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Relativism, Constructivism, and Progress in Goodman and Kuhn

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by

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ABSTRACT: Relativism, Constructivism, and Progress in Goodman and Kuhn

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The purpose of my thesis will be to defend Goodman's constructivism and Kuhn's account of scientific development. In the first chapter, I will begin by describing Goodman's constructivism and clarifying a few key ideas that are often misunderstood. Then I will describe Kuhn's account of scientific development and explain how it is similar to Goodman's constructivism. In the second chapter, I will present a few key criticisms of Kuhn's account of scientific development and describe Kuhn's responses to them. Following this, I will provide a brief analysis of Kuhn's responses and argue that they are insufficient to respond to all of the criticisms. In the third chapter, I will put forward the same criticisms against Goodman's constructivism and provide his responses to these criticisms. I will then compare Kuhn's responses to Goodman's responses to the criticisms, and argue that Goodman's responses are much stronger. Following this, I will argue that Goodman's responses, and his constructivism, could be used to strengthen Kuhn's account of scientific development in a way that would enable him to adequately address the criticisms brought against his work. I will conclude my thesis by arguing that Goodman's responses to the criticisms are stronger than Kuhn's responses because Goodman accepts and defends the relativism in his work, while Kuhn attempts to dismiss and minimize the role that relativism plays in his account of scientific development.

PREFACE

This thesis is original, unpublished, independent work by the author, V. Lavergne.

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RELATIVISM, CONSTRUCTIVISM, AND PROGRESS IN GOODMAN AND KUHN

Introduction

In my view, the philosophical contributions of Nelson Goodman and Thomas Kuhn have been misunderstood and misrepresented, and their views have been unfairly criticized and rejected. Kuhn has been accused of endorsing radical relativism and an irrational account of science, while Goodman has been largely ignored in the literature and dismissed for endorsing a view of the world that is apparently absurd, nihilistic, utterly unbelievable, and far too radically relative.[1] The hostility towards, and dismissal of, their work is unwarranted and stems from a misunderstanding of their philosophies. It is my aim in this thesis to dispel and address the misrepresentations of both Goodman's work and Kuhn's work in an effort to show how their philosophies are important, interesting, and useful.

Before I get into the philosophical content of my thesis, I will begin by making some preliminary clarifications. First, I want to clarify that I will be defending relativism, not radical relativism. The sort of relativism that I will be referring to in my thesis is the relativism of our descriptions, representations, theories, and evaluative standards. I will be defending the belief that the worlds that we live in and experience are constructed by us, and are therefore relative to our ways of constructing them. This sort of relativism is often criticized for entailing the ridiculous and radical conclusion that anything goes. If we construct the world, then it seems like the world is however we want it to be. However, I will not be endorsing this conclusion. I will explain exactly how the relativism in my thesis can be distinguished from radical relativism, but for now, I think it is enough to state that I do not plan on endorsing radical relativism.

Second, I would like to note that I will be identifying Goodman's work as *constructivism*, not *constructionalism*. Goodman is a constructionalist and says that we construct the worlds that

[1] See Sider (2009, 399) and Franklin-Hall (2015, 930) for these criticisms of Goodman.

we live in and experience. I will call this philosophy constructivism since that is the term that is more commonly used in the philosophical literature that I will be engaging with. By constructivism, I mean the philosophy that aims at showing how important concepts, entities, and worlds are constructed by us.

The purpose of my thesis will be to defend Goodman's constructivism and Kuhn's account of scientific development. In the first chapter, I will begin by describing Goodman's constructivism and clarifying a few key ideas that are often misunderstood. Then I will describe Kuhn's account of scientific development and explain how it is similar to Goodman's constructivism. In the second chapter, I will present a few key criticisms of Kuhn's account of scientific development and describe Kuhn's responses to them. Following this, I will provide a brief analysis of Kuhn's responses and argue that they are insufficient to respond to all of the criticisms. In the third chapter, I will put forward the same criticisms against Goodman's constructivism and provide his responses to these criticisms. I will then compare Kuhn's responses to Goodman's responses to the criticisms, and argue that Goodman's responses are much stronger. Following this, I will argue that Goodman's responses, and his constructivism, could be used to strengthen Kuhn's account of scientific development in a way that would enable him to adequately address the criticisms brought against his work. I will conclude my thesis by arguing that Goodman's responses to the criticisms are stronger than Kuhn's responses because Goodman accepts and defends the relativism in his work, while Kuhn attempts to dismiss and minimize the role that relativism plays in his account of scientific development.

Chapter I: Constructivism

Introduction

In this chapter, I will explain in detail exactly what constructivism is, and why it is a position worth exploring. I will begin by describing Nelson Goodman's constructivism. Following this, I will present Thomas Kuhn's account of scientific development and explain how it is also a form of constructivism. Then, I will conclude by identifying some of the similarities between Goodman's constructivism and Kuhn's constructivism, and I will defend constructivism from two preliminary objections.

1. Goodman's Constructivism

Introduction

Goodman describes himself as an *irrealist* when it comes to theorizing about the relation between the world and our descriptions of it (Goodman 1984, 29).[2] That is not to say that he thinks everything is either real or non-real. Instead, it means that Goodman believes we ought to

[2] Irrealism does not play a huge role in my thesis. However, I think it is important to bring up because it sets the stage for Goodman's constructivism and relativism. Goodman does not want to enter the debate between realism and anti-realism in the typical way. Instead of taking sides, he wants to reconceptualize the debate. He does this using his constructivism. By reconceptualizing the relationship between the world and our descriptions of it, we can avoid the hopeless debate that realists and anti-realists engage in, thereby dissolving their disagreement. I will explain exactly how Goodman manages to dissolve the debate between realists and anti-realists on pages 66 and 67.

give up searching for the way the world is, and start thinking about the ways the world is. For Goodman, the world melts into many versions, which in turn make worlds (Goodman 1984, 29). These versions of the world, or *worldversions*, are independent systems of representation that tell us a way that the world is, rather than the way it is. We construct these worldversions and thus, we construct the worlds that we live in. In this section, I will begin by describing Goodman's argument that we ought to give up the objective world and focus on our descriptions of it. Then I will explain why Goodman thinks we ought to conceive of our descriptions of the world as distinct independent worlds, or worldversions. After, I will describe Goodman's argument that we construct these worldversions, and therefore construct the worlds that we live in. To conclude this section, I will describe two concepts Goodman identifies that constrain his constructivism to ensure that it does not fall victim to unconstrained radical relativism.

i. Giving Up the World

There are two reasons why Goodman thinks that we ought to give up the objective world. The first reason is that the notion of the objective world is elusive. Goodman says that, to begin our search for the objective world, we may "gain some light on the way the world is by examining the way it is given to us by experience" (Goodman 1972, 25). We may think that the objective world can be found in the way that it is given. For example, consider the situation that I found myself in while I was writing this chapter. One day, I was sitting in a café with my friend, trying to get some schoolwork finished. I put my notebook on the table and asked my friend to describe it to me. They humoured me and said that it was purple, spiral-bound, and rectangular. I asked them why they described my notebook like this. Confused, my friend responded by saying that it was because they had eyes, and asked me how else they could have described it. My friend may think that the way that my notebook really exists in the world can be discovered in the

sensory experience that it invokes in them. They think that the notebook is given to them as purple and rectangular, so, the notebook must be purple and rectangular. However, Goodman says that we need only to examine the idea of the given to see that it is empty. He says that opinions "do not differ about what is contained in the given, or what can be found there. A certain visual presentation, all agree, contains certain colours, places, designs, etc.; it contains the least perceptible particles and it is whole… The issue is not *what* is given but *how* it is given" (Goodman, 1972, 26). While my notebook is given in a way that has the potential to invoke the sensory experience of its being rectangular and purple, its actually being rectangular and purple is not what is given.

Instead, its being rectangular and purple depends on our conceptual perspective wherein we have the ideas of rectangular and purple. If we were colour blind and without the idea of purple, the notebook would not be given to us as purple, and if we had no ability to make out shapes, the notebook would not be given to us as rectangular. Moreover, if we were a dog, the notebook might not be given to us as a purple notebook at all, and instead, it might be given to us as a blue chew toy. With different conceptual perspectives, the givenness of the world differs. Consider a maple leaf. It appears green, solid, and stationary. This is how it is given to our naked eye. Now, consider how the leaf would be given to us using a microscope. The leaf would no longer be given as a green, stationary, and whole object, but as a collection of moving and opaque cells. The question of how the leaf is given to us depends entirely on how we see it, and how we apprehend the visual experience that it invokes. This is why Goodman says "[is the world] given as a whole or is it given as many small particles? This captures the precise issue – and at the same time discloses its emptiness. For I do not think any sense can be made of the phrase 'given as'" (Goodman 1972, 26-27). There is no way that the world is given, only how we

apprehend and interpret the sensory information available to us using our conceptual abilities and perspectives. Thus, the question of how the world is seems to be a question of how we apprehend and interpret it, not how it is given.

To continue our search for the objective world, Goodman thinks we ought to examine how we apprehend it. This, Goodman argues, brings us "to a more familiar version of the question of the way the world is. How is the world to be described? Does what we call a true description faithfully depict the world?" (Goodman 1972, 29). We use our descriptions and representations of the world to make sense of and understand it. These descriptions and representations are typically judged on a scale from faithful and realistic to unfaithful and unrealistic. This is why Goodman suggests that we analyze how descriptions can be faithful and realistic in order to see if we can find the way the world is. Consider a colour photograph of a tree. It is arguably the most realistic way of seeing and representing the way this tree really is. However, Goodman argues that even pictures distort when they represent the world. Pictures are taken from a certain perspective. Perhaps the picture of the tree is taken from an angle that makes the tree look real. But taken from a different angle, we would realize that the tree is actually a cardboard cut-out.

Moreover, even our faithful or realistic descriptions of the world distort. They pick out certain features of the world and leave out others. Let us return to the example of the maple leaf. Consider how you might describe the maple leaf in the most faithful and realistic way possible. Would this description be from the perspective of an average adult, where the leaf would be described as being green and lobed with five to seven tips? Or would it be from the perspective of a microscope set to 400X total magnification, where the leaf is made up of hundreds of tiny opaque cells? Again, it seems as though there is no fact of the matter, no single perspective from which we can construct the most realistic and faithful description of a leaf. The way that we

describe it depends entirely on our abilities, concepts, conventions, and constructions. Without our retinas, the leaf could never be described as green, and without a microscope, the leaf could never be described as a collection of cells.

The world is not given to us and we can make nothing of it. We organize our experiences of the world into various descriptions and representations of it. We use these descriptions and representations to grasp for the way the world really is, yet we can never truly attain it. This is why Goodman says that "neither the way the world is given nor any way of seeing or picturing or describing it conveys to us the way the world is" (Goodman 1972, 30). Our realistic and faithful descriptions of the world are constructed from our conceptual and physical perspectives; and different perspectives yield different realistic descriptions. Even our most realistic and faithful descriptions of the world seem to fail to get how it really is. Thus, the objective world continues to elude us, and trying to find it is a hopeless and pointless endeavour.

The second reason why Goodman argues that we ought to give up the objective world is because the very notion of the objective world is self-defeating. Let us return to the situation that I found myself in when I was talking to my friend about my notebook. My point in asking my friend to describe my notebook, and then questioning their description of it, was to show them that they have this underlying belief that their descriptions are informed by the structure of the world. They thought that they had no choice in their description of my notebook because they were just passively observing and articulating the structure of the notebook as it exists out there in the world. Goodman argues that this understanding of the relation between the world and our descriptions of it is misguided. He claims that the notion of the world beneath our descriptions, the one that our descriptions supposedly correspond to, is actually self-defeating.

We believe that our descriptions of the world get at some inherent structure out there, and that this structure of the world is what gives structure to our descriptions of it. However, descriptions and representations of the world are actually interpretations of phenomena that are filtered through, and given structure by, our minds. The moment that we perceive something, we impose characteristics, form, and structure onto it. We have no access to the world as it is since this world is necessarily filtered through our minds using various conceptual perspectives. In the way that we are never without physical perspective, our perceptions and descriptions are never without conceptual perspective. Imagine that there is a strawberry sitting on a table in front of you. Now, try to describe it without imposing form or structure onto it. You cannot. The moment that you perceive the strawberry, you impose colour, shape, size, depth, and position onto it. Let me illustrate this point by returning to the situation with my friend and my notebook. As soon as my friend saw my notebook, they picked out its colour and shape as descriptive identifiers because they had a specific conceptual perspective where these properties exist and are descriptively important. If my friend had no conception of rectangles or the colour purple, they would not have described my notebook as being rectangular and purple. They brought these concepts of colour and shape with them when perceiving and describing my notebook.

Goodman says that there is no such thing as an innocent eye that can grant us access to the way the world really is. Moreover, our minds do not just passively observe phenomena, they construct interpretations of it from a specific perspective. We cannot talk about the unstructured world because any talk of it comes from a conceptual perspective that imposes structure onto it. Our access to the very notion of the unstructured world is denied since such a notion is elusive and self-defeating, and our search for the objective world is futile since it's a search for a conceptual ghost. The world is not given to us, and we do not passively perceive or describe it.

We take the world, forcefully, subjectively, and with great difficulty. Even our most faithful and realistic representations and descriptions of the world fail to get at the way the world really is because the world eludes us. The world as it exists outside of our perceptions and descriptions is conceptually dead to us, and for this reason, Goodman argues that we ought to move on and give up this notion of the objective world.

With no objective world, Goodman's constructivism may seem nihilistic. If our representations of the world are not of the way the world really exists, then it remains unclear what they are of. However, instead of admitting defeat and concluding that our descriptions and representations of the world are not of the world, Goodman argues that we need only reconceptualize the relationship between us, our descriptions, and the world. Goodman says:

> If we say that all true descriptions and good pictures are equally as unfaithful, then in terms of what sample or standard of relative faithfulness are we speaking? We have no longer before us any clear notion of what faithfulness would be. Thus, I reject the idea that there is some test of realism or faithfulness in addition to the tests of pictorial goodness and descriptive truth. There are many different equally true descriptions of the world, and their truth is the only standard of their faithfulness. And when we say of them that they all involve conventionalizations, we are saying that no one of these different descriptions is *exclusively* true, since the others are also true. None tells us *the* way the world is, but each tells us *a* way the world is. If I were asked what is *the* food for men, I should have to answer "none". For there are many foods. And if I am asked what is the way of the world, I must likewise answer "none". For the world is many ways. (Goodman 1972, 30-31)

Goodman does not want to side with the mystics and radical relativists, who seem to conclude that there is no world. If there is no world, then what are our descriptions and experiences of? This is why Goodman draws a different conclusion. He says that the world without objectivity seems to be whatever we experience and describe it as. So, we ought to think of the world as being made up of these descriptions and experiences. Examining these descriptions and representations will lead us to conclude that there is no single way the world is, rather, there are many ways the world is. In the following paragraphs, I will elucidate this point further.

Since the objective world eludes us, and any talk about this world is self-defeating, all that we are left with is our descriptions. Someone might argue that, while we may not be able to talk about the unstructured world, our descriptions of it can be compiled and reduced to form a single world-description. The world, then, is whatever this description turns out to be. Goodman argues that many of our descriptions of the world are irreducible, so they cannot be reduced to a single description (Goodman 1978, 4). For example, a point can be defined differently using different systems of description. A point can be defined as a pair of intersecting lines, a different pair of intersecting lines, or as a nest of regions (Goodman 1978, 99). The fact about what a point is depends on which system is being used. There is no single ultimate way to reduce the fact of what a point is since a pair of intersecting lines are not reducible to a nest of regions, and vice versa. Despite this irreducibility, no system of description used to define a point seems to discredit the other systems of description. It is entirely correct to describe a point as being intersecting lines A and B, or intersecting lines C and D. Neither system of description is privileged, yet both systems of description are correct. So, these systems of description for a point are incompatible, irreducible and yet also credible.

To illustrate the irreducibility of world descriptions further, consider the following contradictory claims (Goodman 1978, 111):

1) The earth always stands still
2) The earth dances the role of Petrouchka

Claims 1 and 2 are claims that negate each other, and yet both are true relative to their own systems of description. If we try to relativize them so that they are true and non-contradictory in the same system of description, we lose the meaning of the original claims. Consider the relativized versions of the claims (Goodman 1978, 112):

3) In the Ptolemaic system, the earth always stands still

4) In certain Stravinsky-Fokine-like systems, the earth dances the role of Petrouchka

Claims 3 and 4 do not negate one another and contain claims 1 and 2, but fail to say anything about the truth of the earth's movements, which are what claims 1 and 2 are about. Thus, we seem to be left with the problem of reconciling how so many descriptions of the world can be irreducible, contradictory, and credible. Goodman's solution is to argue that we ought to conceive of our descriptions and representations of the world as being independent versions of the world.

ii. Worldversions

Goodman says that we can make sense of our irreducible and contradictory descriptions of the world if we think of them as individual versions of the world (Goodman 1978, 116). Since we have given up the objective world and recognize that our descriptions cannot be reduced to form a single world-description, we ought to accept that there is no single way that the world is, rather, there are many ways that it is. Our versions of the world, what Goodman calls worldversions, are systems of description and representation that pick out and develop these ways of the world using various concepts, perspectives, and principles. They essentially describe different worlds since they give the world a different structure. For example, the Ptolemaic worldversion identifies and structures the way the world is when the earth is stationary, and certain Stravinsky-Fokine-like worldversions describe and structure the way that the world is when the earth dances the role of Petrouchka (Goodman 1978, 112). In one worldversion, the world is structured such that the earth stands still, and in the other worldversion, the world is structured such that the earth dances. These contradictory worldversions are entirely compatible since they describe different ways that the world is, rather than the same way the world is.

Worldversions are independent of one another; even if the facts that they pick out are contradictory, they are entirely relative. Thus, we can reconcile the many irreducible and contradictory descriptions of the world by confining them to their own worldversions.

iii. Constructing Worldversions

So far, we have talked about worldversions as being these distinct systems of description that identify a way that the world is. However, we have yet to discuss how these worldversions are developed, or where Goodman's constructivism fits in. Goodman argues that we construct worldversions, which in turn give structure to the world. We construct worldversions in order to explain phenomena that we experience and observe.

Worldversions can be constructed through processes including composition, decomposition, weighting, ordering, deletion, supplementation, and deformation (Goodman 1978, 7-17). Composition and decomposition involve taking labels, names, predicates, and gestures in various worldversions apart and then either putting them back together again or rearranging them in a new worldversion. For example, one worldversion may identify plant taxonomy as being important, and organize objects in the world by kingdom, division, class, order, family, genus, and species. Another worldversion may be created out of this worldversion by taking apart this plant taxonomy, and reorganizing plants into edible and inedible categories. Different weightings in worldversions also make worlds by changing the emphasis on and types of categorizations within them. For example, in one worldversion, chemical classifications may be extremely important and the kinds they are organized into may be considered incredibly relevant, while in another worldversion, chemical classifications may be considered irrelevant while colour classifications may be considered relevant and important. Different orderings in worldversions may also make new versions. For example, a worldversion where time is ordered

into twenty-four-hour increments would be different from a worldversion where time is ordered into dawn, dusk, and twilight. Worldversions may also undergo deletion and supplementation processes in order to be altered or made. Some aspects of versions may be added or removed in order to create a new worldversion. For example, one worldversion may have described the world according to phlogiston chemistry. However, another worldversion may describe the world using chemistry without phlogiston. Finally, worldversions may have aspects corrected or distorted in order to create other worldversions. For example, the worldversion that describes the world from the perspective of an ant would have a distorted view of the same world as described from the perspective of a giant.

iv. Choosing Worldversions

Goodman's constructivism tells us that one correct system of description or worldversion cannot undermine another correct system of description or worldversion. However, if many systems of description can be correct, then it seems like we have no way of privileging one system over another. If this is the case, then constructivism would fall into unconstrained radical relativism, where any system of description goes. Goodman avoids radical relativism using constructivist tools that we can employ to privilege some worldversions over others. Goodman acknowledges that systems of description compete, and there are instances where privileging one system over another is required. For example, imagine that you are in an introductory astronomy class at the University of Calgary. Your professor asks you to stand up and describe the motion of the earth to the entire class. You can say that the earth is revolving around the sun, that it is stationary, or that it is dancing. Any of these descriptions are correct, yet you will have to make a decision on which system of description is the best to use in this instance. How should you

decide which worldversion to use when describing the motion of the earth? Your professor is looking for an answer, and not just any description will suffice.

There are times when we must privilege a system of description for pragmatic reasons (Goodman 1978, 124). Depending on the astronomy class and the context of the discussion leading up to your professor asking for your input on the movement of the earth, it may be more right for you to describe the earth as revolving around the sun. This choice in privileging a specific system of description may come down to which system is most useful given the circumstances. Your astronomy professor is likely asking about the movement of the sun as described by the modern astronomy worldversion in your textbook. It is implicitly clear, then, that your statements about the movement of the earth are being evaluated within that worldversion; thus, to make a correct statement, you must describe the earth's movement from the conceptual perspective of that worldversion.

Sometimes, it may not be so easy to decide how to privilege a specific system of description. Determining what system of description or worldversion is the right one to use can be difficult when we do not have some objective structure to compare our descriptions to. For this reason, Goodman develops some tools, *projectability* and *entrenchment*, that we can use to evaluate the rightness of worldversions and constrain the relativism in his constructivism. In the following section, I will develop Goodman's account of both projectability and entrenchment and explain how they can be used to privilege worldversions and determine descriptive rightness.

v. Projectability and Entrenchment

When we describe the world and develop worldversions, we work with a lot of descriptive projections. For example, the description that snails lay eggs is projectible if instances of snails confirm the claim that they do, in fact, lay eggs. Goodman argues that projectability is a

necessary and constraining condition for rightness in constructivism. To begin determining the projectability of descriptions, Goodman starts by differentiating between right projections and accidental projections. Some instances of a projection seem to increase the credibility that a projection is valid and right, while others do not. Consider the hypothesis *C: copper conducts electricity* and *S: men in this room are third sons* (Goodman 1954, 74). An instance of C, that a piece of copper conducts electricity, seems to increase the credibility that C is a valid projection. On the other hand, an instance of S, that a man in this room is a third son, does not seem to increase the credibility that S is a valid projection. Goodman says that the reason for this is that C is a lawlike projection, while S is an accidental projection.

Hypotheses with confirmable and supportable instances are projectible, lawlike, and more likely to be a right projection; whereas hypotheses with instances that violate them are non-projectible, accidental, and wrong. If we were to consider further instances of both C and S, we would likely discover that there are more instances that support C, while there are more instances that violate S. To distinguish between right and wrong projections, we need to examine further instances of the projections and determine if their instances support or violate them. However, while projectability is a necessary constraint for the rightness of projection, it is not a sufficient one (Goodman 1954, 95).

Projectability is not a sufficient condition for rightness in constructivism because some projections appear projectible and are contradictory. When two projections both appear projectible and are contradictory, we can confine them to their own independent worldversions. But we may still need some way to determine which projection is more right since we may need to privilege one worldversion over another. Consider Goodman's (1954, 74-75) thought experiment:

Grue

All emeralds examined before time *t* are determined to be green. At *t,* our observations support the hypothesis that all emeralds are green. However, there is a new predicate, grue, that we can use to describe these emeralds. An emerald is grue when it is green if observed before time *t* and blue otherwise. At *t*, we have evidence that an emerald is green, and parallel evidence that the emerald is grue. However, if an emerald is green, then it cannot be grue, and vice versa.

Imagine that we are trying to determine what colour emeralds are. We can correctly say that emeralds are green, or that emeralds are grue, depending on which worldversion we are using. However, we need to determine which worldversion is best to use and thus is more right; we need to find a way to privilege one system of description over another, or else constructivism becomes too radically relative. We cannot simply analyze instances of these projections by searching for ones that support or violate each projection in order to determine which description of emeralds is more right. Each instance of an emerald being green at t supports both the description that emeralds are green, and the description that emeralds are grue. We need something more to determine which description we ought to privilege, subsequently finding some way to eliminate one of the incompatible projections. Goodman argues that we should recognize that we never come empty handed to evaluating projections; we have access to past projections and other evidence that he thinks we ought to use to aid us in distinguishing between right and wrong projections (Goodman 1954, 87-88). We should make use of our contextual knowledge that situates projections and descriptions when evaluating rightness.

To begin evaluating projections, Goodman says that we can start by eliminating all projections that have instances that violate them (Goodman 1954, 94). Next, we can eliminate

any projection that is exhausted and has no unexamined instances left since these projections are also non-projectable. Finally, we can eliminate any unviolated and unexhausted projection that is also unlawlike. However, this may be difficult since any unviolated and unexhausted projection may appear to be lawlike and projectable. Luckily, projections that are unexhausted, unviolated, and unlawlike often conflict with unviolated, unexhausted, and lawlike projections. Let us return to Goodman's grue thought experiment. The projection that all emeralds are grue and the projection that all emeralds are green are both unviolated, unexhausted, and equally as supported by their instances. However, they also contradict one another. Furthermore, since we need to choose a projection to make about the colour of emeralds, we can treat one of these projections as unlawlike. The question becomes how we can choose which hypothesis is right, and which one we should set aside. Goodman's solution is to argue that the projection that all emeralds are green is better *entrenched* than the projection that all emeralds are grue, and for this reason, we should choose to privilege the former and set aside the latter (Goodman 1954, 95).

Entrenchment is a relation between a projection, its predicates, its related projections, and our past projections. When paired with lawlike projectability, it becomes a sufficient condition for rightness. The entrenchment of a predicate or projection is determined by how it has been used in past projections. The more projections that a predicate has been involved in, the better entrenched it becomes. In Goodman's thought experiment, we are able to set aside the description that all emeralds are grue in favour of the description that all emeralds are green in virtue of green's history in our projections. We use the predicate "green" in our adopted descriptions of the world and in other projections; the same cannot be said for the predicate "grue". We describe grass, jade, kale, glass frogs, and katydids as green, not as grue. So, the projection that all emeralds are green is not only confirmed by instances of emeralds, but it also

has a longer history of being used in our descriptions of the world and fits into our inductive practices much better than the hypothesis that all emeralds are grue.

Goodman notes that there may be cases where two projections seem to have an equal amount of earned entrenchment (Goodman 1954, 105-106). Imagine a world where neither grue nor green have been used in past projections. Goodman says that in cases like these, we ought to look at the inherited entrenchment of each description. A predicate or projection can inherit entrenchment from related predicates or projections. For example, quarks were a new classification with seemingly no entrenchment of their own. However, given their relation to subatomic particles, and their projectible inductive ability, quarks inherited the entrenchment of subatomic particles and were adopted by the scientific community as being projectible. When we analyze the entrenchment of a predicate or projection, we should consider both earned and inherited entrenchment before making any decisions. In the cases where it is not obvious that a projection is better entrenched than another one, Goodman thinks that we should hold off on adopting or eliminating either one until more information is available. Thus, we can evaluate the rightness of projections and privilege one system of description over another by looking at their projectability and entrenchment.

Entrenchment and projectability are constructivist tools. They do not require the notion of the objective world beneath our descriptions of it. Instead, they simply require experience, analysis, and knowledge about our inductive practices. Projections are projectible when they have the right conceptual structure and fit into our conceptual perspective. My friend's description of my notebook is a projectible description in so far as it was made using the concepts *purple* and *notebook* correctly in a worldversion where purple and notebook can be applied to my notebook. Some realists may try to use projectability and entrenchment as tools in

their own conceptions of the world. However, if they use them in any way that requires the existence of the world beneath our representations of it, then they are misappropriating these constructivist tools. A projection is not projectible because it corresponds to the way the world really is. Copper does not conduct electricity because that is the way the world is really structured; copper does not exist outside of our conceptual perspective. If we did not have the concept of copper in a worldversion that we use to investigate electrical conductibility, then copper would not conduct electricity. It only does so because we construct the world in a way where copper exists, and it conducts electricity. We give structure to the world; it does not give structure to us. And we evaluate the structure we give the world using tools like projectability and entrenchment because they give us enough independence to ensure that constructivism does not fall victim to unconstrained radical relativism. While we can have a near infinite number of correct worldversions, we can still privilege some worldversions over others so that not every worldversion is the right worldversion to use. And when one worldversion fails to work in a way that we need it to, we have the ability to privilege a new worldversion that works better with our conceptual needs and goals. Goodman calls this process worldmaking. Thomas Kuhn, as I will explain in the next section, calls this process a scientific revolution.

2. Kuhn's Constructivism

Introduction

Kuhn endorses a form of constructivism in his book, The Structure of Scientific Revolutions, where he takes on the task of analyzing the development of scientific theory throughout history. He identifies these periods of science, called periods of *normal science*, where there is a consensus among scientists on what the fundamental laws of nature are. During these periods,

scientific activity and progress appear to be cumulative, building on the facts and theories that scientists have already identified and developed. Kuhn claims that periods of normal science make our interpretation of the world appear cumulative, and are a matter of correspondence rather than of construction. However, Kuhn also argues that periods of normal science are often disrupted by some series of discoveries that leads to a period of scientific crisis and eventually to a scientific revolution. Periods of crisis and scientific revolution highlight an interesting and inescapable consequence of our relation to the world, that we construct it. In this section, I will clarify how Kuhn endorses constructivism. To begin, I will describe what periods of normal science are. Next, I will explain the processes of discovery and crisis that lead to scientific revolution. After, I will illustrate how these processes suggest that science is a constructive rather than cumulative enterprise, and explain how this results in Kuhn's endorsement of constructivism.

i. Normal Science

We take the structure of nature for granted. We believe that our knowledge of the laws of nature are essential and necessary in our understanding of the world. Our scientific education tells us that the world is a certain way. For example, it tells us that a body at rest will remain at rest and a body in motion will remain in motion unless acted upon by an external force, that the mitochondria is the powerhouse of the cell, and that electrons have a negative charge. Our scientific education also tells us which scientific puzzles are interesting and how we ought to go about solving them. Science appears stable during these periods because scientists agree on the fundamental elements and laws of nature. Kuhn calls these periods of scientific activity periods of normal science, and he says that they are characterized by a scientific community's acceptance of a *paradigm*, a constellation of commitments including a commitment to a set of

scientific beliefs, methods, standards, and values (Kuhn 1962, 10). Paradigms are used to identify acute or interesting problems and constrain the methods scientists can use to solve them. For example, phlogiston theory was a chemical paradigm back in the 1700's. It guided scientific research to focus on phlogiston, a fire-like property contained in objects that was believed to make them combustible. Scientists were conditioned by this paradigm to expect combustible objects to contain phlogiston. They were interested in ways of dephlogisticating heat, how phlogiston could explain chemical qualities, and how chemical reactions occurred as a result of phlogiston. Paradigms like phlogiston chemistry appear stable, and science appears cumulative, during periods of normal science because scientists accept and build upon the foundations set by that paradigm. Consequently, normal science promotes scientific puzzle-solving using paradigmatic commitments in order to articulate and disambiguate the paradigm. Paradigms earn their status in normal science by successfully solving problems that their competitors could not. Scientists build on the success of a paradigm's ability to solve puzzles by applying the paradigm to other incomplete puzzles in an effort to solve them.

Paradigms help us identify puzzles and solutions explicitly by giving us clear foundational principles to adopt, and implicitly by giving us exemplars to internalize and use. Kuhn says that:

> The process of learning a theory depends upon the study of applications, including practice problem-solving both with a pencil and paper and with instruments in the laboratory… [this] process of learning by finger exercises or by doing continues throughout the process of professional initiation. As the student proceeds from his freshman course to and through his doctoral dissertation, the problems assigned to him become more complex and less completely precedented. But they continue to be closely modeled on previous achievements as are the problems that normally occupy him during his subsequent independent scientific career. (Kuhn 1962, 47)

Paradigms supply the achievements that the practice puzzles and solutions are based on, and that students use during their scientific education. For example, imagine the student learning classical logic for the first time. They learn that propositions and conclusions can be translated into logical

variables. Next, they learn that the truth value of propositions and validity of arguments can be evaluated using logical connectives like $\sim$, $\wedge$, $\vee$, $\rightarrow$, and $\leftrightarrow$. Let us say that a student has two propositions p and q. They are taught that if p is negated, $\sim$p, then the truth value of p is false. Assuming that all of their compound statements are true, if p$\wedge$q is true, then p and q are both true; if p$\vee$q is true, then either p is true or q is true; if p$\rightarrow$q is true, then if p is true then q is true, and if q is false then p is false; and if p$\leftrightarrow$q is true, then if p is true q is also true, and if p is false then q is also false. After being taught these basic rules of classical logic, the student is shown logic problems and their solutions. If p is true and p$\rightarrow$q is true, then the student is told that they can derive q. Once they understand logical connectives and truth values of statements, the student is given various sample problems and solutions in order to assist them in identifying logical problems and the processes available to them to solve similar problems. These sample problems and solutions are considered paradigmatic exemplars and are used to communicate ways of identifying problems and solutions. Ask any logic professor what the best way to learn logic is and they will tell you that it is by practicing logic puzzles until you do not even have to think about how to solve them. Paradigmatic exemplars teach us to internalize characteristics of interesting problems and appropriate solutions. This is how we use paradigms to identify and solve problems during periods of normal science.

Normal science also aims at stabilizing a paradigm during experimentation and the interpretation of results. Kuhn illustrates this feature of normal science using phlogiston chemistry and the discovery of oxygen (Kuhn 1962, 54). British scientist Joseph Priestly was investigating various airs involved in physical substances when he stumbled upon an anomaly. He observed and collected a gas that was released by heating red calx of mercury, a gas that was not predicted by phlogiston chemistry. Priestly tried to describe this gas as being common

dephlogisticated air that was released because the red calx of mercury absorbed the air's phlogiston (Kitcher 1978, 530). This air facilitated combustion better than normal air because its affinity to absorb phlogiston was higher. Priestly identified the gas as dephlogisticated air because if he identified it as something that was not explained by phlogiston chemistry, then the paradigm he was using would begin to destabilize. So, phlogiston chemists kept this identification in an attempt to accommodate the anomaly within phlogiston chemistry.

Normal science aims at stabilizing a paradigm; at explaining and predicting phenomena that are consistent with, and coherent within, the existing scientific framework supplied the paradigm. Kuhn says that:

> Normal science… is a highly cumulative enterprise, eminently successful in its aim, the steady extension of the scope and precision of scientific knowledge. Yet, one standard product of the scientific enterprise is missing. Normal science does not aim at novelties of fact or theory, and when successful, finds none. New and unsuspected phenomena are, however, repeatedly uncovered by scientific research, and radical new theories have again and again been invented by scientists… [This is because] research under a paradigm [is] a particularly effective way of inducing paradigm change. (Kuhn 1962, 52)

Despite the aim of normal science to stabilize paradigms, new and unexpected phenomena are still uncovered and disrupt periods of normal science, pushing them into periods of crisis. We try to fit nature into our paradigms. But nature resists conforming, and consequently produces anomalies. Normal science is often too rigid and inflexible to stabilize paradigms for long. In the next section, I will explain how discovery occurs, and how it pushes science into a period of crisis.

ii. Discovery and Crisis

Normal science leaves a lot of mop-up work for scientists to deal with (Kuhn 1962, 24). The paradigm present during periods of normal science supplies a preformed and inflexible box to fit nature into. For instance, the gas released by heating red calx of mercury did not fit into the

phlogiston paradigm since it did not follow phlogiston theory principles. For this reason, Priestly attempted to dismiss it as dephlogisticated air, while other chemists ignored the anomaly all together. When data and phenomena do not fit into a paradigm during periods of normal science, they are dismissed, ignored, or missed by scientists until they can be ignored no longer. The process of crisis begins with the discovery of an anomaly, and results in paradigmatic change or scientific revolution. In this section, I will begin by describing what discovery is. Then I will explain how discovery leads to a period of scientific crisis. Finally, I will discuss the various resolutions to periods of crisis.

Discovery begins with the awareness of an anomaly and its continued exploration. Sometimes scientists uncover data or a phenomenon that does not fit into the paradigm and that they cannot simply ignore or dismiss. This anomaly becomes puzzling with its continued resistance to paradigmatic explanation. Kuhn identifies three conditions of discovery in science (Kuhn 1962, 62). First, there must be a previous awareness of an anomaly before a discovery can occur. Second, there must be a gradual recognition that it is an anomaly by the scientific community. Third, there must be some change in the accepted paradigm in order to deal with the anomaly. Let us take another look at the case of phlogiston chemistry and the discovery of oxygen. Priestley's identification of the gas was insufficient and unsatisfactory. Another scientist, Antoine Lavoisier, built on Priestley's experiment and concluded that the gas must be unaltered, pure, and breathable air. Lavoisier had already begun to notice anomalies in chemistry that could not be explained using phlogiston chemistry. He started to conceptualize this gas outside of the phlogiston paradigm since it was so resistant to explanation. Other chemists began to recognize this anomaly, and finding an appropriate explanation for it became an acute puzzle for chemists at the time. The phlogiston chemistry paradigm ceased to be in a period of normal

science, and entered into a period of crisis. When an anomaly, like the gas released by heating calx of mercury, is discovered, resistant to paradigmatic explanation, and is recognized as a serious puzzle by the scientific community, the paradigm enters a period of crisis.

Kuhn says that science can resolve crisis in one of three ways (Kuhn 1962, 84). First, a crisis may eventually be solved by the paradigm. Second, the crisis may be set aside for the time being, left for future generations to solve with better technology. Third, the crisis may be solved by a reconception of the science and results in the emergence of a new paradigm. When scientists fail to explain a resistant anomaly using their paradigm, they begin to loosen their paradigmatic commitments in an effort to find an appropriate solution. If the anomaly continues to resist explanation, paradigmatic commitments are loosened even more, and the conceptual constraints set forth by the paradigm begin to blur. This enables scientists to develop novel foundational theories and come up with more creative ways of explaining phenomena. In the case of the discovery of oxygen, scientists attempted to explain the anomalous gas using the phlogiston paradigm, and repeatedly failed. Eventually, Lavoisier concluded that this gas was not dephlogisticated air, as Priestly had said, but was actually a distinct species of gas, oxygen, that was involved in combustion and was part of the atmosphere. This explanation of the gas did not fit into the phlogiston paradigm and instead, was a novel theory. Lavoisier's identification of oxygen and his subsequent theory of combustion gained traction in the chemical community. Instead of objects emitting phlogiston during combustion, chemists theorized that objects used oxygen to sustain combustion. Consequently, and with the development of pneumatic devices, there were as many pneumatic chemists as there were phlogiston chemists. Scientists dealt with this crisis by blurring paradigmatic rules, rejecting phlogiston chemistry, and adopting pneumatic

chemistry, thereby completing a scientific revolution. In the next section, I will describe scientific revolutions in more detail.

iii. Scientific Revolutions

Kuhn calls the process of replacing an old paradigm with a new one a scientific revolution (Kuhn 1962, 90). It is called a scientific revolution and not a scientific progression because this change in paradigm is a reconceptualization of nature. It involves a reconstruction of the entire field of science from new fundamentals, including a reconstruction of the field's most elementary generalizations, methods, and standards (Kuhn 1962, 85). This reconceptualization of the paradigm is both incompatible and incommensurable with the old paradigm (Kuhn 1962, 146-148). It is incompatible with the old paradigm because the adoption of a new paradigm requires the adoption of different fundamental beliefs. The objects that populate the world in the new paradigm are not the same objects that populate the world in the old paradigm. Moreover, the laws that these new objects follow are not the same laws that the old objects follow. For example, in phlogiston chemistry, phlogiston is a fundamental property in nature, and objects are combustible if they contain phlogiston (Kitcher 1978, 530). During combustion, phlogiston is emitted into the air, and combustion eventually stops in enclosed spaces as a result of the air's limited capacity for absorbing phlogiston. In pneumatic chemistry, phlogiston does not exist, and chemicals do not follow phlogiston principles. Oxygen is taken from the air to facilitate combustion; it is not emitted. The move towards pneumatic chemistry cannot be a cumulative progression from phlogiston chemistry since phlogiston plays a foundational role in one paradigm, and does not exist in the other.

Someone might argue that while the paradigms categorize the world using different labels, the substances they identify are essentially the same. The dephlogisticated air in the phlogiston

paradigm is essentially just oxygen in the pneumatic paradigm. However, these substances are not the same. One facilitates combustion by absorbing phlogiston, the other feeds combustion. The gases identified by the two paradigms are very different and follow different laws; they are not identical. Thus, different paradigms say very different things about the nature of the world, and pneumatic chemistry does not build on top of the foundations set by phlogiston chemistry.

Moreover, Kuhn says that new paradigms are incommensurable with old ones since "[t]heir standards or their definitions of science are not the same" (Kuhn 1962, 147). The standards that scientists use to evaluate identifications and theories are dependent on, and relative to, the paradigm that the evaluation is taking place in. For example, in the phlogiston paradigm, the identification of the gas that was released by heating red calx of mercury as dephlogisticated air requires that this identification is compatible with phlogiston chemistry. In the pneumatic paradigm, the identification of the gas as oxygen requires that it be compatible with pneumatic chemistry. So, the identification of this gas as dephlogisticated air can be evaluated as being correct in the phlogiston paradigm, and incorrect in the pneumatic paradigm; and the identification of this gas as being oxygen can be evaluated as correct in the pneumatic paradigm, and incorrect in the phlogiston paradigm. Evaluative criteria in science are relative to paradigms since paradigms dictate the fundamental beliefs, methods, standards, and values that scientists ought to have. How things are evaluated in one paradigm will differ from how things are evaluated in another paradigm. So, old paradigms are incommensurable with new paradigms, and the process of scientific revolution cannot be a cumulative one. Although a new paradigm may be born out of an old paradigm, it does not build on top of it. Instead, new paradigms use old paradigms as jumping points from which they land onto their own foundational and fundamental commitments and conceptions of nature. This process is constructive, or

reconstructive, since the laws and fundamental elements of nature are reconstructed into a new paradigm. In the next section, I will argue that the reconstructive process involved in scientific revolutions is Kuhn's endorsement of constructivism.

iv. Constructivism

Kuhn argues that paradigmatic change is indicative of world change (Kuhn 1962, 110). He says that "paradigm changes do cause scientists to see the world of their research-engagement differently. In so far as their only recourse to that world is through what they see and do, we may want to say that after a revolution, scientists are responding to a different world" (Kuhn 1962, 110). When scientists use different paradigms, they are responding to different worlds. Scientists ask different questions, use different technology, gather different data, and make different conclusions when they work with different paradigms. For example, pneumatic chemists use pneumatic devices to gather data and then base their conclusions about the structure of the world on the data they have gathered. Phlogiston chemists have no access to this data since they do not use pneumatic devices. Thus, the world that pneumatic chemists respond to is not the same world that phlogiston chemists respond to. To further illustrate this point, Kuhn asks us to consider how the world changed when scientists discovered the planet Uranus (Kuhn 1962, 115). Before the discovery of another planet in our solar system, scientists only saw stars when they examined the sky. However, after they discovered that Uranus, another planet, also inhabited our solar system, they were able to identify distinguishing planetary characteristics in space. Where they had once only seen stars, they now saw other planets and asteroids. Scientists studying space before the discovery of Uranus were living in a world full of stars, while after the discovery of Uranus, scientists started living in a world full of planets.

Kuhn says that this change in the world cannot be chalked up to a simple reinterpretation of data that has always been there; to do so would be a gross oversimplification (Kuhn 1962, 120). Data is paradigm relative. How and what data is collected depends on the paradigm it is being collected in since different paradigms use different technology to look at different aspects of the world. In the phlogiston paradigm, chemists looked for phlogiston during combustion, and prioritized the relation between phlogiston and heat. In the pneumatic paradigm, chemists prioritized weight relations among chemicals and used pneumatic devices to collect data that had nothing to do with phlogiston (Kuhn 1962, 71). What we do when we collect and analyze data is not just interpret the phenomena that we are given by the world. Instead, we beat nature into line so that we can extract data that corresponds to what our paradigm tells us to anticipate. There is no objective and anticipation free process of data collection or interpretation. We see the world the way that our paradigm tells us to, and our paradigm tells us to see the world in this way because we have structured it to do so. Thus, while the world may not change geographically when we adopt a new paradigm, the world that we respond to does. Therefore, we construct paradigms to explain the world, and paradigms structure the world according to how we construct them. It is in this way that Kuhn endorses constructivism.

3. General Remarks

i. Parallels Between Goodman's and Kuhn's Constructivism

There are a lot of parallels to be drawn between Goodman's constructivism and Kuhn's constructivism. Both of them involve acknowledging our lack of access to the objective structure of the world. Goodman tells us that the notion of the world beneath our descriptions is self-defeating, and Kuhn says that we try to fit nature to our paradigms, rather than try to fit our

paradigms to nature. They both ask us to recognize that we literally construct these systems of description, explanation, and representation of the world to enable us to interpret and organize nature. And they both value competition, or privileging one construction over another, when the need arises. For Goodman, we can privilege a system of description by evaluating the entrenchment and projectability of worldversions. For Kuhn, we can choose to privilege a system of description when the accepted paradigm fails to deal with an anomaly and enters into a period of crisis.

During crisis, when paradigmatic commitments and rules begin to blur, and novel theories emerge, we may construct a new paradigm in order to continue with our interpretation and explanation of the world. In order for the new paradigm to be accepted, there must be a collective agreement among scientists that the new paradigm is better than the old paradigm. By better, Kuhn means better at solving puzzles and at promising future solutions to puzzles. The promise of future successful research is very important for Kuhn. If a paradigm does not promise success in solving puzzles in the future, then there does not seem to be any reason to continue with that paradigm. This is why the recognition of anomalies leads a paradigm into crisis, anomalies are indicative of a paradigm's shortcomings and failure to solve puzzles.

The competition between paradigms both vying for adoption by the scientific community is typically a persuasive process, rather than a rationally necessary one (Kuhn 1962, 93). Since we structure the box that we try to fit nature into, our paradigms do not correspond to the way the world really is. And even if they do, we have no reason to believe it to be the case, and so scientists cannot appeal to the paradigm's alleged correspondence to reality as a reason to accept a new paradigm. Instead, they must show that the new paradigm is better at addressing anomalies that sent the old paradigm into crisis, and convince the rest of the scientific community that this

new paradigm will solve future anomalies and problems. The incommensurability of paradigms makes it difficult for scientists to rationally require other scientists to adopt their paradigm. Scientists may simply place different values on scientific theories and explanations. When one paradigm eventually beats out another paradigm for adoption, scientists who refuse to evolve are often left behind since they refuse to practice the new scientific paradigm.

ii. A Preliminary Defence of Constructivism

Constructivism asks us to stop searching for the way the world is, and acknowledge that we give structure to the worlds we live in. Some preliminary objections to this form of constructivism may be that it is too counterintuitive to give up the world, and it is too implausible to believe that we create the world. In this section, I will address these concerns and argue that they originate from misunderstandings of constructivism.

To begin, I will address the concern that it is too counterintuitive to give up the world. We have very strong ties to the existence of the world. When a physiotherapist examines a sprained ankle, they are operating with the assumption that the anatomical structure of the ankle is how ankles are really structured out there in the world. They base their treatment plan for the sprain on this belief in the objective anatomical structure of ankles. If I were to tell the physiotherapist that ankles can have many other structures, they would likely nod their head while questioning my mental state. In their mind, the world must be structured in such a way that ankles have the anatomy they do, otherwise their treatments for sprains would not be as effective. Our intuition that the structure we ascribe to the world, and all the ankles contained within it, gets at how the world is really structured seems to be what shapes our experience.

Constructivism does not tell us that the structure of the ankle that physiotherapists believe in does not exist. Neither Goodman nor Kuhn argue that the world does not contain structure.

What they argue is that there is no single structure out there in the world. There are many ways that ankles could be structured in the world, and there are many worlds where there are no ankles. The construction that modern day physiotherapists use to evaluate and treat ankle sprains contains genuine structure. The reason physiotherapists are so effective in treating ankle sprains is because in the construction they use, ankles have the structure that they assume ankles do. Constructivists like Goodman and Kuhn do not pretend to purport that the data we collect, or phenomena we experience, are entirely constructed in our minds. Discovery and construction for Goodman and Kuhn involves finding things that are already there. The data we collect and phenomena we experience are out there. But the relation between our constructions and the world is not one of correspondence; it is a relation of construction, where what we construct is how phenomena are interpreted and how we attain the data we collect. We create instruments and experiments to collect data that our constructions tell us is out there. We grab this data and organize it. We give it structure using our conceptual perspectives, our constructions. If the world has any structure, then it has lots of structure. In fact, if it has any structure, then it has so much structure that we must organize it using various independent constructions in order to make any sense of it. How we can organize this mess of structure is endless. What we do when we interpret and organize phenomena is give structure to the structure out there.

Thus, the physiotherapist can operate with the underlying belief that the anatomical structure of the ankle is a certain way since that belief will help them treat ankle sprains and the ankle really is structured that way in the construction. If a physiotherapist was constantly conflicted over what structure the ankle has, then they would likely fail to develop any treatment programs for injuries and would be useless in their occupation. The construction that physiotherapists use is one where the belief in the world being structured a certain way is

important. So, since the physiotherapist works with a construction where anatomical structure is weighted as being incredibly relevant, they can operate with the foundational belief that ankles genuinely have a certain structure. Having the belief that the world is a certain way is a good belief to have while working in some constructions, since constructions do tell us one way that the world is.

Critics of constructivism who argue that it is too counterintuitive to believe that our relation to the world is one of construction and not one of correspondence misunderstand what constructivism is claiming. Constructivism argues that the world is many ways, and so we can talk about one way of the world, one way that the world is structured, while working within a construction. Once we switch constructions, or we compare multiple constructions at once, constructivism says that we ought to accept that these constructions are independent ways that the world is and there is no single way to structure it. Thus, the only difference between the intuitive notion of the world and the constructivist's notion of the world is that the constructivist believes in many *the* worlds, not just one.

Other critics may reject constructivism on the grounds that it is too implausible to claim that we literally create the world. Constructivism argues that we construct paradigms and worldversions, which in turn construct worlds, and therefore, we construct worlds. The concern is that this is implausible because we clearly do not construct worlds and everything in them. Consider the shift from a construction without stars, to a new construction where stars exist. Have the stars always existed, even before they were discovered? Or did we construct them when we constructed the new construction? Critics say that constructivism argues for the latter, which seems ridiculous. How do we create stars that are billions of miles away?

This objection to constructivism is based on a misunderstanding of how worlds, or constructions, are made. As I briefly mentioned in the preceding paragraphs, Goodman argues that constructing worlds involves finding what is already there (Goodman 1984, 35). For example, imagine that you are put into a very cluttered room. Eventually, while looking around, you are able to distinguish a computer in the corner. Constructivism says that what you are doing is constructing what is in the room by distinguishing the computer's components, categorizing their function, and uniting these components into a whole computer. Now, imagine that someone from the 1700's is placed into the cluttered room. They have no conception of what computers are, and have no way of distinguishing the computer from the other junk in the room. The room that the visitor is in is one where computers do not exist, much like the worldversion without stars is one where stars do not exist. Finding what is already there and selecting for it, like what you did in the cluttered room with the computer, or what scientists did when they conceptualized planets, is what constructivists mean when they say we make the worlds and everything in them. Constructing and making involves finding what is already there, so the critic's objection that constructivism is implausible because we cannot create the world is based on a misunderstanding. There are many other, seemingly acute, criticisms of constructivism. In the next chapter, I will present these criticisms, and explain how Kuhn addresses them.

Chapter II: Kuhn and His Critics

Introduction

Kuhn's work in The Structure of Scientific Revolutions is often criticized for being ambiguous, for endorsing relativism and irrationality, and for failing to make room for genuine scientific progress. In this chapter, I will describe each of these criticisms, and present Kuhn's responses to them. Then, I will conclude by arguing that, while Kuhn's responses are sufficient, his failure to defend relativism weakens his account of scientific progress.

1. Kuhn and the Ambiguity Criticism

i. The Role of Paradigms

The concept of a paradigm is fundamental to Kuhn's work on scientific development. Paradigms provide us with models of scientific activity that historians can analyze and examine in order to gain an understanding of how science has developed over the years. Throughout his work, Kuhn describes paradigms in various ways. In the beginning of The Structure of Scientific Revolutions, he says that paradigms are scientific achievements that attract an "enduring group of adherents away from competing modes of scientific activity" and are "sufficiently open-ended enough to leave all sorts of problems" that still need to be solved (Kuhn 1962, 10-11). Later on, he says that paradigms are identified and implicitly articulated by exemplar problem-solutions (Kuhn 1962, 47). And in the postscript, he says that paradigms "[stand] for the entire constellation of beliefs, values, techniques, and so on shared by the members of a given community…[including] the concrete puzzle-solutions which, employed as models or examples, can replace explicit rules as a basis for the solution of the remaining puzzles of normal science" (Kuhn 1970, 175). Their role in Kuhn's work seems to be to help scientists make sense of the

world around them, as determined by the paradigm they use. Paradigms dictate the beliefs, values, and techniques that scientists adhere to in order to solve puzzles; they make it clear to scientists what puzzles are important, and guide scientists in developing solutions to these puzzles. For Kuhn, paradigms function by assisting us in understanding how science and scientific knowledge achieves, changes, develops, and operates, and how it develops into the sort of science that we use today. They play the role of the fundamental unit on which Kuhn thinks we can base our analysis of scientific development on.

ii. The Criticism

Some of Kuhn's critics argue that paradigms cannot possibly be the fundamental unit on which we base our analysis of scientific development on since it is not clear what paradigms are. Shapere says:

> Most fundamentally … Kuhn considers [paradigms] as not being rules, theories, or the like, or a mere sum thereof, but something more "global" (p. 43), from which rules, theories, and so forth are abstracted, but to which no mere statement of rules or theories or the like can do justice. The term "paradigm" thus covers a range of factors in scientific development including or somehow involving laws and theories, models, standards, and methods (both theoretical and instrumental), vague intuitions, explicit or implicit metaphysical beliefs (or prejudices). In short, anything that allows science to accomplish anything can be a part of (or somehow involved in) a paradigm. (Shapere 1966, 385)

For Shapere, it seems as though identifying or analyzing paradigms is impossible. Scientists may abstract their theoretical commitments to certain beliefs, values, or techniques from a paradigm, but these commitments are not what a paradigm is comprised of. Instead, it consists of something more, something intangible that no statement can do justice to, and yet can still help scientists solve puzzles and achieve scientific success. It is this intangible something that makes a paradigm what it is, and plays the role of the fundamental unit on which Kuhn thinks we should base our analysis of scientific development on.

However, as Shapere points out in the quote above, if a paradigm cannot be fully articulated, then it is unclear what a paradigm is. While paradigms seem to help scientists solve puzzles, their inability to be fully identified entails that they are comprised of everything that helps scientists achieve anything, including commitments to certain fundamental laws, standards and theories that bind a scientific community together, vague intuitions that scientists develop, and anything that is implicitly revealed through experiments, exemplars, lectures and textbooks. This determination of a paradigm is far too broad and ambiguous to analyze. Moreover, it seems impossible to examine what cannot be fully stated or articulated. Thus, Shapere concludes that the concept of a paradigm is too ambiguous to be used as the fundamental unit to base an account of scientific development on.

Furthermore, some critics argue that a paradigm's inability to be fully articulated is not the only way that Kuhn's account is ambiguous. Lauden agrees with Shapere's critique that the concept of a paradigm is "systematically ambiguous" (Lauden 1977, 73). He says that "Kuhn's paradigms or 'disciplinary matrices' are always implicit, never fully articulated… [and] can only be identified by pointing to their exemplars" (Lauden 1977, 75).[3] As Shapere argues, no

[3] I want to note that Lauden admits he failed to understand Kuhn's responses in his postscript. This is why he criticized Kuhn's original work from the Structure of Scientific Revolutions. In an endnote, Lauden says the "ambiguity of Kuhn's analysis [of science] has been multiplied as a result of Kuhn's later retractions of many of the basic ideas from the first edition of his *Structure of Scientific Revolutions* (1962). Unable to follow the logic of his later changes in of mind, I have been forced to characterize Kuhn's views in their original form" (Lauden 1977, 231). I will

statement about a paradigm's components can adequately capture what a paradigm is. There is something intangible, something that cannot be made explicit, in the determination of a paradigm. One reason Lauden gives for the intangible and implicit nature of Kuhn's paradigms is that they can only be identified by their exemplars. As I explained in the previous chapter, exemplars teach us to internalize paradigmatic characteristics in order to solve puzzles using that paradigm; and rather than providing us with explicit rules and principles to apply to the paradigm, exemplars give us implicit knowledge about the paradigm that we internalize in order to identify and solve puzzles.

If Lauden is right when he claims that paradigms are never adequately articulated and can only be identified by their exemplars, then it seems like paradigms are too ambiguous and implicit to base an account of scientific development on. Lauden claims that it is "difficult to understand how [Kuhn] can account for the many theoretical controversies which have occurred in the development of science, since scientists can presumably only debate about assumptions which have been made reasonably explicit" (Lauden 1977, 75). Since paradigms cannot be made reasonably explicit, Lauden says that Kuhn seems to "run squarely in the face of the historical fact that the core assumptions of all… paradigms [are] explicit even from their conception" (Lauden 1977, 75). Lauden seems to be stating that it is a historical fact that when scientists create paradigms, they make the core assumptions of the paradigms explicit so that other scientists can use and build upon them. However, Lauden points out that Kuhn makes it clear that the core assumptions of a paradigm are not made entirely explicit since what makes a

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describe the changes that Kuhn made to his original work and explain how they resolve the ambiguity that Lauden mentions, rather than multiply it.

paradigm a paradigm is something that is implicit and intangible. For these reasons, Lauden concludes that the ambiguity and implicit nature of paradigms reveals that Kuhn's account of science is an inadequate characterization of scientific activity and development.

iii. Kuhn's Response

A large portion of the postscript to Kuhn's Structure of Scientific Revolutions is dedicated to clarifying and defending his notion of a paradigm. In response to critics, who argue that the concept of a paradigm is ambiguous and are unsure about what it encompasses, Kuhn acknowledges that his "original text leaves no more obscure or important question… [and that] the term [was] used in at least twenty-two different ways [in his book]" (Kuhn 1970, 181). However, he also says that "[m]ost of [the differences between the ways he was using the term paradigm were] … due to stylistic inconsistencies… and can be eliminated with relative ease" (Kuhn 1970, 182). Kuhn recognizes that his failure to distinguish between the ways he was using the notion of a paradigm resulted in the ambiguity in his account of scientific development. To deal with this ambiguity, Kuhn all but abandons the term paradigm, noting that it has "assumed a life of its own" (Kuhn 1970, 187). To remove the ambiguity from his account of science, Kuhn distinguishes between two new concepts, disciplinary matrices and exemplars. In this subsection, I will explain what disciplinary matrices and exemplars are, and how they replace Kuhn's old notion of a paradigm. Then I will explain how these improved concepts address the objections raised in the previous subsection.

Kuhn says that "there are two very different" ways that he uses the term *paradigm* in his book (Kuhn 1970, 182). The first way is globally, where a paradigm is what binds a scientific community together. In the postscript, Kuhn replaces this notion of a paradigm with a refined concept that he calls a *disciplinary matrix*. He says that a disciplinary matrix "refers to a

common possession of the practitioners of a particular discipline… [and] is composed of ordered elements of various sorts" (Kuhn 1970, 181). These ordered elements include a commitment to certain beliefs, values, theories, and practices that any given group of scientists share. So, scientists can be said to be members of the same scientific group when they share a particular disciplinary matrix. In developing the concept of a disciplinary matrix, Kuhn identifies four of its key components: symbolic generalizations, shared commitments, shared values, and exemplars.

Symbolic generalizations are the formal components of a disciplinary matrix and look like laws of nature (Kuhn 1970, 182). They are either "formal or the readily formalizable components of a disciplinary matrix" (Kuhn 1970, 182). For example, *f=ma* and *all actions have an equal opposite reaction* are symbolic generalizations within their respective disciplinary matrix. These symbolic generalizations can be expressed in their formal symbolic form, like *f=ma*, or as they are ordinarily expressed using words, like all actions have an equal opposite reaction. Kuhn says that members of a disciplinary matrix rarely disagree on what its symbolic generalizations are. This is because symbolic generalizations tend to be the core assumptions that the disciplinary matrix supplies.

A second component of a disciplinary matrix is shared commitments to specific beliefs or particular scientific models. (Kuhn 1970, 184). Shared commitments help scientists determine which analogies they ought to use, and what puzzles or solutions ought to be considered. For example, members of a specific disciplinary matrix might share the model that molecules of gas behave like tiny elastic billiard balls. Kuhn notes that "members of scientific communities may not have to share… models, though they usually do" and points out that "membership in the community of chemists in the first half of the nineteenth century did not demand a belief in atoms" (Kuhn 1970, 184). This is an interesting feature of a disciplinary matrix since beliefs and

models provide information about what puzzles are interesting and the sort of solutions that scientists can develop. If scientists do not need to share models, then presumably, they do not need to share in the acceptance of the exact same puzzles or types of explanations.

A third component of a disciplinary matrix is shared values (Kuhn 1970, 184). Sharing scientific values provides scientists with a sense of community. Kuhn says that "their particular importance emerges when members of a particular community must identify crisis or, later, choose between incompatible ways of practicing their discipline" (Kuhn 1970, 184-185). The importance of these shared values tends to reveal itself during periods of disagreement. This is because values are what scientists use to make decisions and evaluate theories. Some examples of these values include accuracy, compatibility, consistency, fit, simplicity, and scope. When members of a scientific community are required to choose between incompatible ways of practicing their science, or are required to respond to an anomaly, the values that they share come into play. However, what values a group of scientists share, and how they evaluate their importance, may vary. For example, proponents of the quantum mechanics disciplinary matrix may choose to value accuracy over external compatibility, but members of a biology disciplinary matrix may value simplicity over accuracy. This point will be explained and defended in greater detail later on in this chapter.

A fourth component of a disciplinary matrix is what Kuhn calls an exemplar, and encompasses the local use of the term paradigm (Kuhn 1970, 186). Exemplars are the problem-solutions that students encounter during their scientific education. Kuhn says that exemplars teach scientists about the world since "[d]oing problems is learning consequential things about nature. In the absence of such exemplars, the laws and theories…previously learned would have little empirical content" (Kuhn 1970, 187). Exemplars teach scientists to make connections

between the paradigm and our experiences, relating exemplar problems to new problems that we encounter. To explicate this point, consider the following example. Students in a kindergarten class are given flash cards with colours on them. They are taught that certain colours correspond to terms like “blue”, “red”, and “yellow”. Then, they are given pictures of apples, suns, and trees, and are asked to determine which items are blue, red, or yellow. These exemplars are what give colour terms their empirical content, and implicitly provide the children with the means to identify the colour of objects around them.

Kuhn says that working with exemplars helps scientists “see [their] problem as *like* a problem [they have] already encountered. Having seen the resemblance, grasped the analogy between two or more distinct problems, [they] can interrelate symbols and attach them to nature in ways that have proved effective before” (Kuhn 1970, 189). Exemplars embody the characteristics of a disciplinary matrix. Working with exemplars teaches scientists what the appropriate structure of a problem or solution is according to the disciplinary matrix. Once scientists have worked with enough exemplars and have begun to internalize this structure, they are able to recognize a similar structure when they encounter new problems or solutions. Exemplars provide scientists with embedded implicit knowledge of what the appropriate structure of a problem or solution is so that they can learn how to identify similar problems and solutions later on.

Someone might try to argue that what has been acquired when scientists work with exemplars is an understanding of rules and how to apply them, not some intuitive internalization of structure. However, this description of what exemplars teach scientists is incorrect. Kuhn says “recognition may also be involuntary, a process over which we have no control. If it is, then we may not properly conceive it as something we manage by applying rules and criteria” (Kuhn

1970, 194). Consider the situation where you walk into a store and see your father, who you were certain was at home cooking dinner (Kuhn 1970, 194-195). After a moment or two, you think to yourself that the person you just saw could not have been your father because he had red hair and you father has brown hair. You are left wondering how you could have mistaken that man for your father. Kuhn says that what happened here is a deliberative process involving recognition. When you first saw the man in the store, you subconsciously drew parallels between him and your father. Perhaps they have the same posture, or the same limp when they walk. This process of recognition is not a voluntary or conscious one, and is not adequately summarized as an application of criteria or rules. If it were, then you would not have thought that that man was your father in the first place. Kuhn says that "the processes involved [in recognition] must ultimately be neural, and they are therefore governed by the same *physiochemical* laws that govern perception on one hand, and the beating of our hearts on the other" (Kuhn 1970, 195). The process of recognition happens prior to a conscious evaluation. And so, exemplars assist scientists in the process of recognition by providing them with the structure of problems and solutions that they then internalize to assist them in identifying similar problems or solutions.

Disciplinary matrices and exemplars address the criticisms of paradigms from the previous subsection in a few different ways. First, the criticism that paradigms are too ambiguous no longer applies. The global use of a paradigm has been replaced by the concept of a disciplinary matrix. So, what binds a community of scientists together is identified by that community's shared symbolic generalizations, commitments, values, and exemplars. When scientists share enough of these components, they can be said to be members of the same disciplinary matrix, and are practicing the same science.

Second, Lauden's criticism that paradigms are only identified by exemplars becomes an uncharitable summarization of Kuhn's work. Nowhere in The Structure of Scientific Revolutions does Kuhn say that paradigms can *only* be identified by exemplars. Moreover, now that exemplars are only one component of a disciplinary matrix, it becomes clear that there are many explicit ways of identifying a disciplinary matrix. Scientists can certainly identify and critically analyze disciplinary matrices through components like symbolic generalizations, shared commitments, and values. Thus, disciplinary matrices are made sufficiently and reasonably explicit and clear, and can provide an adequate characterization of scientific activity and development.

Third, Lauden's criticism that exemplars are too implicit is no longer as problematic as he claims it is. Exemplars embody the rules and intricate features of a disciplinary matrix. They are able to translate this information to scientists by promoting similarity relations between accepted ideal structures of problems or solutions and actual exemplar problems and solutions. For example, consider the young philosophy student learning sentential logic for the first time. After learning the basic logical connectives, students are provided with various exemplar problems that provide them with the rules they need in order to be able to derive some conclusion from a set of premises. They practice these problems using the solutions provided, until they are able to derive without any trouble. Automatically, they recognize that they can derive ~q from a set of premises $q \rightarrow p$, ~p. It has been ingrained in their minds to expect to see p when q is true, and to see ~q when p is false. A relation between the connectives $\rightarrow$ and ~ has been formed in their minds, and they have this embedded knowledge about what this relation means in practice. This is one reason why the best way to learn logic is to look at problems or solutions and to practice them until solving logic puzzles becomes second nature. So, contrary to what Lauden might argue, the

implicit nature of exemplars is not problematic, it is simply an educational tool present in both science and in logic. Moreover, while exemplars implicitly convey information, they are not entirely implicit. They have explicit problems and solutions with an explicit structure that students learn from. These problems and solutions can be discussed, criticized, and written down. Therefore, while exemplars are in some sense implicit, they are made sufficiently explicit in order to be analyzed and critically discussed.

2. Kuhn and the Radical Relativism and Irrationality Criticisms

i. The Criticisms

Kuhn is also accused of endorsing a version of relativism that is so radical it entails that science is irrational (Lauden 1977; Popper 1970; Scheffler 1967). Scheffler argues that Kuhn's characterization of scientific debate collapses into non-rational and self-justifying decision-making processes (Scheffler 1967, 86). If he is right, then Kuhn's account of science would entail that any rational attempts to evaluate a paradigm would be impossible. This would be problematic because science seems to depend on the critical analysis of disciplinary matrices, theories, and paradigms. Popper says that the "critical discussion and a comparison of … various frameworks is always possible" (Popper 1970, 56). Scheffler and Popper agree that any account of scientific development ought to account for and facilitate the critical and rational evaluation of paradigms, or else it fails to characterize scientific development in an appropriate manner. Kuhn, they say, fails to do this. In this section, I will begin by developing Scheffler's criticism that Kuhn's characterization of science entails a radical relativism that results in irrationality. Then I will present Kuhn's argument that he does not endorse radical relativism or irrationality.

Kuhn's disciplinary matrices and paradigms are incommensurable; this means that they dictate any criteria and standards that need to be met during evaluative processes. Kuhn acknowledges that when paradigms are being evaluated or analyzed, any arguments for their success become circular and self-justifying. He says "[when] two scientific schools disagree… they will inevitably talk through each other when debating the relative merits of their respective paradigms. In the partially circular arguments that regularly result, each paradigm will be shown to satisfy more or less the criteria that it dictates for itself and fall short of a few of those dictated by its opponent" (Kuhn 1962, 108-109). In the preceding quote, Kuhn is claiming that paradigms dictate what standards ought to be met when solving puzzles that a paradigm determines are important. However, what might be evaluated as a good solution in one paradigm may not be evaluated as a good solution in another paradigm. For example, consider the identification of the gas released by heating red calx of mercury as being dephlogisticated air. The phlogiston chemist using the phlogiston chemistry paradigm would evaluate this identification as suitable since it uses phlogiston principles, which the paradigm determines are required in chemical explanations. However, this identification would be evaluated as incorrect by the pneumatic chemist using the pneumatic chemistry paradigm since it uses phlogiston principles, which the paradigm determines are unsuitable for chemical explanations. Next, consider what would happen if scientists were trying to evaluate and compare these paradigms. Since the phlogiston chemistry paradigm requires that a paradigm explain chemistry using phlogiston principles, the phlogiston chemist would evaluate the phlogiston paradigm as being better than pneumatic chemistry. At the same time, the pneumatic chemistry paradigm prohibits the use of phlogiston principles in chemical explanation, and so a chemist using this paradigm would evaluate it as being a better paradigm than phlogiston chemistry. Since determining which paradigm is better depends

entirely on which paradigm is being used for the evaluation, any evaluation or defence of a paradigm in Kuhn's account of science becomes circular and self-justifying. As a result, when scientists evaluate paradigms, each paradigm seems to defend itself according to its own evaluative criteria and standards. This entails that there is no objective way to use the evaluative standards dictated by a paradigm to make analyses or choices.

Scheffler argues that if Kuhn wants to make room for the critical analysis of paradigms, then he must make it possible for a scientist to "step back and consider the respective bearings of the paradigm with regard to issues he holds relevant. Such consideration is itself not formulated within, nor bound by, the paradigms which constitute its objects. It belongs rather to a second-order reflective and critical discourse" (Scheffler 1967, 82). In order for Kuhn to make room for the critical analysis of paradigms, Scheffler says that he requires some account of second-order evaluative criteria that a scientist can access; something that Kuhn does not seem to make possible.

To see how evaluation and scientific debate works in Kuhn's account of science, let's begin by considering how Kuhn makes room for critical analysis. First, critical analysis is possible within a paradigm in virtue of the evaluative standards proponents of that paradigm share. For example, phlogiston chemists are able to critically analyze the identification of the gas released by heating red calx of mercury in virtue of the standards they share when it comes to chemical explanations. Since they are proponents of the phlogiston chemistry paradigm, they agree that phlogiston principles ought to be used in the identification of this gas. If someone were to contradict phlogiston principles in their identification of the gas, proponents of phlogiston chemistry would be able to critically evaluate this identification as being incorrect using the evaluative standards that they share. The standards determined by a paradigm to

evaluate concepts within that paradigm are what Scheffler calls *internal standards* (Scheffler 1967, 84). I will refer to these standards as *first-order evaluative standards* since they are used at the first level of scientific debate, where scientists debate concepts within a paradigm.

As we saw in the previous few paragraphs, these first-order standards are insufficient to facilitate the critical analysis of paradigms since they are entirely paradigm-relative. Scheffler says that:

> [Any] comparative evaluation of rival paradigms is quite plausibly conceived as a deliberative process occurring at a second-level of discourse, that paradigm debates may indeed be considered to occur at this second level, regulated, to some degree at least, by shared standards appropriate to second-order discussion… [Kuhn's work seems to imply that] such sharing of second-order standards is impossible. For to accept a paradigm is to accept not only theory and methods, but also governing standards or criteria which serve to justify the paradigm as against its rivals, in the eyes of its proponents. Paradigm differences are thus inevitably reflected upward, in critical differences at the second-level. It follows that each paradigm is, in effect, inevitably self-justifying. (Scheffler 1967, 84)

The only way for Kuhn to make room for paradigm evaluation is to make room for evaluative standards that transcend and override first-order standards. These transcendent standards are what Scheffler calls *second-order evaluative standards* since they are not paradigm-relative. If Kuhn is unable to account for these second-order evaluative standards, then how we evaluate scientific paradigms, or determine what counts as a good reason for accepting a scientific theory, becomes relativized to whichever paradigm is being used to dictate such standards and fails to make room for the critical analysis of paradigms. Consider the following example from Kuhn:

> The oxygen theory … was universally acknowledged to account for observed weight relations in chemical reactions, something the phlogiston theory had previously scarcely attempted to do. But the phlogiston theory, unlike its rival, could account for the metals' being much more alike than the ores from which they were formed. One theory thus matched experience better in one area, the other in another. To choose between them on the basis of accuracy, a scientist would need to decide the area in which accuracy was more significant. (Kuhn 1977, 323)

Both the phlogiston and pneumatic paradigms seem to be accurate descriptions of our experience of the world. One accurately explains why metals are more similar to each other than to ores, while the other one accurately predicts the changes in weight relations during chemical reactions. Which paradigm is better or more accurate seems to depend on which phenomena is considered more important, and which phenomena is considered more important seems to depend on which paradigm is being used.

Now consider the situation where Sarah, a chemist who values accurate representations above all else, is required to choose between the phlogiston paradigm and the pneumatic paradigm. On the one hand, the phlogiston paradigm explains why metals are more alike than the ores they come from, something that the pneumatic paradigm does not account for. On the other hand, the pneumatic paradigm explains the changes in weight relations that occur during chemical reactions, something that the phlogiston paradigm does not account for. If Sarah values an accurate representation that explains why metals are so similar, then she should adopt the phlogiston paradigm. However, if Sarah values an accurate representation that explains the changes in weight relations that occur during chemical reactions, then she should adopt the pneumatic paradigm. The problem here is that there seems to be no good reason to value an explanation of the similarity of metals over an explanation of the changes in weight relations. Given Kuhn's characterization of paradigms, there is no objective rational process that Sarah can undergo that will aid her in choosing one paradigm over the other. Which phenomena she thinks is important to explain seems to be entirely relative to whichever paradigm she uses.

This is problematic because it seems like the only sort of evaluative standards that Kuhn accounts for are internal first-order standards. Evaluative criteria and standards are determined by a paradigm. However, each paradigm has its own standards and criteria that it abides by. So,

the standards of one paradigm cannot be used to evaluate other paradigms. Thus, any evaluative standards in Kuhns account are only first-order, internal, and relativistic evaluative standards.

Returning to Sarah's predicament, since Kuhn cannot account for any objective second-order standards to evaluate a paradigm or to assist Sarah in making a choice on which phenomena she deems more important to explain, how we rationalize our beliefs or make choices seems to be entirely relative and subjective. The rationality that Sarah employs when making her decision thereby becomes irrational since any decision she makes will be the right decision according to the paradigm she chooses to adopt. Since a paradigm determines what standards ought to be met and what evaluative criteria ought to be used during any sort of evaluation, how rightness is evaluated becomes entirely relative. So, the argument could be made that anything can be right and any reasoning can be rational according to some paradigm or other. This relativization of rationality becomes problematic when there are no objective or external standards to evaluate rationality or rightness. This sort of unconstrained relativism turns into radical relativism, where anything can be anything. Therefore, Scheffler concludes that "the only recourse [Kuhn leaves us with] is non-rational" and the relativity of his paradigms fails to make room for critical analyses or debate (Scheffler 1967, 86).

ii. Kuhn's Response

In the postscript, Kuhn says that "though values are widely shared by scientists and though commitment to them is both deep and constitutive of science, the application of values is sometimes considerably affected by the features of individual personality and biography that differentiate the members of the group" (Kuhn 1970, 185). Since Kuhn's account of science relativizes values to paradigms and disciplinary matrices, not all scientists share the exact same values or apply them in the same ways. One disciplinary matrix may teach scientists to value

internal consistency and simplicity rather than external compatibility, and tell scientists that these are good reasons for adopting a theory. Another disciplinary matrix may teach scientists to value external compatibility and scope, and tell scientists that these are good reasons for adopting a theory. However, Kuhn does not consider this relativization to be as problematic as his critics, like Popper and Scheffler, seem to think it is. In this section, I will argue that just because there is no single objectively correct way to apply and weight scientific reasons and values does not mean that any way of applying and weighting reasons and values is correct. Kuhn's constructivism is not that radical.

Science is the sort of activity where most internal scientific standards and values are relatively stable across disciplinary matrices. In explaining why scientific values remain relatively stable across disciplines, Kuhn says:

> Values like accuracy, consistency, and scope may prove ambiguous in application, both individually and collectively; they may, that is, be an insufficient basis for a *shared* algorithm of choice. But they do specify a great deal: what each scientist must consider in reaching a decision, what he may and may not consider relevant, and what he can legitimately be required to report as the basis for the choice he has made. Change the list, for example by adding social utility as a criterion, and some particular choices will be different, more like those one expects from an engineer. Subtract accuracy of fit to nature from the list, and the enterprise that results may not resemble science at all, but perhaps philosophy instead. Different creative disciplines are characterized, among other things, by different sets of shared values. (Kuhn 1977, 331)

So, Kuhn says that science aims at puzzle-solving, simplicity, consistency, compatibility, and coherence because that is the sort of activity that science is. These values, while given their importance internally, can still be considered external scientific values. Kuhn claims that "though values are widely shared by scientists and though commitment to them is both deep and constitutive of science, the application of values is sometimes considerably affected by the features of individual personality and biography that differentiate the members of the group" (Kuhn 1970, 185). That such values are given a different level of importance or are allowed to be

applied differently in different disciplinary matrices or by different scientists is not an endorsement of radical relativism, rather, it is a fact about how science develops. Kuhn says:

> Individual variability in the application of shared values may serve functions essential to science… Most anomalies are resolved by normal means; most proposals for new theories do prove to be wrong. If all members of a community responded to each anomaly as a source of crisis or embraced each new theory advanced by a colleague, science would cease. If, on the other hand, no one reacted to anomalies or to brand-new theories in high-risk ways, there would be few or no revolutions. (Kuhn 1970, 186)

Scientists are not expected to respond to anomalies or theories in the same way. If they were, then scientists would never disagree on whether an anomaly is actually an anomaly. It is a sociological fact that we do not expect all scientists across all disciplinary matrices and cultures to value the same things or respond to the world in the same ways. Kuhn says:

> When scientists must choose between competing theories, two men fully committed to the same list of criteria for choice may nevertheless reach different conclusions. Perhaps they interpret simplicity differently or have different convictions about the range of fields within which the consistency criterion must be met. Or perhaps they agree about these matters but differ about the relative weights to be accorded to these or to other criteria when several are deployed together. (Kuhn 1977, 324)

This is not problematic; it is an accurate description of scientific evaluation. The fact of the matter is that scientists respond to anomalies and apply values differently. This relativism and subjectivity does not result in radical relativism. A scientist cannot simply choose to adopt a disciplinary matrix that explains the world through alien intervention. They would not be applying scientific values correctly, unless of course the explanation of the world by alien intervention was the simplest, most coherent, accurate, and the best at solving puzzles and making promises of future research. Just because a scientist can apply scientific values and evaluate reasons for adopting one theory over another differently does not entail that they can apply any values however they would like, or decide that any reason counts as a good reason for adopting a theory.

Moreover, this relativization of scientific reasons and values does not undermine the rationality of science. While what counts as a good reason may be subjective, cultural, or relative to a disciplinary matrix, rationality is still involved. Scientists are still expected to value and evaluate certain scientific standards correctly. There are tangible ways of determining if a theory is simple, consistent, accurate, and predictive. These values are not just made up and evaluated however a scientist would like. This process is a rational one, though it may not be entirely objective. And scientists can still critically analyze and evaluate disciplinary matrices since the evaluative standards they use will be the standards dictated by scientific practice, not just by the disciplinary matrix that they use. Kuhn does not consider this problematic, nor does he see it as a misrepresentation of science. Any relativity, subjectivity, and irrationality involved in science and scientific development is not created by Kuhn, he is merely pointing it out.

3. Kuhn and the Progress Criticism

i. The Criticism

Some critics argue that Kuhn's constructivism is too relative to account for genuine scientific progress. Scientific and categorical progress is believed to be progress in getting closer to understanding nature as it really is. We believe that our descriptions, representations, and theories get at some innate structure that is really out there in the world. It seems like what we are doing when we refine or clarify our concepts and theories is representing nature more accurately. We seem to think that making scientific progress is making progress by improving the correspondence between our scientific theories and the structure of the world as it really exists. If we had some correspondence theory of science, where science aims at improving the

match between our theories and nature, then this picture of what progress is and how we achieve it would be accurate.

However, Kuhn does not rely on correspondence when he illustrates scientific activity and development. He says:

> Compared with the notion of progress most prevalent among both philosophers of science and laymen, however, this position [that is, Kuhn's position on scientific progress] lacks an essential element. A scientific theory is usually felt to be better than its predecessors not only in the sense that it is a better instrument for discovering and solving puzzles but also because it is somehow a better representation of what nature is really like. (Kuhn 1970, 206)

Kuhn's position on scientific progress does not require an improvement in the match between the ontologies of our theories and the way the world really is. He says that "[l]ater scientific theories [become] better than earlier ones for solving puzzles" (Kuhn 1970, 206). Science, for Kuhn, does not get at how the world really is, and scientific progress is not progress in matching our theories and concepts to the world. Instead, science for Kuhn is a constructive puzzle-solving activity where we create disciplinary matrices that dictate which puzzles are interesting and how we can go about solving them. Any progress in puzzle-solving seems to be progress that we construct, rather than objective progress in our ontology. One criticism of Kuhn's work is that it seems like any advancement during a scientific revolution is a mere change in disciplinary matrix, rather than a progression to a better disciplinary matrix (Shapere 1970, 67). For this reason, critics of Kuhn argue that real progress is not possible in his constructivism.

ii. Kuhn's Response

In the postscript, Kuhn addresses the concern that his account of science is too relativistic to make room for genuine progress. He argues that, if progress is relativistic, it is not "merely so" (Kuhn 1970, 205). There are ways that we can make progress given his account of scientific development. First, we can make progress within a disciplinary matrix. This sort of progress is

cumulative and occurs when scientists build upon facts and theories supplied by the disciplinary matrix. It can be evaluated by analyzing any improvements made in the articulation, clarity, and scope of the disciplinary matrix. And while this progress is relative to the disciplinary matrix, it can still be evaluated and measured and is thus real progress.

Second, Kuhn says that his characterization of science and scientific progress is "far from *mere* relativism in a respect that its critics have failed to see that genuine progress is possible during a scientific revolution" (Kuhn 1970, 205). Kuhn's critics have mischaracterized this sort of genuine progress present in Kuhn's work as being impossible or too relativistic because it does not look like the sort of progress they expect to see in science. Progress during a scientific revolution cannot be characterized as improving the correspondence between our theories and the world, nor is it cumulative with a clear ontological direction like the progress we see within a disciplinary matrix. Instead, it is progress in a disciplinary matrix's ability to solve puzzles and generate new solvable puzzles. A change in which disciplinary matrix is used or adopted is not mere change, rather, it signifies genuine improvement. This can be evaluated by comparing two disciplinary matrices. For Kuhn, new disciplinary matrices are genuinely better than earlier ones when they solve more puzzles and promise progress in more research areas than older paradigms (Kuhn 1970, 206). It is in this way that genuine, tangible, and measurable progress can be made during scientific revolutions.

4. Kuhn and the Conceptual Progress Criticism

i. The Criticism

Another criticism of Kuhn's work comes from Lauden who argues that "Kuhn [fails] to see the role of *conceptual problems* in scientific debate and in paradigm evaluation… The whole

notion of conceptual problems and their connection with progress finds no serious exemplification in Kuhn's analysis [of science]" (Lauden 1977, 74). Furthermore, Lauden argues that "[t]he posing and resolving of conceptual problems – a phenomena Kuhn relegates chiefly to short-lived periods of crisis – continues unabated throughout the life of any active research tradition" (Lauden 1977, 134). Lauden is arguing that Kuhn does not make enough room for conceptual progress in his characterization of science. The only time where Kuhn seems to account for conceptual progress is during periods of crisis, where scientists modify their paradigm in order to deal with acute anomalies. Lauden seems to think that this is an inadequate role for conceptual progress to play in any account of scientific development since conceptual progress is certainly a major component present during all stages of scientific development.

Lauden characterizes conceptual progress as being progress in solving conceptual problems of the well-foundedness of conceptual structures (Lauden 1977, 48). He says that there are two types of conceptual problems where scientists make progress. The first are internal conceptual problems, which arise when a theory exhibits internal inconsistencies (Lauden 1977, 49). Some examples of internal inconsistences include ambiguities, contradictions, or circularities. Internal conceptual progress occurs when scientists fix, clarify, or remove these inconsistencies from their theories and solutions. The second type of conceptual problems are what Lauden calls external conceptual problems. Lauden says that these problems "are generated by a theory, T, when T is in conflict with another theory or doctrine which the proponents of T believe to be rationally well founded" (Lauden 1977, 50-51). So, external conceptual problems are generated when components of T are in conflict with some other theory, T', that proponents of T believe is a good and rational theory. Lauden says that this tension is what creates the

conceptual problems that scientists can address, and reconciling these incompatible theories results in external conceptual progress.

Lauden argues that Kuhn misses a huge component of scientific development by failing to account for conceptual progress in scientific development (Lauden 1977, 74). However, it seems clear to me that Kuhn does make room for internal conceptual progress, and not just during periods of crisis. Making conceptual progress seems to be the primary aim of normal science. When scientists work at further articulating a disciplinary matrix, they are aiming at improving the clarity, consistency, and scope of the "phenomena and theories that the paradigm already supplies" (Kuhn 1962, 24). Their goal seems to be to achieve the internal conceptual progress that Lauden describes. Kuhn says that most work in normal science aims at "working with both fact and with theory… [to produce] a more precise paradigm, obtained by the elimination of ambiguities that [the original paradigm] had retained" (Kuhn 1962, 33). Normal science, then, aims at further articulating a paradigm in order to clear up any ambiguities and internal inconsistencies that may be present, thereby making internal conceptual progress. Therefore, the role of conceptual progress is certainly seriously exemplified in Kuhn's characterization of science, and is not only present during short-lived periods of crisis, but also makes up most of the progress that is present during periods of normal science.

Lauden may be arguing that Kuhn only fails at making room for external conceptual progress in his theory of scientific development. Lauden believes that reconciling incompatible or contradictory theories is an important element of scientific progress. Since Kuhn seems to restrict incompatible theories to their own disciplinary matrices, Lauden may believe that Kuhn is incapable of making room for this external conceptual progress in reconciling cross-theory

incompatibilities. This is the criticism that I will respond to on Kuhn's behalf in the next subsection.

iv. Kuhn's Response

I agree with Lauden that Kuhn does not make room for external conceptual progress. Incompatible and incommensurable theories are restricted to their own disciplinary matrices and scientists are not required to find ways of reconciling these incompatibilities. Since phlogiston theory and pneumatic chemistry were incompatible, Kuhn determined that they signified the existence of two different disciplinary matrices where scientists did not have to find ways of reconciling the existence of phlogiston within pneumatic chemistry.

However, I do not think that Kuhn believes that external conceptual progress is a necessary component of scientific development. When two theories are incompatible and belong to different disciplinary matrices, it seems like scientists either make a choice to adopt one theory and get rid of the other one, as was the case in the scientific revolution from phlogiston chemistry to pneumatic chemistry, or they can characterize this incompatibility as being a product of two different sorts of theories that belong in two different scientific disciplines. One disciplinary matrix or way of organizing the world may be incompatible and incommensurable with another disciplinary matrix, yet scientists do not try to reconcile their incompatibility. Instead, this theoretical incompatibility is viewed as being a product of different scientific disciplines.[4] Since the incompatibility of disciplinary matrices is viewed as either being a result of belonging to different scientific disciplines, or as being indicative of making a choice to throw one disciplinary matrix out in order to adopt a new one, external conceptual progress does not seem to be required to make scientific progress. Therefore, Lauden's criticism that Kuhn does

[4] There must be many examples of this in the history of science.

not make room for external conceptual progress does not seem to be a problem since Kuhn can still account for both internal conceptual progress and empirical progress.

I find Lauden's criticisms of Kuhn particularly interesting, given the similarities in their accounts of scientific development. Both Lauden and Kuhn agree that science is a non-cumulative activity. Lauden writes that the aim of science is to maximize empirical problems that we can solve, and minimize anomalous problems we create (Lauden 1977, 124). Like Kuhn, Lauden also sees progress as an improvement in our research tradition's ability to exemplify this process, rather than an improvement in the correspondence between our theories and the way the world really is. This, in turn, relativizes how we evaluate theories and research traditions in Lauden's account of scientific development, a relativization that neither Kuhn nor Lauden see as problematic. Overall, the similarities between Lauden and Kuhn's work are striking. At the same time, I can understand why Lauden criticizes Kuhn's responses to his critics. Kuhn's responses seem to lack a self-awareness of the relativism his constructivism endorses. And, I think that it is this lack of self-awareness that ultimately hinders Kuhn's defence of his account of scientific development.

Conclusion

Kuhn's work is accused of employing ambiguous fundamental concepts, of endorsing relativism and irrationality, and of failing to account for genuine scientific progress. He addresses these accusations by clarifying the concepts he bases his account of scientific development on, by arguing that any irrationality and relativism in his work is a sociological symptom rather than a theoretical consequence, and by claiming that despite the incommensurability of disciplinary matrices, we can still compare their puzzle-solving ability to

evaluate progress. While I think that these responses are close to being sufficient, I think that they would be made stronger if he were to genuinely defend relativism.

First, I believe that Kuhn's response to the ambiguity criticism is adequate. He recognizes that his use of the term paradigm was ambiguous in his original work, and decides to replace the term in order to clearly and explicitly explain what he means by it. Kuhn makes it very clear that a disciplinary matrix is what binds scientists together, and it is comprised of four components. He also explains how these components can be identified and criticized. For these reasons, his disciplinary matrices avoid the ambiguity that his paradigms are guilty of.

However, I believe that Kuhn's response to the criticism that his constructivism is radically relative is inadequate. Whether the relativism in his work is a sociological symptom or not, I think that it deserves a better defence. Kuhn dismisses the relativity in his work as being a fact about how we engage with science. He does not defend relativism itself, and instead says while "the temptation to describe [his] position as relativistic is understandable, the description seems wrong to [him]" (Kuhn 1970, 206). Instead of defending the relativism that is certainly present in his work, he merely states that he does not consider it relativism, but if it is, it is more than relativism. His reluctance to admit that he is a relativist leaves the door wide open for his critics to simply accuse him of being relativistic. If he were to argue that relativism itself is not that bad, and explain how it makes room for critical comparison, discussion, and evaluation, then his critics would have to find fault with relativism, rather than just accuse him of it.

The fact of the matter is that Kuhn endorses relativism, the incommensurability of his disciplinary matrices ensures that. Kuhn even admits that his account of scientific development relativizes evaluative standards. However, he denies that this is problematic since science is the sort of discipline where evaluative standards are shared across disciplinary matrices. Science

aims at puzzle-solving, simplicity, consistency, compatibility, and coherence. The respective weighting, application, and importance of these values may vary, but the values and standards themselves are stable across disciplinary matrices. So, while in some respect evaluative standards are relative in Kuhn's account, in another respect, they are not. This, Kuhn argues, allows his account of science to make room for external evaluative standards and avoid the relativistic implication that any evaluative standard can be used to evaluate disciplinary matrices.

I think Kuhn is on the right track with his response. However, I also think that he fails to explain exactly why scientific standards are shared by disciplinary matrices and how they can be used as external evaluative standards. What makes science the sort of discipline that it values standards like puzzle-solving, simplicity, consistency, compatibility, and coherence? And why do most disciplinary matrices share these standards? Moreover, if the importance and application of these values is relative, what happens when scientists disagree about the evaluation of a disciplinary matrix? Is one of them right? Are they both right? Is their disagreement merely a difference of opinion and nothing else? Is there such a thing as rightness and wrongness with such relativity? In order to strengthen this response, we should explain how relativistic evaluation is possible, and what rightness can look like in Kuhn's relativistic account of science.

Furthermore, Kuhn fails to give a sufficient account of progress. He says that progress during a scientific revolution is possible and can be measured by evaluating a disciplinary matrix's comparative puzzle-solving ability and promise of future research. However, he fails to adequately explain how this is possible given the incommensurability of disciplinary matrices. Even if we could use external evaluative standards to evaluate a disciplinary matrix, what counts as a puzzle or solution is still entirely relative. Disciplinary matrix A may state that X, Y, and Z are puzzles, and x, y, and z are solutions. Disciplinary matrix B may state that V, W, and X are

puzzles, and v, w, and x' are solutions. How do we compare the puzzle-solving ability of different disciplinary matrices when they disagree on what the puzzles are or what an appropriate solution is? The relativity in such a comparison is inescapable, whether Kuhn embraces this fact or not. And if Kuhn fails to defend relativism, then his critics will continue to accuse him of being a relativist despite his protest.

To make Kuhn's responses to his critics stronger and more persuasive, we need to defend the relativism in his work, rather than dismiss it. Relativism is not bad, nor does it make critical evaluation, rightness, or progress impossible. Goodman acknowledges and argues this very point. Goodman is entirely aware of the relativism his constructivism endorses. And he defends it openly, arguing that genuine progress can be made with the acceptance of new constructions, and explains how we can be right in our evaluations despite working within a construction. In the next chapter, I will present Goodman's defence to each of the criticisms that face Kuhn, explain how he defends relativism, and argue that Goodman's responses can be used to strengthen Kuhn's responses to his critics.

Chapter III: How Goodman Can be Used to Strengthen Kuhn's Responses

Introduction

In this chapter, I will use Goodman to respond to the criticisms that face Kuhn. Goodman's constructivism can be criticized for endorsing radical relativism, for being ambiguous, and for failing to make room for genuine progress. In this chapter, I will describe each of these criticisms, and respond to them using Goodman's work. Then, I will give a brief overview of Kuhn's responses to these criticisms and explain why Goodman's responses are stronger. Finally, I will conclude by arguing that Goodman's responses can be used to address the inadequacies of Kuhn's constructivism.

1. Goodman and Ambiguity

i. The Criticism

Like Kuhn, Goodman's constructivism also faces the criticism that it is ambiguous. Scheffler says that "[t]he world-making argued by Goodman is elusive; Are worlds identified with (true) world-versions, or do they rather comprise what is referred to by such world-versions" (Scheffler 1979, 618). He says that Goodman describes worlds and worldversions in many different and conflicting ways. Goodman writes that "each [worldversion] tells us *a* way that the world is" (1972. 31), that "right world-descriptions and world-depictions and world-perceptions can be treated as worlds" (1978, 4), that "the world [is] displaced by worlds that are but versions" (1978, 7), and that "all true [world]versions describe worlds" (1978, 119). These descriptions seem to conflict with each other. Not only do worldversions describe a way the world is and have a world answering to them, Goodman says that they can also be treated as worlds and that they are worlds themselves.

As Scheffler points out, these varying descriptions of worldversions seem to be incompatible. If a worldversion is a description of a world, then it cannot also be the world that it describes. And if worldversions are worlds, then they cannot be their own description. For example, assume that phlogiston chemistry is a worldversion. According to Goodman's many descriptions of worldversions detailed in the previous paragraph, the phlogiston chemistry worldversion seems to describe a world that has a specific structure. However, if the phlogiston chemistry worldversion is a description of a world, then it cannot also be the world that it describes. Put another way, Goodman would say that the phlogiston chemistry worldversion is a world. However, as shown in the previous paragraph, Goodman would also say that worldversions have worlds answering to them that they describe. So, Goodman would seem to have to conclude that the phlogiston chemistry worldversion is a world, and that it also describes a different world. Still, if the phlogiston chemistry worldversion is a world, then it seems like any world that answers to it would also be the phlogiston chemistry worldversion. Thus, this conceptualization of worldversions is confusing and unclear. Therefore, Scheffler concludes that Goodman's worldversions and worlds are ambiguous, and his account of constructivism is unacceptable.

ii. Goodman's Response

Goodman agrees with Scheffler's claim that he describes worldversions in many different ways. However, he also says that he "brazenly declare[s] that [he is] *not sorry* for what [he] has written" and "[t]o say that every right version is a world and to say that every right version has a world answering to it may be equally right even if they are at odds with each other. Moreover, talk of worlds and talk of right versions are often interchangeable" (Goodman 1984, 40-41). Goodman does not consider his descriptions of worldversions to be problematic. As argued in

Chapter I, worldversions are independent systems of description that tell us a way that the world is. In some ways, worldversions are worlds, while in other ways, they are other than worlds. Worldversions can be thought of as the worlds that they describe because they create these worlds. Without worldversions, worlds would not exist. For example, the phlogiston chemistry worldversion organizes the world in such a way that phlogiston exists and is what facilitates combustion. If the phlogiston chemistry worldversion did not exist, then neither would the world where phlogiston facilitates combustion. The conceptualization and description of phlogiston is what brings phlogiston into existence. This is why worldversions can be treated like worlds, because the existence of these worlds depends on them.

At the same time, worldversions are other than worlds. Goodman argues that to "say that there is a star up there is not itself bright or far off; and the star is not made up of letters" (Goodman 1984, 41). Worlds and their descriptions are not the same sorts of things. While descriptions may organize our experience and create worlds, to say that there is a star up there does not physically put a bright spot into the sky. Instead, our concept of a star enables us to make sense of that bright spot in sky. Without the concept of a star, that bright spot might be something else, like a God or a lightbulb. Worldversions create worlds like they create stars, but this creation involves reconceptualizing things that are already there; the world is ready to be made, but it is our descriptions that make it. Worldversions are descriptions and representations of worlds, they make worlds and are the worlds themselves. At the same time, they describe worlds and are not the worlds themselves. Worlds would not exist without worldversions, and so there is no firm line that can be drawn between worlds and worldversions. The relativism in Goodman's work entails that delineating worldversions from worlds is impossible. Worlds are made by worldversions, and worldversions depend on worlds. Descriptions without worlds are

empty, and worlds without descriptions are elusive and incoherent. Where a worldversion stops and a world begins is therefore unclear. Thus, we can say that worldversions are worlds, and we can say that worldversions are descriptions that worlds answer to, and both conceptualizations of worldversions are equally as correct. This is not an issue for Goodman since his constructivism entails that worlds are relative to our constructions and descriptions of them.

This point is philosophically interesting and valuable since it explains why Goodman is an irrealist, and it frees us from the philosophical mud we are stuck in when trying to conceptualize the reality of the world, thereby dissolving the dispute between realism and idealism. Goodman's irrealism "does not hold that everything or even anything is irreal, but sees the world as melting into versions and versions making worlds" (Goodman's 1984, 29). Goodman does not take a stance on whether or not there is a world; he just states that "if there is any world, there are many" (Goodman 1984, 31). For Goodman, worlds are born out of versions of them. So, if we accept that there is a right version of the world, then we accept that there is a world. Consequently, we must accept that there are many right versions of the world and therefore there are many worlds. This point is neither a realist's position nor is it an idealist's position since "the realist will resist the conclusion that there is no world [and] the idealist will resist the conclusion that all conflicting versions describe different worlds" (Goodman 1978, 119). The irrealism of Goodman's constructivism dissolves the dispute between realism and idealism by making their dispute a matter of convention rather than a matter of fact. A realist can interpret Goodman's constructivism as arguing that the collection of worldversions is the world, while the idealist can interpret it as arguing that there is no world, only worldversions.

Goodman finds both of these interpretations "equally delightful and equally deplorable – for after all, the difference between them is purely conventional" (Goodman 1978, 119). Both the

realist's conclusion that there is a world and it just happens to be a collection of worldversions, and the idealist's conclusion that there is no world, just a collection of worldversions, leads to the same result; there is a collection of worldversions that we construct. Our choice in how we conceptualize these worldversions is just that, a choice. Therefore, Goodman's irrealism and constructivism dissolves the dispute between realism and idealism, thereby freeing us from the conceptual mud that philosophers have been stuck in for years.

Moreover, while worldversions may be described in many different ways, they are not as ambiguous as Scheffler claims. Goodman argues that worlds are created and picked out by worldversions. He explicitly explains how worldversions are made and how they can be identified in order to also distinguish worlds. First, Goodman says that worldversions can be "distinguished by the conflict and irreconcilability of their versions" (Goodman 1984, 31). When descriptions of the world are too different or incompatible to be reconciled, they demarcate different worldversions. For example, phlogiston chemistry and pneumatic chemistry are incompatible and irreconcilable descriptions of the world. They disagree on how the world is structured. In the phlogiston worldversion, the world is structured in such a way that phlogiston exists and is what facilitates chemical reactions like combustion. In the pneumatic worldversion, oxygen, not phlogiston, exists and is what facilitates chemical reactions like combustion. Goodman would say that it is this disagreement that makes these two systems of descriptions irreconcilable and thus distinguishes them as two different independent worldversions.

Furthermore, Goodman makes it clear how we can identify worldversions. Different worldversions are made up of different compositions, orderings, and weightings of objects (Goodman 1978, 7-17). We can identify and distinguish different worldversions based on what objects they say exist, and how they organize these objects. Consider the phlogiston

worldversion. It structures the world in such a way that phlogiston is a substance that exists and is contained in objects. When objects are rich in this substance and begin to emit it, they begin to combust. The pneumatic worldversion is structured in such a way that oxygen exists and is absorbed by objects during chemical reactions like combustion. Each worldversion has a different composition of objects and thus can be identified and distinguished from other worldversions in virtue of their composition. Therefore, Goodman's worldversions can be described in different ways without being problematic, and can certainly be identified, thereby avoiding Scheffler's criticism that they are too ambiguous.

iii. An Evaluation of Both Kuhn's Response and Goodman's Response

The ambiguity criticisms that face Goodman and Kuhn are similar, but they are not identical. Goodman is accused of using worldversions to refer to both worlds and descriptions of worlds; and Kuhn is accused of failing to adequately define paradigms by using them to refer to the thing that binds scientific communities together as well as the concrete puzzle-solutions that students encounter during their scientific education. Both Kuhn's response and Goodman's response to their respective ambiguity criticisms are adequate since they both clarify the ambiguity. However, they do so in different ways. Kuhn's response to his ambiguity criticism is to back track on some of his original claims and create two new concepts to address the ambiguity, while Goodman chooses to defend his use of worldversions by arguing that it is entirely consistent with his constructivism.

Goodman is able to defend his many uses of worldversions in virtue of his acceptance and defence of relativism. What worldversions refer to is entirely relative to the context that worldversions are being used in. If worldversions are being used in the context of discussing how we construct worlds, then they can be said to be worlds themselves since they are what create

worlds. If worldversions are being discussed in the context of rightness, then they can be used to refer to the descriptions of worlds since descriptions can be right while worlds cannot be. Differentiating between worldversions and their worlds results in an ambiguity because it is impossible to do it. Like trying to separate conception from perception, separating worldversions from worlds cannot be done. This is an important feature of Goodman's constructivism, not a failure of it. Thus, both Kuhn and Goodman adequately respond to their respective ambiguity criticisms. However, Goodman's response differs from Kuhn's response in virtue of his acceptance and defence of relativism. This does not make his response to the ambiguity criticism stronger than Kuhn's response. However, it does set the stage for Goodman's ability to respond to the other criticisms in ways that are much stronger than, and not available to, Kuhn.

2. Goodman and Radical Relativism

Introduction

Another criticism of Kuhn's work that also faces Goodman's constructivism is the criticism that it is radically relative. As I explained in Chapter I, Goodman asks us to give up the notion of the objective world. As a result, we are left with our many descriptions of the world, our worldversions. Critics argue that this sort of constructivism is radically relative because without an objective world to compare and constrain the rightness of our worldversions to, any worldversion can be constructed and be right. In this section, I will begin by reviewing Goodman's arguments that we ought to give up the notion of the objective world. Then I will present the criticism that giving up the objective world results in radical relativism. Finally, I will explain Goodman's argument that his constructivism does not endorse radical relativism.

As I argued in Chapter I, Goodman provides two arguments for why we should give up the objective world. One argument is that the very notion of the objective world is self-defeating. There is no way to conceptualize the world as it exists unstructured by our descriptions of it because the very thought of this world gives it structure. We cannot conceptualize, think about, or talk about the world as something that is structured in a certain way, and so, we should give up the very notion of the unstructured and objective world since it collapses in on itself. Another argument that Goodman gives for giving up our notion of the objective world is that the concept of the objective world is elusive. The world is not contained in what is given to us or in how it is given, nor can it be found in our descriptions and representations of it. This is why Goodman says that the objective world is a conceptual ghost, and we need to stop searching for it. The world is created by our descriptions and versions of it, and its existence relies on these descriptions and versions.

i. The Criticism

Goodman acknowledges that some of his critics argue that his constructivism is radically relativistic. Since he says that we construct worldversions and that worldversions make worlds, if the rightness of worldversions is "neither constituted nor tested by correspondence with a world independent of all versions… [then it seems like] the criteria of rightness [in his constructivism are] relative" (Goodman 1984, 39-40). If there is no objective world to constrain right worldversions to, then presumably, any worldversion is a right worldversion, and we can construct the world in any way that we desire. Similar to Kuhn, Goodman needs to develop some form of external evaluative standards in order to constrain the relativism in his constructivism and ensure that not just any worldversions is a right way to describe the world.

ii. Goodman's Response

Goodman accepts that his constructivism is relativistic. However, as I explained in Chapter I, he constrains it in order to avoid radical relativism. He develops and identifies pragmatic evaluative standards and tools including accuracy, coherence, context, entrenchment, and projectability in order to explain how worldversions can be compared, evaluated, and privileged. Using these tools, Goodman is able to generate an account of rightness with evaluative standards that are external to, and independent of, his worldversions. These standards, while relativized to us, our aims, our needs, our wants, and our use of entrenched concepts, are still external to our constructions themselves. They do not entail that any worldversion is just as right or as good as any other. There is still a fact of the matter that some worldversions fit into our practices better, use more entrenched and projectible predicates, and are simpler or more coherent. Consider the situation where two scientists disagree about what the moon is made of. One scientist uses the worldversion that describes the moon as being made up of cheese. The other scientist uses the worldversion that describes the moon as being made up of rock. While the fact about what the moon is *really* made of depends on which worldversion is being used, the scientists can use projectability as a tool for choosing which worldversion ought to be privileged in a scientific context. Each worldversion makes a projection about the material of the moon. If we were to examine instances of moon material, we would likely find that one worldversion makes projectible projections while the other one does not. We can privilege the worldversion that makes projectible projections and consider it to be a better and more accurate description of the material of the moon. Thus, Goodman's account of rightness can be used to evaluate and privilege worldversions without the use of a specific worldversion so that his constructivism avoids ridiculous consequences like entailing that every worldversion is as good or as right as

any other worldversion. Therefore, while Goodman's account of rightness is relativistic, it is not radically so.

iii. An Evaluation of Both Kuhn's Response and Goodman's Response

Both Kuhn and Goodman respond to the criticism that their work entails radical relativism. Kuhn's response to the criticism that his constructivism is radically relative is to argue that it is not merely relative. He passes off the relativity in his work as being a sociological fact rather than a theoretical concern. He refuses to accept that his constructivism is merely relativistic and attempts to argue that there are non-relativistic ways of comparing, evaluating, and choosing disciplinary matrices. He claims that we can use evaluative standards like puzzle solving ability, accuracy, and simplicity in order to determine the rightness of disciplinary matrices. He says that we can use these evaluative standards because science is the sort of activity that values them and because they are shared across disciplinary matrices. He argues that these standards are not relative since there is a right and wrong way to evaluate them.

However, despite Kuhn's claims that his constructivism and its evaluative standards are not merely relativistic, they are. Kuhn fails to explain how these standards are shared across disciplinary matrices and how they constrain the relativity that is so clearly in his work. If disciplinary matrices are incommensurable, then there is no non-relative way to evaluate their comparative puzzle-solving ability, accuracy, scope, and simplicity. What counts as a puzzle or simple solution in one disciplinary matrix does not count as a puzzle or simple solution in another disciplinary matrix. There is no non-relative way to compare, evaluate, or choose between disciplinary matrices since they necessarily disagree on what counts as a puzzle or solution. Consequently, any disciplinary matrix can evaluate itself as being better or more right than any other disciplinary matrix according to its own criteria and standards. Kuhn is unable to

create an account of rightness similar to Goodman's because rightness and progress for Kuhn is entirely relative to his disciplinary matrices. This results in unconstrained radical relativism. Thus, in Kuhn's attempts to avoid radical relativism, he incidentally endorses it.

Goodman's response to the radical relativism criticism is stronger than Kuhn's response for two reasons. First, Goodman constrains the relativism in his constructivism, he does not simply dismiss it. Goodman explicitly denies that the relativism in his work is radical since he constrains it using his account of rightness. Unlike Kuhns's account of rightness, Goodman does not relativize evaluative standards to his constructions. Instead, Goodman relativizes evaluative standards to us and our aims. The evaluation of the projectability and entrenchment of predicates and claims is not relative to the worldversion they are being evaluated in. A predicate or claim either is, or is not, projectible. Moreover, its entrenchment is evaluated by considering its relationship to our many worldversions and ways of describing the world, not just one. This entails that progressive change is possible in Goodman's constructivism. Moving from one worldversion that makes unprojectable claims or uses less entrenched predicates to another worldversion that makes more projectible claims and uses better entrenched predicates is indicative of genuine conceptual progress. For Goodman, we evaluate and privilege worldversions according to what we think is important, rather than what our constructions tell us is important.

However, Goodman's relativization of rightness and evaluative standards might still seem to entail radical relativism. If our evaluative standards are relative, then where does the relativism stop? How can we be certain that we are using the right evaluative standards or if our worldversions really are right? Goodman argues that the relativism in his constructivism goes all the way up, and that we can never be certain that our worldversions are right. However, he does

not consider this to be problematic. First, he argues that the relativization of our evaluative standards does not entail the radically relativistic conclusion that any worldversion is as right as any other. Our evaluative standards are still external to our constructions. They are second-order evaluative standards and can be non-arbitrarily used to compare and evaluate worldversions. There is a fact about which projections are projectible and which are not. While our reason for valuing projectability is relative to our desire to make predictions, our evaluation of the projectability of projections is not. Examining further instances of copper does not support the projection that copper conducts electricity because we want it to; it supports the projection that copper conducts electricity because our worldversion is structured in such a way where instances of what we call copper conduct what we call electricity. In the way that we do not put stars in the sky, we do not make copper conduct electricity. Therefore, Goodman's constructivism avoids entailing radical relativism because it does not relativize evaluative standards to our constructions and instead, it relativizes them to us and our aims.

The second reason why Goodman's response to the radical relativism criticism is stronger than Kuhn's response is because Goodman can refute the very criticism that his worldversions are radically relativistic. To argue that the relativism in constructivism needs to stop somewhere, and that evaluative standards need to be objective or non-relative, is based on the premise that objectivity is possible. Goodman does not assume that objectivity exists. And unlike Kuhn, he gives two convincing arguments explaining why the notion of the objective world is elusive and self-defeating. Goodman can reject the criticism that his constructivism is radically relativistic since that criticism assumes that there is something other than relativity; an assumption that Goodman explicitly denies. Thus, not only is Goodman able to constrain the relativism in his constructivism by developing an account of rightness that is not relative to our constructions, but

he can also refute the very criticism that his work is radically relativistic. Therefore, Goodman's response to the radical relativism criticism is stronger than Kuhn's response.

Goodman's response to the criticism that his constructivism is radically relativistic can be used to strengthen Kuhn's response to this criticism. Goodman and Kuhn share similar views on evaluative standards. They both value things like projectability, accuracy, and simplicity. The difference between their accounts of rightness and their responses to the criticism is that Goodman gives a complete account of rightness where he explains how we can evaluate our constructions despite the relativistic nature of rightness, while Kuhn does not. Kuhn inadvertently relativizes evaluative standards to disciplinary matrices when he refuses to defend relativism, whereas Goodman relativizes evaluative standards to us when he defends relativism. If Kuhn were to defend relativism and adopt Goodman's account of rightness, he could adequately respond to the criticism and explain how his constructivism avoids being radically relativistic. Furthermore, Kuhn could defend relativism and refute the criticism that his work is radically relativistic if he were to adopt Goodman's arguments against the objective world. Thus, Goodman's defence of relativism and his response to the criticism that his constructivism is radically relativistic can be used to address the inadequacies in Kuhn's response to this criticism.

3. Goodman and Progress

i. The Criticism

The final criticism of Kuhn's work that can also be applied to Goodman is the criticism that his constructivism fails to make room for genuine progress. As I explained in Chapter II, some philosophers believe that progress is characterized by improving the match between our categories or theories and the objective world. They think that what we are doing when we

modify or change our categories and theories is increasing the correspondence between them and nature. For example, they think that scientific progress was made when scientists rejected phlogiston chemistry in favour of a chemical theory that better matched nature, pneumatic chemistry. For these philosophers, pneumatic chemistry is better than phlogiston chemistry because it more closely resembles the structure of the world.

These philosophers might criticize Goodman because this form of progress is not possible in his constructivism. Goodman asks us to give up the notion of the objective world. Without the objective world, we cannot improve the match between our categories or theories and the world. So, any change in our categories, theories, or worldversions seems to be mere change rather than any sort of improvement. Critics would argue that this is problematic because if progress is not characterized by the improvement in the correspondence between our theories and the world, then it seems like progress cannot exist.

ii. Goodman's Response

Goodman would respond to this criticism by pointing out that it relies on the assumption that there is an objective world that our theories can correspond to; an assumption that Goodman whole-heartedly rejects. Goodman argues that there is no way for us to access the objective world, or to evaluate how well our theories match it, since the objective world is an elusive and self-defeating concept. So, in Goodman's constructivism, there is no need for progress to be characterized by the correspondence between our theories and the world. This criticism of Goodman fails to get off the ground since Goodman rejects its very premise.

Instead of correspondence, Goodman says that his account of rightness is what makes "leeway [for] progress" in categorizations and projections (Goodman 1978, 128). As I explained in greater detail in the previous sections of this chapter, Goodman's account of rightness uses

criteria like convenience, utility, coherence, fit, context, simplicity, scope, projectability, or use of entrenched predicates in order to evaluate rightness both within a worldversion and in our use of them. These considerations aid us in improving how we construct and privilege worldversions. We can also use these criteria of rightness to aid us in our evaluation of progress within worldversions. Goodman would say that we make progress when we adopt, construct, or use worldversions that assist us in our aims. For example, consider the situation where a child makes progress in their understanding of the movement of a pen. This child drops a pen from their hand, and it is carried six feet away from them. They decide that this must mean that pens fly away when they are dropped. In order to test this projection, the child tries dropping the pen again, to see if it will fly away. Instead, the pen drops straight to the ground. The child tries to drop the pen a few more times, and each time, the pen falls to the ground. The child eventually realizes that it is quite windy outside, and they surmise that the wind must have carried the pen six feet away; it did not fly away. So, they conclude that rather than flying, pens merely drop when they are released from hands. This child can be said to have made genuine progress in their understanding of the movement of pens. They change the worldversion they use to describe this motion from one where pens fly to one where pens fall to the ground. This is a change from a worldversion that makes unprojectable projections to a worldversion that makes more projectible projections. The progress, then, is not in improving their understanding of the way the world is, rather, the progress is made in their move towards a more projectible projection from an unprojectable projection. Thus, even when progress is not characterized as being improvements in the match between the world and our theories, it can still be evaluated, measured, and genuine.

Another example of this sort of progress would be the progress that was made during the scientific revolution from phlogiston chemistry to pneumatic chemistry. Chemists chose to adopt

the pneumatic worldversion and reject the phlogiston worldversion in virtue of pneumatic chemistry's ability to solve puzzles, make projections, and further their scientific aims. The chemists can be said to have made progress in their chemical theories without appealing to some objective world that their theories supposedly correspond better to.

Thus, when we modify, change, or privilege worldversions, we are not merely modifying, changing, or privileging them. We are making genuine and evaluable improvements in our worldversions and in our use of them. Moreover, we are doing so without making the problematic assumption that there is some objective world that they can correspond to. Therefore, contrary to some critics, Goodman does make room for genuine progress in his constructivism.

iii. An Evaluation of Both Kuhn's Response and Goodman's Response

Unlike Goodman, Kuhn fails to adequately address the criticism that his work is radically relativistic and to constrain the relativism in his constructivism using an adequate account of rightness. Consequently, his attempt to address the criticism that his work does not make room for genuine progress also fails. Kuhn argues that we make progress when we change or modify our disciplinary matrices so that they solve more puzzles. He says that newer disciplinary matrices are genuinely better than older disciplinary matrices when they solve more puzzles and promise more research for the future. However, as I explained in the previous section, we cannot compare or evaluate the puzzle-solving ability of disciplinary matrices when they disagree on what counts as a puzzle. As a result, Kuhn's account of progress collapses in on itself.

Goodman is able to address the progress criticism using his account of rightness. He argues that genuine progress cannot be characterized by improving the match between our theories and the objective world since the objective world is a self-defeating and elusive concept. Instead, he

argues that progress is characterized by constructing and privileging right worldversions. We can evaluate our progress by comparing our worldversions use of projections, their accuracy, scope, and entrenchment.

Goodman's response to the progress criticism, like his response to the radical relative criticism, is stronger than Kuhn's response. Where Kuhn's account of progress collapses in on itself, Goodman is able to make room for genuine measurable progress in his constructivism. We could strengthen Kuhn's account of scientific development so that it adequately makes room for progress by adopting Goodman's account of rightness and his argument against the objective world. Doing so would enable us to constrain the relativism in Kuhn's work in order to reject the criticisms that his work is radically relativistic and fails to make room for progress.

4. Goodman and Conceptual Progress

i. The Criticism

Another criticism of Kuhn's constructivism that can be applied to Goodman is the criticism that his constructivism fails to make room for external conceptual progress. As I explained in the previous chapter, Lauden argues that Kuhn fails to account for an important and significant portion of scientific progress; namely the external conceptual progress that scientists make when they reconcile incompatible theories (Lauden 1977, 74). Lauden could apply this criticism to Goodman's constructivism since Goodman also seemingly fails to account for external conceptual progress. Goodman argues that incompatibilities in our descriptions, representations, and theories are what distinguish independent worldversions. For example, phlogiston chemistry and pneumatic chemistry are incompatible since one relies on phlogiston principles in its explanation of chemical reactions and the other prohibits the use of phlogiston principles in its

explanation of chemical reactions. For Goodman, when two theories or descriptions are incompatible, he seems to want to relegate them to their own independent worldversions. This would entail that external conceptual progress cannot be made since external conceptual progress is characterized by reconciling incompatibilities. Therefore, Lauden may argue that Goodman fails to account for external conceptual progress in his constructivism.

ii. Goodman's Response

Goodman's response to this criticism would likely be that he does not need to make room for external conceptual progress in his constructivism. The belief that two incompatible theories or worldversions can be reconciled rests on the assumption that we can reduce our theories and worldversions into a single coherent version. As I explained in Chapter I, Goodman rejects the premise that our descriptions of the world can be reduced. It is a fact that many of our descriptions of the world are incompatible and yet do not discredit one another. Consider our many descriptions of a point. We can describe it as a pair of intersecting lines, a different pair of intersecting lines, or as a nest of regions (Goodman 1978, 99). The fact about what a point is depends on which system is being used. There is no single way to reduce the fact of what a point is since a pair of intersecting lines are not reducible to a nest of regions, and vice versa. Despite this irreducibility, no system of description used to define a point seems to discredit the other systems of description. It is entirely correct to describe a point as being intersecting lines A and B, or intersecting lines C and D. Neither system of description is privileged, yet both systems of description are correct. So, these descriptions of a point are incompatible, yet irreducible. Another example of the irreducibility of descriptions can come from art. A pictorial representation of a chair cannot be reduced to a verbal description of a chair. These two descriptions are too different; they are incompatible as a result of their different means of

representation, and yet they do not discredit one another. These incompatible representations of a chair cannot be reconciled, and this lack of the possibility of external conceptual progress is not as problematic as Lauden might make it out to be. Thus, since Goodman rejects the premise that incompatible theories or versions of the world can be reconciled, Lauden's criticism that his constructivism does not make room for external conceptual progress would fail to get off the ground. Therefore, Goodman successfully defends his constructivism against critics who argue that he fails to make room for genuine progress, externally conceptual or otherwise.

iii. An Evaluation of Both Kuhn's Response and Goodman's Response

Kuhn's response to the criticism that his account of scientific development fails to make room for external conceptual progress is similar to what Goodman's response would be. They would both likely argue that external conceptual progress is not necessary in a robust account of progress. For Kuhn, when two scientific theories are incompatible, he restricts them to their own disciplinary matrices or scientific domains. Different scientific domains and disciplinary matrices conceptualize the world differently using different commitments, symbolic generalizations, values, and exemplars. These differences produce different scientific theories that may be incompatible. However, these incompatibilities are not indicative of a problem with the science. Instead, they are simply indicative of different foundations that produced them. External conceptual progress, for Kuhn, is not a necessary form of scientific progress, and so, he would likely reject the criticism.

Similarly, Goodman argues that incompatibilities in descriptions, representations, and theories are indicative of different worldversions. These incompatibilities do not need to be reconciled because sometimes, there is no way to reconcile incompatibilities. The criticism that theoretical and descriptive incompatibilities need to be reconciled assumes that reconciliation is

possible, and that there is some coherent way to reduce all of our theories and descriptions. Goodman rejects this assumption when he argues that there is no single way that the world is, and there is no single right description of the world. Thus, Goodman would reject the criticism that his constructivism fails to make room for external conceptual progress by arguing that the criticism rests on an assumption that he himself denies is possible.

Goodman's response to the criticism that his constructivism fails to make room for external conceptual progress can be used to strengthen Kuhn's response to the same criticism. While Kuhn can defend his constructivism against the criticism by arguing that external conceptual progress is not a necessary component of scientific progress, Goodman can outright reject the criticism by denying its premise. Goodman explicitly argues that incompatible descriptions, representations, and theories need not, and cannot, be reduced or reconciled. Not only is external conceptual progress an unnecessary component of progress, but it is an impossible and unsound concept in and of itself. If we were to use Goodman's rejection of the way the world is in order to strengthen Kuhn's work, we could also reject the criticism on his behalf.

Conclusion

1. A Final Comparison of Goodman and Kuhn

There are many similarities between Goodman's constructivism and Kuhn's constructivism. Goodman and Kuhn both endorse a brand of constructivism which argues that we construct the world that we live in and experience. Goodman says that we construct worldversions which in turn makes worlds, and Kuhn says that we construct paradigms, or disciplinary matrices, in order to make sense of, and organize, the world. They both acknowledge that we lack access to the objective structure of the world. Goodman argues that the objective world is an elusive and self-defeating concept, while Kuhn argues that nature resists conforming to our disciplinary matrices. And they both agree that privileging a construction is not a matter of choosing which construction best corresponds with reality. Instead, Goodman says that privileging worldversions depends on determining which worldversion best serves our aims and goals; whereas Kuhn claims that choosing between disciplinary matrices depends on determining which disciplinary matrix is most useful and solves the most puzzles.

Despite these similarities, Goodman's constructivism and Kuhn's constructivism are not identical. Most notably, Goodman's worldversions and Kuhn's disciplinary matrices are different. Goodman's worldversions are systems of description and representation that organize the world that we live in using predicates, projections, theories, and styles. Worldversions are not merely descriptions or representations of the world, they are worlds themselves. They literally construct the world and tell us a way the world is, not just a way that the world could be. Kuhn's disciplinary matrices, on the other hand, are constructions of features of nature that we identify and try to explain. Disciplinary matrices are not only made up of theories and representations, like worldversions, but they also depend on how scientists accept, practice, and participate in

them. Disciplinary matrices are constructed to tell us a way that nature could be, not to tell us a way that nature is. Once a disciplinary matrix is adopted, it is treated as referring to a way the world is. Unlike worldversions, disciplinary matrices do not literally make worlds, they just shape the world that we experience in a way that enables us to say that people using different disciplinary matrices are essentially experiencing and interacting with different worlds. Goodman's constructions and Kuhn's constructions are different. They are constructed using different methods and have different referents. Nevertheless, Goodman's constructivism and Kuhn's constructivism are similar enough to warrant using Goodman's responses to the radical relativism and progress criticisms, as well as his explicit rejection of the objective world, in order to defend and strengthen Kuhn's own account of constructivism.

2. Final Comments

Goodman and Kuhn face various criticisms of their constructivism. While the criticisms that they face are not identical, they are similar enough to warrant a comparison. It seems as though a common reaction to constructivism is to argue that it is ambiguous, that it endorses radical relativism, and that it fails to make room for genuine scientific and categorical progress. In this chapter, I have argued that this reaction is wrong. Constructivism is radical, but it is not so radical as to merit the response that Scheffler, Shapere, and Lauden have to it. Ambiguities in constructivism can be clarified. Moreover, constructivism, when constrained by an account of rightness that relativizes evaluative standards to us and our aims, does not fall victim to radical relativism. Finally, when the relativism within constructivism is constrained by such an account of rightness, it can account for genuine categorical and scientific progress. The knee jerk reaction to reject constructivism in virtue of its relativism is an unfounded and weak reaction that makes

assumptions about the world that are not only elusive, but are also self-defeating. Giving up the objective world is not nearly as counter-intuitive or as radical as it may seem. And I hope that this project has shown how attractive and plausible it is to reconceptualize the relationship between us, the world, and our descriptions of it.

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