that Kitcher can accommodate the paleontological example, but I am reluctant to make

38. Ibid.

this claim outright, since there is still a great deal not known about how many conclusions each pattern can derive.

Finally, I shall consider the beach stroller case. Recall for this one that we take as our class of explananda *E* the set of all statements *K* describing causal processes in open physical systems. Such systems demonstrate a temporal asymmetry with respect to the prediction and retrodiction of their causal processes.[39] For example, we know when we see footprints in the sand that the beach is an open system on which walkers have strolled; the footprint did not evolve from a prior state of the beach isolated from outside forces (such as strollers). We know that the footprint did not evolve from a prior state of the beach because it is highly unlikely that a low entropy state, such as the footprint, would evolve. A force from outside the system must have caused the footprint. Thus, such causal processes are open to retrodiction, but not prediction, because the causal processes involved in an open system are unpredictable.

Since retrodictions are not explanatory, Kitcher has a problem again because there is a retrodictive pattern that can be used to deduce the explananda of causal processes in open systems.[40] There is no greater unifying force that could defeat the retrodictive explanation, so Kitcher must affirm that the retrodictive pattern is explanatory.

Jones attempts to solve the stroller case by utilizing a derivation from the "Origin and Moving forces (O and M) family of patterns, a relative of Kitcher's Origin and Development patterns. Using such a pattern, he gives the following account of the

39. Barnes, "Explanatory Unification and the Problem," 567.
40. Ibid.

footprint on the beach: "The stroller was previously at another location a certain distance from the spot in question. The stroller wanted to be at a different spot, and in trying to get there, she had to pass by the spot in question."[41]

I think Jones is right on the beach stroller case. Consequently, Kitcher has the means necessary to respect asymmetry; it will not affirm the retrodictive pattern as the most explanatory in this case.

To review, it looks like Kitcher can accommodate the two evidentiary cases given by Barnes. I think Jones argued well for how Kitcher can handle the beach stroller case. His argument against the paleontological example was less convincing, but my arguments helped here. It seemed that Jones was a bit mistaken or unclear concerning families of patterns, stringency, and similarity. I believe that I helped clarify how these notions should be used with regard to Kitcher's theory. Once I did this, a way forward appeared in the paleontological example, and it looks like Kitcher might be equipped to handle this case too.

Kitcher wants to say that it is not important to work out the precise criteria for how we determine what counts as most unificatory. He says, "I am prepared to allow for the possibility that, with respect to some corpora *K*, there might be genuine indeterminacy in deciding how to weigh relative stringency, paucity of patterns and range of conclusions against one another, with consequent indeterminacy about *E(K)*."[42] He thinks that in actual scientific practice, it is fairly easy to tell which rival pattern is more unifying.

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41. Jones, "How the Unification Theory," 236-237.
42. Kitcher, "Explanatory Unification and the Causal," 435.

We saw in this section that the indeterminacy that Kitcher is comfortable with often hampers our ability to judge between cases. Going forward, the unificationist should work out the criteria in a more precise fashion in order to help determine which rival pattern is more unifying. For instance, we need more detailed criteria for how to decide between cases in which we have an explanation that involves more patterns that can derive more conclusions with a competing explanation that uses fewer patterns, but derives fewer conclusions. In the next section, I consider the Newtonian case.

3. WHAT TO DO WITH THE NEWTONIAN CASE?

In the previous section, I skipped over Jones' attempt to show that the unification theory is equipped to handle Barnes' Newtonian case. This is because the Newtonian case is fundamentally different than the evidentiary cases. Up until now, I have been happy to assume forward causation along with Barnes. In this section, I no longer assume forward causation, but take seriously the possibility that there may be worlds in which causation is different. At this point, readers might wonder why I am suddenly accepting backwards causation. I am accepting backwards causation now because the Newtonian example is different from the evidentiary ones. Unlike the other examples, there is absolutely no difference between the retrodictive pattern and the predictive pattern, except for the direction of causation. Furthermore, physics tells us there may be real cases of backwards causation, and we are going to examine one of them.

In order to prevent confusion, I will speak to what I mean by "forward causal", or "forward causation". By "forward causation", I have in mind the kind of causation in which causes precede their effects. Causes, in forward causation always are earlier in time than their effects. An example of forward causation is when a pool player hits a queue ball to break at the beginning of a pool game. In this case, the cause is the pool player's hit on the queue ball, and the effect is the breaking of the billiard balls. So we see the cause working in a forward casual time-line.

Although I am now accepting backwards causation, it does not seem that Barnes ever does. I will eventually argue that, once we take into account the fact that the

direction of causation does not matter in the Newtonian example, the argument against Kitcher based on the Newtonian example should be completely rejected. I first want to make the case that Barnes assumes that forward causation, and consequently, forward explanations are the only type of causation and explanation that are truly explanatory. Let's consider the first case involving any temporally closed system *N*, and let this closed system be a Newtonian Particle System. The class of explananda *E* is the set of all statements in *K* of the form "Object *O* in *N* has position *P* and velocity *V* at time *T*." The Newtonian Predictive Pattern, which can account for all explananda by using Newton's laws and the state of *S* prior to the explananda, seems to be both explanatory and maximally unifying. However, the Newtonian Retrodictive Pattern, which allows the retrodiction of the state of the system at some time from a complete description of a later state of the system, is just as unifying as the Newtonian Predictive Pattern.[43]

Since the Newtonian Retrodictive Pattern is seemingly as unifying as the Newtonian Predictive Pattern, the unification theory has no principled way of picking between the two patterns. It is important that we see why Barnes thinks this is a problem for Kitcher. Notice, the only difference between the Newtonian Predictive Pattern and the Newtonian Retrodictive Pattern is that the former is a directionally forwards explanation and the latter is directionally backwards. So, the problem has to be that Barnes does not think backwards explanations are legitimate. He thinks that the correct, forward derivation ties with a nonexplanatory backwards derivation. If he thought that backwards explanations are at least sometimes acceptable, then it is likely that he would

43. Barnes, "Explanatory Unification and the Problem," 564.

not find it problematic that the two patterns seem to tie. He does not say why he thinks this, but it is reasonable to guess that he thinks this because he thinks causation must be forward.

Now I consider the beach stroller case. Recall that our class of explananda *E* is the set of all statements in *K* describing causal processes in open physical systems. In this case, the surface of the beach is smooth with the exception of one place in which there seems to be a human footprint. The observed footprint leads to the high probability conclusion that a human was walking along the beach. This conclusion is a retrodiction, and Barnes says that, "Retrodictions cannot serve to explain their conclusions."[44] Barnes never says why he thinks that retrodictions cannot serve to explain their conclusions, but it seems likely that the reason is because he thinks that retrodictions are not explanatory of the causal processes that lead to their respective explananda. So, the beach stroller case is also dependent upon it being the case that the only causation that is explanatory is forward causation.

Lastly, I consider the Paleontological Example, which shares a similar structure to the beach stroller case. Recall that the argument pattern for this example is as follows:

1. A fossil of type *F* indicates a dinosaur of skeletal type *S*.
2. A fossil of type *F* has been found.
3. Therefore, a dinosaur of skeletal type *S*, existed.[45]

The conclusion is another retrodiction, so it fails to be explanatory for the same reasons as the beach stroller case, according to Barnes. Once again, the example is dependent upon it being the case that forward causation in the only causation that is explanatory.

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44. Ibid., 567.
45. Ibid., 569.

So, all three cases are dependent upon it being true that the only causation that is explanatory is forward causation.

We have finished with the first step in my argument by showing the dependence in Barnes' cases. It is not surprising that Barnes' cases have this dependency. Indeed, in our contemporary setting, it is a deeply entrenched belief that causes must precede effects. However, this may not always be the case. In contrast to Barnes, Kitcher's theory is not dependent upon a certain type of causation being the only type that is explanatory. He does not privilege forward causation. So, if science discovered an instance of backwards causation, it would not be a problem for him. Next, I want to show how Jones' argument fails to show how Kitcher can account for the Newtonian case.

Jones says that we must look, not only to how many conclusions a pattern can produce, but also at how similar a pattern is to other patterns. Additionally, he says,

> The Newtonian Predictive Pattern begins with a configuration of moving particles with a certain mass and velocity and uses the dynamics equations to predict future configurations. Thus, this pattern belongs to the family of patterns that seeks to explain something's form by describing its form at the time of origin and how subsequent forces have altered that form to produce its present state—the O and D family described above.[46]

The idea here is that the predictive pattern belongs to the O and D family of patterns; using this pattern unifies our knowledge because it shows us another example in which we can use the O and D family of patterns. While the retrodictive pattern can produce the same conclusions, it does not belong to the O and D family of patterns, and so is not unificatory.[47]

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46. Jones, "How the Unification Theory," 237.
47. Ibid.

Jones makes an error when he uses similarity and families of patterns for the Newtonian case. The only difference between the two patterns is their direction, so while the predictive pattern might belong to the O and D family, the retrodictive pattern belongs to a backwards explanation family. Remember that we are not assuming forward causation anymore. So, while the predictive pattern might be more explanatory in this world, it is not more explanatory in a backwards causal world. In a backwards causal world, the retrodictive pattern is explanatory. The O and D pattern cannot span worlds and also be the most unificatory in a backwards causal world, or in a Newtonian world. In a Newtonian world, there is a tie between the retrodictive and the predictive pattern. And Jones cannot try to save his case by appealing to partial explanations or speculative explanations, since the patterns are exactly the same except for in direction.

However, the unificationist need not worry about Jones bad argument. There is a better reason for rejecting the Newtonian case as a reason to reject Kitcher. Since we are not assuming forward causation anymore, the retrodictive pattern can be explanatory. This argument is very quick, but it is all that I need. If we are talking about a Newtonian world, then backwards explanations are just as unifying as forwards. This is because in a Newtonian world, there is no fact of the matter as to whether causation is forwards or backwards.

Now I will turn to physics to provide us with a possible case of backwards causation in this world. I see this exercise as one that gives even more reason for rejecting Barnes' use of the Newtonian case. Additionally, it lends support to the claim that backwards causation is possible, perhaps even in this world.

Physicists are not committed to the deeply entrenched belief that causes must precede effects. Moreover, physicists do not seem to care whether causation is forward or not. To date, physicists have not found a physical instance of backward causation, but they are open to the possibility. In fact, some theoretical physicists are actively looking for physical events that might be characterized as backward causal.[48]

The possible case of backwards causation that I discuss makes use of an "inertial frame of reference", so I will now explain what an inertial frame of reference is. An inertial frame of reference is a particular kind of frame of reference. A frame of reference is a device that allows us to make geometrical descriptions of motion while ignoring the masses and forces that may be involved.[49] Robert DiSalle defines it in this way: "A 'frame of reference' is a standard relative to which motion and rest may be measured; any set of points or objects that are at rest relative to one another enables us, in principle, to describe the relative motions of bodies."[50]

An inertial frame of reference is a reference frame in which motions have distinguished dynamical properties. Since motions have distinguished dynamical

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48. It is important to understand that backwards causation is independent of time-travel. In fact, neither of these two logically entails the other, though they do share in common the possibility of causally effecting the past. Time-travel involves causal loops in closed time-like curves, but backward causation, i.e. cases in which an effect precedes its cause, can take place in systems where there are no closed time-like curves. Here is a good summary of the difference: "…an ordinary system *S* taking part in time travel would preserve the temporal order of its proper time during its travel, it would keep the same time sense during its entire flight (a watch measuring *S*'s proper time would keep moving clockwise); but if the same system *S* were to become involved in a process of backward causation, the order of its proper time would have to reverse in the sense that the time sense of the system would become opposite of what it was before its back-in-time travel (the watch will start to move counter-clockwise)."

Jan Faye, "Backward Causation", *The Stanford Encyclopedia of Philosophy (Spring 2010 Edition)*, ed. Edward N. Zalta, http://plato.stanford.edu/archives/ spr2010/entries/causation-backwards/, (accessed April 5, 2012).

49. Robert DiSalle, "Space and Time: Inertial Frames," *The Stanford Encyclopedia of Philosophy (Winter 2009 Edition)*, ed. Edward N. Zalta, http://plato.stanford.edu/archives/win2009/entries/ spacetime-iframes/, (accessed April 8, 2012).

50. Ibid.

properties in inertial frames, the inertial frames must be spatial reference frames combined with a means for measuring time. These inertial frames enable us to distinguish uniform motions from accelerated motions.[51]

In recent particle physics, much work has been done concerning the neutrino. The neutrino is a theoretical subatomic particle with a mass so small that physicists have not yet made an accurate measurement. I am interested in the neutrino because some physicists have speculated that the neutrino may be capable of traveling faster than the speed of light. If cases are discovered in which neutrinos travel faster than the speed of light, these cases would constitute a Lorentz violation.

Before I go any further, I need to describe Lorentz symmetry and how a neutrino traveling faster than the speed of light constitutes a violation of Lorentz symmetry. To understand Lorentz symmetry, one first needs to understand what a Lorentz transformation is. A Lorentz transformation is constituted by a boost part and a rotation part. The rotation part comes in three basic types—there is one type for each of the three spatial directions. The boost part is a change in velocity and also has a type for each of the three spatial directions.[52] Alan Kostelecky, a theoretical physicist from Indiana University, says that, "A physical system is said to have 'Lorentz symmetry' if the relevant laws of physics are unaffected by Lorentz transformations (rotations and boosts)."[53] What does it mean that the rotations and boosts affect the relevant laws of physics? This is very difficult to answer. The best I can do is provide a very general

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51. Ibid.

52. Alan Kostelecky, *Background Information on Lorentz and CPT Violation*, (March 29, 2012), http://www.physics.indiana.edu/~kostelec/faq.html (accessed April 7, 2012).

53. Ibid.

description of what is happening. If rotations and boosts affect the relevant laws of physics, this would be a miniscule deviation from the laws of relativity, showing relativity to be inexact. If relativity is inexact, then spacetime is not the same in all directions.[54] Lorentz symmetry, along with CPT (charge, parity, and time) symmetry, is the foundation of Einstein's relativity.

At this point all the necessary pieces have been introduced for the case I will now consider. Imagine that a neutrino that is faster than light is discovered. Of course, such a neutrino has not yet been discovered. Physicists at CERN thought they had discovered such particles in the fall of 2011, but the seemingly revolutionary discovery was fatally flawed. When neutrinos were sent from Switzerland to a lab in Italy, they seemed to be arriving a few nanoseconds faster than the speed of light. However, scientists have since discovered that the measurements were inaccurate, seemingly because of faulty equipment. Nevertheless, it remains possible that there are neutrinos that are faster than light, and physicists are still searching for them. If physicists one day succeed in finding faster-than-light neutrinos, they will have discovered a case in which Lorentz symmetry is violated.

Imagine shooting a faster than light neutrino from a particular inertial frame of reference. Because the neutrino is faster than light, the neutrino will hit its target in the inertial frame of reference before it is shot. This incredible result is an instance of an effect preceding a cause and constitutes a Lorentz violation, since it would be an instance

54. Alan Kostelecky, *Beyond Einstein: The Search for Relativity Violations*, Indiana University Instructional Support Services, Media Production (September 2006), ASX http://www.indiana.edu/~iss/media_pro/clientstream_point/beyondeinstein.asx.

of a minuscule deviation from the laws of relativity.

This case illustrates a scenario in which effects precede their causes. In fact, my example is an instance of backwards causation. Indeed, there are other such scenarios and they are more than just logical possibilities. Physicists are actively looking for cases of symmetry violation and instances of backward causation. What needs to be addressed now is how what I have just described affects Barnes' argument against Kitcher.

Earlier I argued that Barnes is committed to the view that forward causation is the only causation that is explanatory. Let's put this commitment in more formal terms. Let C be any cause and E be C's effect. Barnes is committed to the following:

C is explanatory of E only if C precedes E.

I will call this the Barnes Commitment. Notice that the Barnes Commitment is false if something like our imagined physics example turns out to be true. It is a necessary condition of the Barnes Commitment that C precede E. However, in my example the faster than light neutrino arrived at its target in the inertial reference frame before the neutrino was shot. The shooting of the neutrino is the cause and is explanatory of why the neutrino hit the target, but the effect precedes the cause. The Barnes Commitment cannot be true if the faster than light neutrinos I described exist. Cases would exist in which E precedes C, yet C is still explanatory.

It may be objected, though, that my case of backwards causation is one that has not been scientifically proven to exist. So, one could agree that the Barnes Commitment would be false if faster than light neutrinos really exist, but as best as we can tell, they do not exist. To date, there are no examples that prove the Barnes Commitment to be false.

This being the case, perhaps I lack a convincing reason to give up on the intuition that forward causation is the only explanatory causation.

This objections does not save the Newtonian case. I already showed that it is spurious for reasons that are not dependent upon my Neutrino example. However, this objection is legitimate concerning the two evidentiary cases. Barnes would need to adjust his position some so that these examples are not dependent upon the Barnes Commitment, but he could do this. This is obvious, since, even if backwards causation were true, the retrodictive evidentiary patterns would not be explanatory. Even if there are worlds where retrodictions are explanatory, evidentiary retrodictions are not explanatory in this world, and Kitcher needs to respect this.

Let's evaluate where things stand at this point. In this section I exposed Jones argument concerning the Newtonian case as spurious. However, this was not harmful to Kitcher. I showed that if we jettison the assumption that all worlds are forward causal, then the Newtonian case does not show that the unification theory cannot respect asymmetry. Therefore, Kitcher is equipped to handle the Newtonian case. Concerning the evidentiary cases, it looks like we are left in the same position as we were at the end of section two.

I have also shown that our theories of scientific explanation should not eliminate backwards causal explanations as an acceptable outcome of empirical research while scientists are actively searching for instances of backwards causation. There may be cases of backwards explanation, such as my neutrino example. If something like the neutrino example were ever discovered, it would render the Barnes Commitment false. I

suggest that, instead of accepting the Barnes Commitment, our theories of scientific explanation should reflect the attitude of physicists when it comes to causation; we should not care if it is directionally forwards or backwards.

4. MORE BARNES-LIKE COUNTEREXAMPLES TO KITCHER

In "Backwards Explanation," C. S. Jenkins and Daniel Nolan try to demonstrate that there may be cases in which explanations of earlier events by later events are successful. They do this without appealing to metaphysically exotic cases like backwards causation or time travel. The central thesis of their paper is that theories of explanation should either accommodate backwards explanations, or have very good reasons for excluding them.

This is an interesting thesis, and is closely related to my project. Jenkins and Nolan believe that Kitcher's theory is equipped to accommodate backwards explanations. They say that, "Some theories of explanation seem well placed to allow for backwards explanation. For example, unification approaches…"[55] I think they are right to say this about Kitcher, but I do not think they have completely understood Kitcher. Jenkins and Nolan specifically say that they are putting aside metaphysically exotic cases like backwards causation and time travel. But, remember that explanatory claims are primitive to casual claims for Kitcher; furthermore, he is committed to the view that, for any world, causation is the most unified theory. Since this is the case, when there are instances of backwards explanations, they must be causal. So, Jenkins and Nolan cannot say that Kitcher can accommodate backwards explanation in the way that they would like, because for Kitcher, when backwards explanations are the most unified theory, backwards causation must accompany the backwards explanations. Since I am sure that

55. C. S. Jenkins and Daniel Nolan, "Backwards Explanation," *Philosophical Studies* 140 (June 2008), http://www.springerlink.com.lib-ezproxy.tamu.edu:2048/content/v110767032008k40/fulltext.pdf, 105.

Jenkins and Nolan do not want to say their cases are really backwards causal, their examples turn in to Barnes-like asymmetry cases against Kitcher. My goal now is to see if Kitcher is equipped to accommodate these cases, otherwise his theory is back in the crosshairs of the asymmetry problem.

To begin their argument, they say, "…a backwards explanation of a token event *e1* which occurs at time *t1* is an explanation in which another token event *e2* which occurs at some later time *t2* plays a key role."[56] Here are three candidate backwards explanations:

1. I am tidying my flat today because my cousin is coming to visit tomorrow.
2. The scarlet pimpernels closed up because it was about to rain.
3. The volcano is smoking because it is going to erupt soon.[57]

Let's look at the first candidate backwards explanation—"I am tidying my flat today because my cousin is coming to visit tomorrow." One might try to explain away this case by saying that my tidying up the flat is not explained by my cousin's impending visit, but by my belief in the occurrence of the future event (my cousin's impending visit). This is a perfectly fine explanation, but nothing about it precludes the backwards explanation as being a legitimate explanation. There are usually various ways of explaining an explanandum. For instance, an explanation of an outbreak of fire might be the intention of the arsonist, and another might be the match that started the fire, and another might be the combination of the two.[58] Jenkins and Nolan say, "It might be that a particular one of these explanations is best in any given particular context or for any

56. Ibid., 103.
57. Ibid., 104.
58. Ibid., 105-106.

particular audience. But it does not follow that the others are not explanations; some of them might even be better explanations in other contexts or for other possible audiences."[59]

We can quickly dismiss this example. Let's say that I am tidying my flat today because my cousin is coming to visit tomorrow. But, then my cousin becomes ill the next day and cannot come. Does my cousin's future visit (which never happened), still account as explanatory? No. I would not cease to clean my flat without knowing that my cousin had become ill and will not be able to visit.

There is a more unified account that Kitcher's theory will affirm. My action of cleaning my flat could be explained by appealing to an argument that uses my belief about my cousin's impending visit, my desire for the flat to look nice when he arrives, and my ability to do the cleaning. This derivation is quite stringent because it belongs to a family of patterns that describes human actions from beliefs, intentions, desires, etc. It also is capable of deriving many conclusions. The derivation in which we explain why I am cleaning my flat by appealing to my cousin's impending visit seems less stringent and probably cannot derive as many conclusions.

I am going to move to the volcano case next and come back to the scarlet pimpernel example later, as it merits special attention. To say that a volcano is smoking because it is going to erupt is a bad explanation. There are many volcanoes around the world that smoke without erupting, the impending eruption of a volcano does not explain why it is smoking. So it seems that a smoking volcano does not indicate that a volcano is

59. Ibid., 106.

about to erupt.

Just like there was a more unifying explanation than the backwards explanation in the first case, there is one for the volcano case as well. Such a pattern might look like this:

1. At location *L*, the earth's crust is unusually weak and susceptible to volcanic activity.
2. At location *L*, there is seismic activity and pressure that occurs.
3. When the pressure and seismic activity at location *L* reaches magnitude *x*, volcanic smoke exits the crust of the Earth.
4. At time *t* the pressure and seismic activity reached *x*, resulting in volcanic smoke.

It seems to me that a pattern something like this one would work for explaining the smoke above any volcano on Earth. Therefore, we can say of this pattern that it is capable of deriving many conclusions. Whereas we saw that it is not explanatory to say that the volcano is smoking because it is about to erupt. This explanation could not derive as many conclusions and probably the conditions upon instantiation are easier than my pattern, so mine is more stringent as well.

So far I have shown that Kitcher can accommodate Jenkins and Nolan's examples without invoking backwards explanations. But, I still have the scarlet pimpernel case to consider. The authors suggest that the pimpernel case might be part of a limited class of cases in which an explanation of a behavior is given in terms of *biological function*. They explain, "On this view, a biological system has a *proper function* when it has a property with a certain history. Roughly, the property must have contributed to an ancestral organism's fitness, and its function is to do what it did to contribute to the organism's

fitness."[60] So, today's scarlet pimpernels close before a rain because their ancestors that closed before rain had more success because of the property.

At this point, they ask how this proper function talk affects the issue of backwards explanation. There are three options. The first option says that proper function shows that there is no backwards explanation involved when we are told that the scarlet pimpernels closed because it is about to rain. However, explaining the closing of the pimpernels by telling their evolutionary story in a way that involves proper function seems incomplete. After all, pimpernels with the same evolutionary history do not close when the weather is fine. The missing piece of information must be the impending rain, but if we need this future fact, then we still have a backwards explanation.[61]

The second option explains the pimpernel's behavior in terms of a current functional property the species possesses—the function of closing before rain. This is in contrast to the first option where we explained the behavior in terms of past selectional history. But, when explaining the activation of the function, we still might need to note the fact that it is about to rain.[62] Without noting this, we do not have an explanation of the function. So, this is still a case of backwards explanation, because the future rain explains the activation of the function.

This leaves us with the third and final option—to accept that there is a good backwards explanation of the pimpernel case. Jenkins and Nolan believe that, "The appeal to proper function then shows us that this explanation is not mysterious—not

60. Ibid., 108
61. Ibid., 108-109.
62. Ibid., 109.

requiring backwards causation, primitive teleology, or any other such metaphysical extravagance."[63]

My concern now is to show that Kitcher can accommodate the scarlet pimpernel case without backwards causation. Kitcher could explain why scarlet pimpernels close before a rain by telling an adaptionist story that makes no reference to proper function or to the impending rain. So, for the pimpernel case, one might say that the ancestors of contemporary scarlet pimpernels had the trait of closing. The closing was triggered by light sensitivity (it has been shown that the pimpernels are, in fact, closing because of a decrease in light). As the sky grew darker, these ancestor flowers closed. Since storms are accompanied by cloudiness, there is generally less light. A flower that closes as light decreases is less likely to be negatively affected by a storm because it is protected from the wind, rain, and hail. So, pimpernels that closed due to decreasing amounts of light were selected over pimpernels without this trait because they were better adapted to handle situations in which there is less light. Therefore, contemporary scarlet pimpernels close before a rain.

In my forward-explanatory story, notice the impending rain has no part in the explanation. Kitcher still needs to decide whether the proper function story or my adaption story is more unificatory. Let's compare the proper function account and the adaptionist account of why the scarlet pimpernels closed (say) a moment ago. First the proper function account:

1. The scarlet pimpernels have the proper function of closing before bad weather in order to protect the pimpernels.

63. Ibid., 109-110.

2. It is about to rain.
3. Therefore, the pimpernels closed a moment ago.

Now, I give the adaptionist account:

1. The scarlet pimpernels have the adaptive trait of closing as the amount of light decreases.
2. There was a decrease in light.
3. Therefore, the pimpernels closed a moment ago.

It does not appear that one is more stringent than the other. But, if we could determine that one can generate more conclusions, then we would know that this account is more unificatory.

The adaptionist account can generate more conclusions. Perhaps the pimpernels were loaded on the back of a flat-bed pickup truck that just so happens to be scheduled to leave ten minutes before the storm arrives. It also happens to be going in a direction that is the quickest escape route from the storm. In this case, the pimpernels were never about to be rained upon. So, something else must have caused them to close. The function account that uses the impending rain in the explanation does not *really* explain why the pimpernels closed. However, the adaptionist account does; therefore, it can generate more conclusions.

One might object that I have mischaracterized the proper function of the pimpernels. The correct characterization is that the pimpernels have the proper function of closing as light is reduced. I would be happy if this was the correct characterization. If the flowers have the proper function of closing as light is reduced, then there is no reference to the impending rain. My concern was that Kitcher might have to affirm an explanation that made use of the impending rain. This would result in Kitcher ascribing

the impending rain as backwards causal. But, if the correct proper function account does not make use of the impending rain, then it is a forward explanatory account. Kitcher's theory could pick the proper function account as the most unified while respecting the asymmetry of explanation.

In summary of this section, I showed that Jenkins and Nolan, who thought that Kitcher was in agreement with them, turned out to be mistaken about Kitcher's position. This results in their cases of supposed backwards explanations being more potential examples in which Kitcher might fail to respect asymmetry. I have examined three of their examples and shown that Kitcher is equipped to respect symmetry in these cases as well.

5. SUMMARY AND CONCLUSIONS

Every theory of scientific explanation must show that it can respect the asymmetry of explanation. It is considered a major flaw of a theory if it allows things like the length of a tower's shadow to explain the height of the tower. Kitcher was aware that he had to show that his theory respects explanatory asymmetry, and this is why he spent a considerable amount of time arguing that he could use tools like Origin and Development Patterns to avoid the problem of asymmetry.[64] However, Eric Barnes made a compelling case that, despite Kitcher's attempts, he could not respect all cases of asymmetry. In particular, his theory had no way of disallowing retrodictions like the Newtonian Retrodictive Pattern as well as the evidentiary patterns (the beach stroller example and the paleontological example).

Barnes' attack on the theory of unification has largely gone unchallenged. The one exception is Todd Jones 1995 paper, which no one has responded to until now. Though Jones paper was a start, it did not free Kitcher from the problem of asymmetry. Recall that Jones claims that forward-looking patterns, such as partial patterns and speculative patterns, are more unifying and preferred on unification grounds. An important reason that they are more unifying, according to Jones, is that they belong to related families of patterns.

I think Jones' solution to the beach stroller case is exactly right once we add my clarification on stringency and families of patters, meaning that the case does not

64. See section one for a reminder of what Origin and Development Patterns are.

illustrate a failure to respect asymmetry on Kitcher's part. In the paleontological example, it was harder to determine if Jones had successfully defended Kitcher. At first, there seemed to be a stalemate between Barnes and Jones as to who was right about this example. However, I may have broken the stalemate by showing some confusion regarding Kitcher's notion of stringency and the way Jones interpreted this notion. I believe that I cleared some of this confusion and laid some groundwork for how to use stringency, similarity and families of patterns. Once this was done, it looked like Kitcher might be able to accommodate this example too, although I was less sure that I was with the beach stroller case.

In the third section, I attacked the Newtonian example. In this instance, Jones argument against it was poor. However, Barnes should have realized that if we do not assume a forward causal world, this example does not work. To finish the section, I described a case of Lorentz symmetry violation and suggested that backwards causation is something that our theories of scientific explanation should not preclude, especially since physicists are doing work that could demonstrate backwards causation.

In the final section, I considered more examples that seemingly threatened the unification theory with the problem of asymmetry. The conclusion from this exercise was that Kitcher's theory seemed capable of accommodating these cases. It was especially interesting to see that he was able to accommodate the scarlet pimpernel case.

So, I conclude that Kitcher's theory does not fail to respect the problem of asymmetry in the cases that Barnes presents or in the cases of Jenkins and Nolan. This is significant, especially since I can think of an instance in which a philosopher, in a

professional journal, assumed that Barnes had put Kitcher's unification theory to rest. Indeed, he did not; it remains a viable candidate in the debate concerning scientific explanation.

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VITA

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