Introduction
The Metaphysics of Powers and the 3d Account

0.1 A World of Causal Powers

Look around. The world is constantly unfolding. Objects move and interact, and their properties change.

Science aims to answer questions about what occurs and how it occurs. We have highly developed physical sciences – physics, chemistry, biology, geology, astronomy. These sciences uncover the nature of objects and their properties as well as how these are related to the unfolding of events in the world. The properties we find in the world include mass, charge, spin, shape, hardness, elasticity, flammability, and many others. These properties, according to the scientific image of the world, make a genuine difference to what occurs. A particle is affected by gravity because it has mass; oil ignites because it is flammable.

We investigate the role of these and other properties in natural events and processes as we attempt to accurately identify and mathematically formulate the laws behind them. But philosophical questions lurk close by these scientific efforts – abstract questions about the ultimate nature of these properties – answers to which can help reveal not just *what* is happening or *how*, but *why*. What are these physical properties like? What are they like beyond their appearances and beyond their mathematical structuring?

Is ours a world of pure qualities – that is, categorical properties? Qualities are, at a first glance, static features of objects that are fully manifest at all times. On this view, properties only play the causal roles they do owing either to the governance of the laws of nature (on a realist, universals-based approach to laws) or they exhibit regularities and patterns over time that we identify as laws of nature (on a Neo-Humean, systems-based approach to laws). If the qualities view of properties is correct, mass is involved in massive displays (e.g., resisting motion or continuing in motion) solely because there are laws of nature – laws of motion and gravity – that determine what happens.

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Or is ours a world of powers – that is, dispositional properties? If properties are powers, the mass of an object is involved in massive displays because that is what mass does: it is the nature of mass. If so, then we should view mass as inherently powerful – as a causal power or a disposition to behave in certain ways under certain conditions in response to certain stimuli. These stimuli are the powers of other objects; therefore, the unfolding of the world is due to a vast array of powers interacting with each other. On this view, the laws of nature – while perhaps true statements about what could or would happen – are metaphysically secondary to the primacy of the powers. Causal powers themselves make the world go – the lawful, modal force of things is owed to their powers.

The debate between powers theorists and their rivals is not new. For instance, Aristotle (1941a: *Metaphysics* 1046a28-1052a12) and Locke (2004: Book II, Chapter VIII), in different ways, were committed to the reality of powers.[1] Aristotle's views on potentiality and actuality, as well as other topics, informs Neo-Aristotelianism (Groff and Greco 2013), represented by philosophers such as Ellis (2001, 2012), Molnar (2003), and Heil (2003, 2012), amongst others.[2] Hume (2002, 2003) denies the reality of powers and necessary connections between events. For Hume, any event could follow from any other event, so there are no powers directed at certain types of outcome. This line of thinking informs Neo-Humeanism, most prominently represented by Lewis (1986a, 1986b) but also other twentieth and twenty-first-century philosophers.[3]

This book is structured around two basic questions. First: Why powers? Second: What are powers like? These questions raise more specific questions. On the first question: why accept a powers view of properties over views based on pure qualities? Intricately related to this are further questions: Why accept a powers-based view of physical modality over accounts based on qualities in conjunction with laws of nature, such as Neo-Humeanism (David Lewis' view) or the universals account of laws (David Armstrong's view)? Moreover, why posit *pure* powers over powerful qualities (powers conceived as simultaneously qualitative)? On the second question: What

[1] Locke, however, wants to fit powers into a mechanical philosophy (contra Aristotelianism) and thereby seems to treat them relationally (Ott 2009: 12).

[2] However, we should be careful to not equate Aristotelianism and powers theory (Meincke 2020: 4). Despite common emphasis on potentiality and activity, powers theorists need not, for example, accept Aristotle's substance ontology.

[3] In this book, I will not conduct historical analysis reaching back into modern philosophy and early twentieth century philosophy. I will, however, refer to historical precedents to contextualize contemporary issues where appropriate. For some historical discussions of the debate, see, for example, Joy (2013) on Hume's theory of powers as well as Anjum and Mumford (2018: 24–46) on precursors to what they call the "dispositional modality" (a notion I will critique in Chapter 6).

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are powers like? We can approach this question from an outside point of view, so to speak, by investigating the relationships that powers have to each other. But what explains why powers have the relationships to each other that they have? What are powers like *from the inside*? Why do they do what they do and what would they be like absent other powers?

Two terminological notes are important before proceeding. First, I use the terms "causal power," "power," "disposition," "capacity," and similar terms interchangeably – though not everyone does[4] – unless a distinction makes a real difference to a specific issue. I prefer "causal power" and its cognates because it accurately connotes causal productivity; however, for efficiency I will mostly just use "power."[5,6] Second, qualities are often called categorical properties by philosophers, but "quality" is fairly common too. I will use the term "quality" unless "categorical property" makes discussing an author's view easier.

In the rest of this Introduction, I explain my approach to metaphysics and how it overlaps with science (Section 2), further explain the differences between powers and qualities (Section 3), explain my stance on properties and substances (Section 4), show how we can "know" powers (Section 5), and distinguish different powers "isms" (Section 6). I then make a distinction between networking and nodal accounts of powers (Section 7) before briefly outlining my proposed view, the 3d account, which is a nodal account of powers (Section 8). The concluding section provides a roadmap for the rest of the book.

0.2 Metaphysics and Science

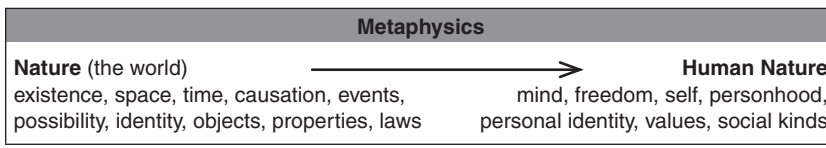

Figure 0.1 The primary concerns of metaphysics (our understanding of Nature influences our understanding of Human Nature)

[4] For example, see Bird (2013) and Fara (2005).

[5] Ellis (2010b: 98–99) distinguishes between "power" and "causal power." Powers are a larger class of properties that include causal powers; the latter's manifestations necessarily involve energy transmission, while the former's manifestations do not (2010b: 87); for instance, mass is a power but not a causal power because its manifestations do not involve energy transmission. This is an idiosyncratic, and in my view dubious, distinction that does not affect my argumentation.

[6] Mumford and Anjum (2011: 3) maintain that all properties in the world are *composed of* powers, which are primitive, as Shoemaker (1980) argues. On this view, powers are parts of properties, a kind of protoproperty. On my view, there is no need to distinguish powers and properties. Rather, powers are a kind of property – and the only real kind.

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Metaphysics aims to understand the most abstract, fundamental features of reality, including *nature* and *human nature*. The understanding of fundamental aspects of nature (the world in itself) informs our understanding of human nature since humans are necessarily part of nature. Humans live in time and space, have identities, possess properties, are subject to laws of nature, and so on. The idea that our understanding of *nature* influences our understanding of *human nature* is captured by the right arrow in Figure 0.1.[7]

My primary concern in this book is with the metaphysics of nature, in particular powers: what they are like and why we should accept them in the groundwork of reality. The metaphysical debate over properties, laws, and related phenomena is highly relevant to our understanding of the nature of the world. Science has a lot to say about these matters, of course. So, an important question arises: What is the relationship between science – rightfully seen as the producer of definite knowledge about the world – and philosophy?

In my view, philosophy and science form a continuum of investigative inquiry, both in methodology and content. There is no sharp cut-off point. There are strong family resemblances to be found in the kinds of questions that philosophers and scientists ask in their different disciplines. Despite occupying different areas of thought along the continuum, some areas of research (e.g., how to interpret quantum mechanics) require both philosophy and science in order to formulate plausible, complete answers to our deepest questions. But the boundaries of philosophy (especially metaphysics) extend beyond science. If science identifies, explains, and applies the laws of nature (or forces of nature more generally) in order to understand and predict reality, then metaphysics asks: Why are the laws true? What grounds reality's modal features? What is the underlying, fundamental reality that makes all this possible (or necessary)?

Metaphysics and science possess some commonalities: they share cognitive tools, emphasizing to varying degrees deductive logic, conceptual analysis, and thought experiments; they both search for and incorporate evidence produced by either empirical or thought experiments; and they have common concern with discovering truths about the world and our place in it. Moreover, to answer some metaphysical questions requires interpretation of scientific theories and ideas. Quantum mechanics, the nature of space and time, and the mind–body problem all involve scientific and philosophical aspects. However, in some important areas metaphysics necessarily goes

[7] Others might wish to include different issues than those listed in Figure 0.1 or to organize the issues differently. For example, Esfeld and Deckert (2018: 1) propose a narrower list of key metaphysical issues – the nature of matter, space, and time – and how these, following certain laws, explain phenomena.

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beyond science, such as what laws of nature are, whether reality is fundamentally unified, and whether properties (if properties are real at all) are powers or qualities.[8] In short, there are meaningful questions about reality that science alone cannot adequately answer (Trigg 2015) and some metaphysical claims are arguably even essential to the advancement of science (Maxwell 2020).[9]

In the areas identified above and more, we often must speculate about the nature of things. Such speculation is justified, so long as the contents of our speculations are logically consistent with what we think we know from science and we can show that such speculations offer some explanatory payoff. Despite its value and importance, we should not expect certainties in metaphysics (Lowe 1998: 27). Although much of my work here should be regarded as speculative metaphysics, I do think that it contributes to part of a complete, scientifically informed metaphysics. Science is generally comfortable with positing causal powers (Cartwright 2017; Ellis 2002: 74–75; Mumford 2006: 476), powers arguably plan an important role in interpreting some of our most successful scientific theories such as quantum mechanics (Dorato 2007) and genetics (Mumford and Anjum 2011: 214–235), and powers arguably form part of a proper understanding of human nature and society (Ellis 2002: 145–166; 2013). In this book, the most speculative parts concern themes in Part II, particularly the Physical Intentionality Thesis and the Informational Thesis concerning powers. I see these as quintessentially answers to "why" questions – Why do causal power behave the way they do? Why are they inherently modal?

The metaphysical question concerning whether properties are powers or qualities (or both) at its root concerns the correct interpretation of fundamental reality and what lies beyond (or beneath) the appearances of things. The "appearances," as I am using the term, include not just the everyday events involving ordinary objects, but the results of scientific experiments as well. Experimental science has proven marvelous at revealing underlying structures and mechanisms, from quantum reality to genetics to geological processes. If these are not *mere* appearances, they are *deep* appearances, things as revealed through observation-enhancing tools and techniques as well as sophisticated scientific theorizing. Yet deeper, more abstract questions remain concerning the underlying ontology of the world.

[8] Concerning what laws of nature are, see, for example, Armstrong (1983); concerning whether reality is fundamentally unified, see, for example, Maxwell (2020); concerning the reality of properties, see, for example, Armstrong (1989) and Campbell (1990); and concerning whether properties are qualities or powers, see, for example, Armstrong (2010) and Mumford (1998).

[9] Maxwell (2020) sees significant implications of the metaphysics of science for how we do science and therefore for practical questions about our basic institutions.

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Ontology is the study of what exists. The outcome of doing ontology well is a warranted list of the kinds of things that exist: properties, objects, laws, forces, events, persons, minds, and so on. Philosophers, particularly metaphysicians, argue about what this list should include and what these things are like. Metaphysics includes not only ontology but the study of the relationship between all types of entities in an ontology, as well as other questions about reality such as identity, essence, time, freedom, and teleology.

This project falls squarely within the purview of the metaphysics of science. I take the metaphysics of science to include the investigation of metaphysical and ontological assumptions – concerning laws of nature, kinds, causal powers, causation – that help make science possible (Mumford and Tugby 2013: 14).[10] The metaphysics of science assumes that both metaphysics and science are serious, rigorous disciplines that try to understand reality from different, but complementary points of view.

I assume a generally scientific realist approach in the philosophy of science, as do most working in the metaphysics of science (Bird, et al. 2012; Schrenk 2017: 298). We have good reason to believe that the entities (objects, properties, forces) posited by our best science are real. This does not mean that science reveals or can understand everything we want to know about these entities. Their ultimate natures might not be fully subject to scientific discernment, based on either observation or inference from observation, because there are background philosophical ideas and commitments that prove more abstract than those that science is able to investigate without the aid of philosophical analysis and insight.

Many metaphysicians and philosophers of science seem to view science as providing a kind of model for metaphysics, where science is the driver of knowledge and metaphysics plays an important but secondary role.[11] Although I agree that metaphysics can and does play a helper role for science, for example in elucidating conceptual implications and assumptions of quantum mechanics and evolutionary theory, I think it can do more. It can break new ground that opens up space for science to operate within. Maudlin (2007: 1) argues that scientific practice should guide choices in building a fundamental ontology; however, I do not think scientific practice should set boundaries for ontology. If we took all the properties of particles posited in fundamental physics into our ontology, we would have mass, charge, spin, and so on. But meaningful questions remain: What *are*

[10] Mumford and Tugby also include the study of the relationships between various sciences, which I am not opposed to although it seems more like pure philosophy of science.

[11] For examples of this approach to the relationships between science metaphysics, see Bird (2007a: 8), Callender (2011: 48), and Maudlin (2007: 1). See Schrenk (2017: 296–297) for further discussion.

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properties? Are they qualities? Are they powers? Are they both? What is their connection to the laws of nature?

By carefully, if speculatively, stretching our understanding of how everything hangs together beyond what science alone shows us, we can put ourselves in position to explore new possibilities that can enhance and deepen our scientific picture of the world. Philosophy can explain things – though, to be sure, with less certainty – that science alone cannot explain.

I agree to an extent with Reichenbach (1951: vii) that there is "a scientific approach to philosophy." Many philosophers today would affirm this – particularly metaphysicians of science and experimental philosophers. It is a good thing that philosophy takes science into account and tries, to some extent, to model its methods. However, contrary to Reichenbach (1951: vii), philosophy has *not* fully "proceeded from speculation to science." Speculation is crucial, though it must be carefully done in a way that it could reasonably fit into a naturalistic picture of the world. Speculation can be part of a legitimate scientific approach to metaphysics. In my estimation, philosophy – especially, but not only, metaphysics – and science need each other: the former to supply the background conception of reality, identify methodological assumptions, and study normative frameworks, and the latter to fill out the empirical details and develop mathematical equations to analyze and predict phenomena.[12]

Descartes (1985: 186), in *Principles of Philosophy*, suggested that "philosophy is like a tree. The roots are metaphysics, the trunk is physics, and the branches emerging from the trunk are all the other sciences."[13] I largely agree. This metaphor makes clear that the boundaries between metaphysics and science are vague; all subjects of study are connected likes branches of one tree, rooted in philosophy.

If the roots are metaphysics, these roots have causal powers.

0.3 Powers, Qualities, and Powerful Qualities

This section characterizes powers, qualities, and powerful qualities. Whether properties are powers or qualities is a metaphysical question. The question is not asking about all the specific types of properties (colors, shapes, etc.), but about how to categorize properties themselves: are they essentially powerful, or qualitative? Powers are properties that have potential for various manifestations. For example, the property of elasticity has the potential to stretch in various ways. To view properties as powers is to view them operationally, in terms of what they can *do*. By

[12] See Bauer (2015) for an overview of why science needs philosophy. See also Laplane et al. (2019).
[13] See Ariew (2014: 106–107) for discussion of the tree metaphor's Scholastic roots.

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contrast, to view properties as qualities is to view them as just being a certain way. For example, the property of circularity just is being circular. To view properties as qualities is to view them nonmodally, in terms of what they are manifestly or categorically. As we will see in Chapter 1, Humeans and Neo-Humeans strongly resist the claim that properties are inherently modal and productive (Schrenk 2017: 71). This commitment to modally inert properties is what Wilson (2010) has called "Hume's Dictum" and helps specify what I mean here by "quality."

To put it too briefly: A quality is what it is; a power is what it can do.

It might be that all properties are powers or that all properties are qualities. Those are monistic views. Alternatively, the world might contain some combination of the two; this is a mixed or dualistic view. A fourth option is that property instances are amalgams of quality and power – on this view, properties are powerful qualities. This is also known as the identity thesis, akin to the identity thesis in philosophy of mind; to distinguish these, I shall call the view that powers and qualities are identical the Identity View. Powerful qualities are not simply powers or pure powers but simultaneously both qualitative and powerful.

Whereas a pure power lacks any trace of quality, and a pure quality lacks any trace of power, a powerful quality features both at once. Powerful qualities have the "just-there-ness" (Armstrong 2004: 141) of pure qualities combined with inherent powerfulness. The difference between powerful qualities, pure powers, and pure qualities can be visualized as follows.

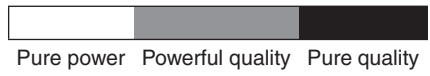

Figure 0.2 Three conceptions of properties

In Figure 0.2, the boundary between each type of property is discrete, not continuous. Each type is represented as homogeneous, as expected for pure powers and pure qualities, but powerful qualities are also represented as homogeneous since the power and quality are one and the same. The gray area is *not* meant to indicate that powerful qualities have a mix of power and quality or possess distinct bits of quality and power. What is meant is that it is a single property: a quality that *is* powerful. (This is, at least, the identity interpretation of powerful qualities; some suggest that powerful qualities have a powerful part and a qualitative part, a view that I will address in Chapters 1 and 2.)

A further characterization of powers will prove helpful. Pure powers theorists as well as powerful qualities theorists often either explicitly or

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implicitly provide identity conditions for powers based on the idea of a *causal profile* (a term from Hawthorne 2001). The causal profile of a power is the total set of conditions and possible stimuli that prompt the power's activation, along with the total set of possible manifestations it can undergo when activated. Essentially, a causal profile describes the power's role in system of properties (other powers) with which it can interact.

Here I am just setting up an initial framework. In Chapter 1, I will show how these different conceptions of properties – qualities on one hand and powers (either pure powers or powerful qualities) on the other hand – figure into different conceptions of physical modality. Physical modality is concerned with possibilities consistent with the laws of nature; different senses of modality will be explained in Chapter 1. I will argue for what I call the Powers Model (subsuming either the Pure Powers Model or the Powerful Qualities Model). In Chapter 2, the differences between powers and powerful qualities, including whether powerful qualities could have two "parts," will be discussed further and the notion of a causal profile will be revisited. There I will argue against the Powerful Qualities Model, thus advocating for the Pure Powers Model.

It is quite possible that any one of the conceptions of properties in Figure 0.2 is logically compatible with the way the world appears or presents itself to us. It seems that the appearances would remain the same under these different ontologies. Furthermore, these conceptions might very well be compatible with our best science. For instance, perhaps both powers theorists and nonpowers theorists can in principle explain gravity, electromagnetism, and evolution.[14] What occurs – and the mechanisms and forces at play in the unfolding of the world – remain the same in terms of their mathematical representation. But the metaphysics is different – and the underlying, fundamental ontology that grounds these metaphysical views is different. However, the logical compatibility of a metaphysic with science is one thing. The explanatory power and depth of a metaphysic is another thing. Here, I think, powers are favored. Furthermore, as I will argue in Chapter 1, nonpowers theorists might not be able to get away with avoiding powers in explaining physical modality.

0.4 Properties and Substances

How do my views on powers fit with closely related metaphysical issues regarding the reality of properties and substances?

This book assumes both the reality of properties and that there is a real ontological distinction between "sparse" (or natural) and "abundant" (or

[14] There are some details where one or the other view might fit better with certain scientific theories, particularly in physics – see, for example, Balashov (2002) and Livanios (2017b).

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nonnatural) properties (Lewis 1986b: 59–61). Nominalists hold that properties are unreal, that they are just concepts or terms that we apply to the world. We talk about properties as if they are real, but in doing so we are only learning about our conceptualization of how objects are propertied. Realists, however, hold that properties are real entities existing independently of our conceptualization. Among the realists, there is a storied disagreement. Some realists claim that properties are universals, according to which each property is an abstract entity that might have multiple instances, yet all these instances are numerically identical; each universal, such as red or mass, can be spread out over many instances. The universals are either transcendent or immanent. Plato's theory of Forms is a theory of transcendent universals. Aristotle, by contrast, holds a theory of immanent universals, according to which universals are not independent of their instances. One can, however, be a realist about properties without accepting universals. Trope theory holds that property instances are particularized, independent entities, not strictly numerically identical to any other instance (Campbell 1990; Williams 1953). Trope theory accounts for the particularity and universality of properties in one ontologically lean package.

Although I assume properties (including powers) are real, I take no definite stance here on whether they are universals or tropes. I intend that all my main claims about powers comport with different realist interpretations of the reality of properties. However, all things considered, I think that the trope theory is most likely to be correct. It is the simplest and most metaphysically unifying view of properties. As such, powers as I conceive them are particularized properties, bounded by spacetime, and not numerically identical to any other instance but exactly similar in some cases.[15,16]

Are there, metaphysically, substances that properties are pinned to, so to speak, or is reality substance-less? Are what we perceive as substances simply bundles of properties? Substances can be admitted into one's ontology whether properties are powers, qualities, of powerful qualities. Some theorists, like Heil (2012), argue that substances fit best with a powerful qualities view and consequently accept a substance-property ontology. Having substances nicely accounts for the apparent permanence of things in the world, even as it changes, propelled by powerful qualities. However, positing substances is not the most economical view. Trope theory, which I tentatively affirm, eschews substances. The substance-like particularity of things in the world is generated by collections (or bundles) of tropes.

[15] So, on my view, properties are not universals in either a Platonic or Aristotelian sense. If I were forced to commit to a universals approach to powers, I would take up the Aristotelian perspective and maintain that they are repeatable properties whose reality is entirely instantiated in space and time.

[16] Amongst powers theorists, some accept that powers are tropes and others accept that powers are universals. For example, Molnar (2003) is a trope theorist while Ellis (2001) accepts a universals approach.

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Tropes are abstract particulars that constitute the basis for reality and, if they are powers, inherently drive changes within the cosmos.

0.5 Knowing Powers

Powers are hidden from direct empirical observation. They are theoretical posits. As such, those with strong empiricist or logical positivist leanings, such as the Vienna Circle and its sympathizers, have been reluctant to accept powers.

So how do we infer that some property is a power? Or, at least, what characteristics raise suspicions that some property is a power? I contend that we can in many cases justifiably infer the existence of powers through their common marks. McKitrick (2003a: 157, 2018: 2) identifies five marks of powers.[17] In Figure 0.3, I formulate these marks and include one additional mark found in Heil (2003: 198, 2012: 75) and Martin (2008: 3).[18]

Mark	Explanation and example
Mark 1: Characteristic manifestations	Powers have characteristic manifestations when triggered (e.g., the fragility of a vase can manifest in breaking, cracking, etc.).
Mark 2: Circumstances of manifestation	Powers have circumstances of manifestation (e.g., a vase needs to be in a certain temperature range: if too hot it will be melty and thus not fragile).
Mark 3: Can remain unmanifested indefinitely	Powers need not ever manifest (e.g., a vase is fragile throughout its existence but never breaks or cracks).
Mark 4: Association with counterfactuals	Powers are closely associated with, or support, true counterfactual conditional statements (e.g., 'if the glass were struck by a hammer, then it would break').[19]
Mark 5: Relevance of overtly powerful locutions	Once identified, overtly powerful locutions apply to powers (e.g., fragility is "the power to break when struck").
Mark 6: Partners in manifestation	A power typically requires one or more powerful partners in order to manifest; the partners are jointly responsible for the manifestation (e.g., hardness and fragility work together to manifest the vase's breaking).

Figure 0.3 Marks of powers

[17] McKitrick (2018: 4–5) advocates a deep and broad dispositional pluralism according to which dispositions (powers) can be extrinsic or intrinsic, fundamental or nonfundamental, natural or unnatural, causally relevant or irrelevant, and so on. Nonetheless, McKitrick thinks that all powers share the marks she identifies.

[18] Martin (2008: 87) advocates for the idea of "reciprocal disposition partners" according to which two (or more) powers causally interact to produce "mutual manifestations." In other words, powers are "inherently directed towards shared results" (Baltimore 2020: 691). The manifestation of an instance of fragility, for example, is equally the manifestation of a hammer striking a glass and the glass responding to the strike, thus shattering.

[19] This does not imply that the conditional analysis of powers, which analyzes powers in terms of counterfactual statements, is true.

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The observable evidence for powers – their supposed effects – is likely to be consistent with a Neo-Humean, qualities-based view of properties. But this does not obviate the relevance and importance of the marks of powers. Any inference that a property is a power based on observable events (manifestation events) and processes (continuous manifestations), linguistic data, and other clues (those indicated by the marks), is going to be an inference to the best explanation, not a deductive inference. So, these marks are not put forward as jointly necessary and sufficient conditions for being a power (although each mark itself might be necessary). But together they help us infer that we are dealing with powers. At least, they serve to introduce some of the most important features of powers.

Mark 6 is somewhat controversial. In order to manifest, it seems that a power needs a powerful partner, that is, a manifestation partner. The trigger or stimulus of a power is, in fact, another power. The hardness of a hammer is a manifestation partner for the fragility of a vase. Hardness is the power to break something fragile, and fragility is the power to break when struck by something hard (or when subject to intense freezing, high-pitched sounds, etc.). This seems intuitive enough if one is already committed to a power-based ontology. However, it might not be a universal thesis, for there might be special cases of self-manifesting powers. Jaworski (2016: 58–59) challenges a common example that radioactive decay is self-manifesting (Harré and Madden 1975) by conjecturing that an environment free of inhibiting factors can itself be interpreted as a powerful partner; the example he gives is that the environment surrounding an atomic or molecular nucleus must be free of inhibiting factors. One might say that this is a circumstance of manifestation, not a power, therefore not a powerful partner. However, environments have properties, which can include the property of not having properties (powers), therefore doubt remains about the possibility of self-manifesting powers. Thus, Mark 6 remains plausibly intact.

Besides the marks of powers, how else might we know powers? Vetter (2015: 12) argues that with "a sufficiently rich view of perception" it is possible that we perceive objects to have powers: for example, "I can see that the glass is fragile, just as I can see that it is a champagne glass." (Inference to the best explanation certainly plays a role as well, as Vetter notes.) It is often assumed that powers are hidden from empirical observation, and I generally agree with that claim. However, if "perception" somehow goes deeper, it could be another way we know powers, although I do not expect that this point would apply to fundamental

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powers. Fundamental powers are theoretical posits to explain the behavior of microscopic particles. Here, inference and indirect observation are required to "know" them.

0.6 Powers "isms"

A number of powers or dispositional "isms" have arisen: dispositional essentialism, dispositional monism, and pandispositionalism.

Dispositional essentialism is a brand of scientific essentialism. While scientific essentialism holds that objects possess some essential features or properties, dispositional essentialists specifically maintain that at least some fundamental properties are essentially dispositional or powerful. Prominent proponents include Ellis and Lierse (1994), Ellis (2001, 2010a, 2010b, 2012), and Molnar (2003). Ellis and Molnar hold that some fundamental properties, for instance locations, are qualities. So, they accept a mixed view allowing both powers and qualities. Dispositional monism (Bird 2007a) is a subtype of dispositional essentialism and maintains that *all* fundamental properties are essentially powerful. Pandispositionalism (Bostock 2008; Mumford 2004; Mumford and Anjum 2011) takes dispositional monism a step further, maintaining that all properties (fundamental or not) are essentially powerful.

In contrast to these dispositional or powers-based views, pure qualities theorists deny views that centralize powers. They hold that properties are essentially qualitative in character. According to Ellis (2002: 71), this view "is the established metaphysic of our culture." This was true at the time of the remark and likely remains so, although powers theorists are gaining ground.

There are two major forms of the qualities view that I will discuss in Chapter 1, but for now it is useful to contrast the form based on David Hume's philosophy with the powers view to get a better grasp of what the various powers "isms" have in common against the qualities view of properties. Humeans (both old and new) regard powers "as a kind of pre-scientific animism" – the world for them is "not potent" but "inert" (Groff 2013: 4). Neo-Humeans maintain that there are no real, inherent powers. Although we can talk as if objects have powers based on the perceived flow of events, this does not represent an ontological commitment to powers. By contrast, powers theorists hold that matter is essentially active (not passive) because objects have irreducible causal powers, that there are necessary causal connections between events (which causal powers underpin), and – if they allow them in their ontology – that laws

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of nature describe how natural kinds must behave (Ellis 2002: 59–60; Groff 2013: 7–9).

The view of this book is firmly situated in the family of powers views. All three powers "isms" require the reality of at least some pure powers, powers devoid of any qualitative character. I am very confidently committed to dispositional monism and, with slightly less confidence, to pandispositionalism. But the major claims of this book could in principle be accepted by pure powers theorists of all stripes (pandispositionalists, dispositional monists, and dispositional essentialists) insofar as those claims are applied only to pure powers.

0.7 Networking versus Nodal Accounts of Powers

Assume that we accept that there are systems of powers, that is, systems of properties that consist entirely of powers. What kinds of accounts of the nature of powers in that system are available? By "account" I do not mean a reductive or conceptual analysis, but a general characterization that illuminates the nature of powers. An account should be explanatory, informative, and, ideally, raise new questions.

There are two types of accounts of powers – or, at least, approaches to developing more specific, detailed accounts: *networking accounts* and *nodal accounts*.[20] Networking accounts present an outside point of view of powers, so to speak. By contrast, nodal accounts focus on the what the nodes of the network are like, from their own point of view and not the system's point of view. Contrasting these approaches can help better situate my view of powers.

Networking accounts understand powers only in terms of their relation to other powers, by claiming that powers (i) are essentially related to possible stimuli and manifestations where (ii) these stimuli and manifestations are also powers and (iii) these connections or relations define what it means to be a power (i.e., they determine a power's nature).[21] A networking account is implied by the various conditional analyses of

[20] The term "nodal" should not be confused with "modal" – although in the case of power networks the nodal units are, of course, inherently modal.

[21] I am not claiming that anyone holds exactly the networking account of powers – though some dispositional essentialists come close enough to it. Instead, my intent is to illustrate a way of conceiving the nature of powers in order to contrast with and better explain my own view (a nodal account). Moreover, I am not trying to outright falsify the networking account but to show that it is inadequate because an account of powers needs to go beyond the network. From the outside, there is the network – we can "see" that powers relate to each other – but what about the situation from each power's point of view?

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powers, according to which powers are analyzable through counterfactual statements (such that an object, *x*, possesses a power to manifest if and only if, if *x* were subject to the appropriate stimulus, then such-and-such manifestation would occur).[22] Powers theorists who accept some version of the conditional analysis do not need to claim anything about powers' internal nature other than that powers are essentially powerful such that it is in their nature to manifest in appropriate circumstances. So, they should be satisfied to accept a networking account of powers. But this leaves many questions about what powers are like from the inside. What does their *directedness* toward manifestations consist of? *How* do powers connect with other powers in their networks? A networking account leaves the "inside" of powers a mystery – or implies they do not really have an inside nature and that their relational nature is exhaustive.[23]

What explains why powers do what they do and why they have the relations to each other that they have? To see powers from the inside is to look beyond the activity of powers and beyond their relations to each other. It is to imagine a lone power – a power token in a one-property world – and ask what it is like. Such one-power universes are clearly possible. Consider two thought experiments. In the first, subtract the entire network of powers around one select power, which remains capable of activity despite having no partners. What is this power like? Why can it do what it is capable of doing? In the second thought experiment, consider a bare world absent any properties and install a single, lone power. Again, it remains capable of activity. What is this power like?

To take this question seriously is to take the directedness of powers seriously and ask what makes them directed toward their merely potential, thus perhaps always nonexistent, manifestations. It is to dig into their hidden nature. To see powers from the inside is to provide a nodal account. My 3d account is such an account.

0.8 The 3d Account of Powers

I contend that the following interrelated theses conjointly yield an informative and plausible account of powers from the inside.

[22] Conditional analyses will be further discussed in Section 6.5.

[23] The idea of a power's "internality" or "inside" is metaphorical, for properties do not literally have insides and outsides. "Intrinsic" (versus "extrinsic") might be the better term, yet the intrinsic/extrinsic distinction itself is contentious. And, to say a property is intrinsic or extrinsic does not tell you everything about that property's genuine, inherent nature independent of other instantiated properties – which is my main interest here.

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The Physical Intentionality Thesis (PIT): Powers and thoughts share the marks of intentionality.

The Informational Thesis (IT): Powers carry information for their potential manifestations.

The core commitment of PIT is that powers are directed toward manifestations that might not occur (e.g., an electron is directed toward accelerating but it need not ever do so), akin to how desires are directed toward objects that might go unfulfilled (e.g., one's desire for chocolate might remain unrealized). The core commitment of IT is that powers carry counterfactual information for the various manifestations that they might undergo.

PIT has explicit and extensive precedence in the debate concerning powers, with some metaphysicians defending it and others criticizing it. Something like IT has also been discussed in previous accounts of powers.[24] However, my development and defense of these theses is original in several regards. First, in defending PIT, I argue that directedness – arguably *the* central feature of intentionality – is best interpreted as representational in nature. As such, powers represent their possible manifestations. This stands in contrast to the nonrepresentational interpretations of directedness advanced by influential PIT advocates such as Molnar (2003). Second, beyond the original five marks of intentionality (Martin and Pfeifer 1986), I extensively discuss five additional marks of intentionality, setting my analysis apart from many opponents and proponents of PIT. Third, with regards to IT, I take seriously the idea that powers carry informational contents and show that this has important implications for the power/quality distinction and other key debates in the metaphysics of powers. Fourth, my combination of both physical intentionality and information sets my account apart from others, and, I hope, illuminates powers from the inside better than other accounts to date.

Given both PIT and IT, my account of **d**ispositions (i.e., powers) combines **d**irectedness (i.e., intentionality) and **d**ata (i.e., information), therefore I call it the **3d** account of powers. The term "directedness" here is meant to suggest all of the marks of physical intentionality more generally (though, strictly speaking, I take directedness to be *the* essential mark of intentionality – if only one were allowed), and the term "data" refers to information more generally.[25]

[24] I will give a robust account of supporters and critics of PIT in Chapters 3–5 and a robust account of previous support for something akin to IT in Chapter 6.

[25] In some contexts, we might want to characterize information as *meaningful data* or something similar; more on this in Chapter 6.

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0.9 Roadmap

Part I of this book argues that we should conceive of properties as pure powers. Chapter 1 argues for the Powers Model of physical modality (this is the powers-based view of modality that includes two main subvarieties, the Pure Powers Model and the Powerful Qualities Model). I argue for the Powers Model by showing that the two principal rival accounts, the Universals Model and the Neo-Humean Model (which are based on qualities combined with laws of nature) implicitly employ powers.[26] Having established the plausibility of the Powers Model, Chapter 2 explores the differences between powerful qualities and pure powers, and argues that interpreting powers as pure is the better way to go, hence the Pure Powers Model should be adopted over the Powerful Qualities Model. I interpret the Pure Powers Model strongly to imply pandispositionalism, although most of my theses and arguments are compatible with weaker interpretations (dispositional monism and dispositional essentialism) provided appropriate adjustments in the domain of relevant properties (more on this in Section 1.4). Moreover, Chapter 2 attempts to solve the problem of being: how pure powers exist through periods of nonmanifestation. This is a Level 1 objection to powers because it concerns the inherent nature and existence of powers. By contrast, Level 2 objections concern systems of two or more pure powers.[27] This book focuses primarily on Level 1 problems: the being of powers and what they are like.

Part II presents a theory of powers from the inside in the form of the 3d account introduced above. Chapter 3 introduces two arguments for the Physical Intentionality Thesis (PIT): the Argument from the Marks of Intentionality and the Argument from the Unity of Nature. In Chapters 3, 4, and 5, I primarily develop the first argument; in Chapter 8, I revisit and develop the second argument. Chapter 6 defends the Informational Thesis (IT), which complements PIT while extending our understanding of powers from the inside. With these supporting theses and arguments in place, the 3d account – especially how PIT and IT are interrelated – will

[26] There are implications of powers theory for philosophical issues beyond physical modality, including areas closely related to physical modality such as causation (Mumford and Anjum 2011) and philosophy of physics (Balashov 2002; Bauer 2011; Dorato and Esfeld 2010), but also more distant issues such as free will (Mumford and Anjum 2015), ethics (Anjum et al. 2013; Doyle 2018), and the nature of social powers and society (Ellis 2013; Groff 2013). However, my focus in this book concerns fundamental questions about the nature of powers and physical modality, although I will have some comments about larger issues in Chapter 8.

[27] These levels of objections are not rigid, but it is a dialectically useful distinction.

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be explained in Section 6.6.[28] Chapter 7 focuses more on Level 2 concerns and accomplishes two tasks. First, it explores how powers might be systematized. Second, it discusses the appearance of qualities: given a system of powers, how can we account for the appearance of qualities in our common, everyday experience? It is argued that qualities are mere appearances generated by the activity of powers. The possibility of emergent qualities is discussed. Chapter 8 (the concluding chapter) argues for the Intentionality Continuum Thesis, that there is a continuum of intentionality throughout nature. Physical intentionality diminishes the mystery of psychological (i.e., mental) intentionality. Physical intentionality, as I see it, is a phenomenon continuous with psychological intentionality. The resulting view provides a foundation for conceptually unifying our understanding of basic physical systems, increasingly complex physical systems to include living systems, and psychological systems. Since powers are everywhere, intentionality is everywhere. This implies a mild form of panpsychism, namely panintentionality.[29]

[28] The 3d account is compatible with any theory regarding the *extent* of pure powers (mixed views allowing both powers and qualities, dispositional monism, or pandispositionalism), insofar as pure powers themselves in those theories are concerned.

[29] Pfeifer (2016), whose view I will discuss in Chapter 8, formulates panintentionality as a brand of panprotopsychism, according to which some precursor states for full mind are everywhere.

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