# Neo-Aristotelian Metaphysics and the Theology of Nature

## Edited by William M. R. Simpson, Robert C. Koons, and James Orr

First published 2022

ISBN: 978-0-367-63714-9 (hbk)
ISBN: 978-0-367-64698-1 (pbk)
ISBN: 978-1-003-12586-0 (ebk)

# 7 The Power to Perform Experiments

*Daniel D. De Haan*

(CC BY-NC-ND 4.0)

DOI: 10.4324/9781003125860-10

The funder for this chapter is Templeton World Charity Foundation

Routledge
Taylor & Francis Group
NEW YORK AND LONDON

# 7 The Power to Perform Experiments

*Daniel D. De Haan*

Do humans have abilities to perform scientific experiments? Do humans possess real powers for performing scientific experiments? I shall treat these two questions in turn where the first will bring us to the second. I shall argue that the scientific image of humans must cohere with the manifest image of humans as having the ability to exercise rational embodied control. This is because the scientific image of humans depends on the results of experiments performed by scientists, experiments that are instances of the manifest image of humans with the power to exercise rational embodied control over physical phenomena. Since the scientific image of humans cannot be incompatible with the existence of scientists who perform scientific experiments, it cannot be incompatible with the manifest image of humans that exercise rational embodied control in scientific experiments. Let us start with why someone might argue the scientific image discredits the manifest image and thereby undermines the theses that humans can perform scientific experiments and are endowed with the real powers to do so.

## 1. Manifest and Scientific Images of Humans

It has become a cliché for philosophers and scientists to pronounce that advances in scientific enquiry have disclosed a scientific image of humans that has overturned our commonsense or manifest image of humans. When Wilfred Sellars coined his post-Kantian distinction between scientific and manifest images of humans, he was identifying a troubling tension that he sought to alleviate by articulating how these two images could be reimagined in deference to the scientific image yet without jettisoning the "irreducible core of the framework of persons."[1] Many since Sellars have ignored his insightful and nuanced conciliatory handling of this tension by endorsing the very confrontational interpretations of this distinction that Sellars cogently argued against. Reductive physicalists argue that the manifest image can be reductively explained by the scientific image. Eliminative physicalists go so far as to contend that the manifest image will be eliminated and wholly replaced by the scientific image because the

DOI: 10.4324/9781003125860-10

results of scientific experiments have purportedly established a form of scientific naturalism that falsifies the manifest image of humans.[2]

These bold contentions overlook a number of important facts that place unavoidable obstacles in the path of these efforts to bulldoze over the manifest image of humans; obstacles these glib revolutionary viewpoints must confront before anyone should lend any plausibility to their ungrounded promissory explanations. Some of these obstacles come from important work in philosophy of science that has turned to focus on the history and practices of scientists. These investigations have overturned many armchair physicalists' assumptions about what it is scientific investigations really discover about nature by their experiments and theorizing. They have also led many to endorse, or at least sympathize with, Nancy Cartwright's "empiricist dictum . . .: Construct our scientific image of the world from our scientific practices that prove successful in interacting with it."[3] This dictum has provided scientific support for an ontology of manifesting but also defeasible causal powers over and against a conception of exceptionless universal laws of nature.[4] This approach to articulating our scientific image of the world must also include an account of its dependence upon the scientists and their successful scientific practices.

This chapter focuses on one of the significant obstacles to the radical revisionist viewpoint that comes from considering what scientific practices in themselves require in order to secure any scientific image of the world and of humans in it. The obstacle I focus on is the fact that humans can perform scientific experiments and that this fact is included among the *explananda* of both manifest and scientific images of humans. My argument will be prosecuted as follows. First, I establish why rational embodied control is indispensable to the ability to perform a scientific experiment. Second, I contend that an ontology of causal powers provides the best explanation for this *ability* to make the causal difference in reality required for scientists to effectively perform scientific experiments and arrive at scientific truths. I then conclude by considering a major objection against the alternative standard causal theory of action, which would also undermine the thesis that scientists perform experiments. I show why neo-Aristotelian causal power realism does not face this objection in its explanation of how scientists exercise real rational embodied causal control within their experiments, which supplies one more reason for endorsing neo-Aristotelian causal power realism over rival causal theories.

To clarify the different stages of my argument I shall stipulate a terminological distinction between abilities and powers. An "ability" denotes a notion of discourse that is underdetermined with respect to its ontological underpinnings. Talk of abilities might be indispensable to intelligible and true discourse, but this discourse does not of itself disclose any ontological commitments. I use the term "power" ontologically and will later argue that true discourse about abilities that make a difference in the world

is best explained by endorsing power realism, wherein powers are the truthmakers that ground true discourse about abilities.

## 2. Rational Embodied Control

What is necessary for performing scientific experiments? We can distill the panoply of features required for performing scientific experiments down to a scientist's abilities for *rational embodied control* over physical phenomena: in physics, scientists orchestrate the collision of proton beams in the Large Hadron Collider; in chemistry, scientists can synthesize an extraordinary range of substances, like ammonia from nitrogen and hydrogen; in biology, scientists can edit genomes using CRISPR. This distillation down to three constitutive and interconnected abilities is not a reductive explanation of scientific experimentation, but rather what Peter Strawson called a *connective* one. None of these three factors – rational, embodied, control – is more primary or basic than the others, rather their interconnection is one of mutual presupposition. Let us examine each of these features in turn.

### *2.1. Rational*

It should be uncontroversial that scientific experiments are rational. Being "rational" is a personal-level attribute in contrast to the subpersonal-level attributes of a human person's nervous and endocrine systems. An agent is rational insofar as it is a person whose observing, thinking, and acting can be intelligently constituted and guided by reasons, as opposed to non-intelligently and mechanically processing information or responding to stimuli. This notion of "rational" therefore excludes much of what cognitive scientists and even functionalists in philosophy of mind call reasons and rationality, which are often ascribed to overtly subpersonal-level objects, states, networks, and processes.

Being rational comprises observing, thinking, speaking, and acting intelligently and voluntarily according to reasons; this includes both practical and theoretical reason. Understood reasons can intelligently govern and guide what one is thinking and what one is doing, wherein thinking and speaking are themselves typically forms of intentional acting, and embodied intentional acting is a manifestation of thinking rationally. To exercise practical reason is to perform actions intentionally – often accompanied by or even constituted by deliberation and decision – and voluntarily or at will with respect to the commencement, and/or continuation, and/or cessation of some overtly observable or unobservable psychological behavior – like calibrating a laser or performing calculations "in one's head."

Human actions are *intentional* because they actually realize and embody one's practical reasons or intentions for acting as one does. The embodied psychological behaviors of scientists are not mere reflexes or instinctual

responses, for then their behaviors would be nonrational. Similarly, the embodied psychological behaviors of scientists engaged in scientific practices are not instances of faking or incompetently calibrating a laser for an experiment, for then their behaviors would be irrational. That is to say, they would be acting against the norms of rationality for truthfulness, integrity, and the deployment of scientific competencies in the intelligent, intentional, and voluntary calibration of a laser for an experiment.

Human actions are *voluntary* insofar as scientists perform their experiments at will, that is, they have the two-way ability to perform experiment $\varphi$ or not to perform experiment $\varphi$. This, of course, drastically underdescribes how complex the performance of an experiment is, for it omits the social collaboration involved in most scientific experiments that rely on the coordination of multiple scientists intentionally and voluntarily performing a scientific experiment by working together. It also obscures how, within such complex *ongoing activities* as collaboratively performing an experiment together, a team of scientists is comprised of individual scientists who must intentionally and voluntarily deliberate together about and enact what they will $\varphi$, whether they will $\varphi$, when they will $\varphi$, where they will $\varphi$, how they will $\varphi$, and why they will $\varphi$ in this way and at this time rather than $\varphi$ in that way and at that time.[5]

For example, for any neuroscientific experiment on long-term memory in rodents that employs optogenetic stimulation, neuroscientists need to answer and then intentionally and voluntarily enact their answers to these questions, the following questions, and many more. Given past experimental data and theorizing relevant to these questions, neuroscientists designing, enacting, and interpreting their optogenetics experiment on rodent long-term memory need to decide what kind of mice to use, how many mice are sufficient for a control group, what kind of task(s) should be employed, how long the mice should train on the task(s), what kind of diet the mice should have, when trials should start following recovery from surgery, and so on to conduct their experiments applying optogenetic stimulation. Within the trials themselves experimenters need to work through a similar battery of questions concerning when to apply optogenetic stimulation vis-à-vis the task(s), for how long during each task, how many times, how long should each trial run, and so on. In each case a variety of variables, counterfactuals, and contravening factors need to be intelligently discerned and experimentally controlled for, mitigated, or eliminated.

It would not be difficult to explicate – and in more detail and with greater depth beyond the surface level surview I have presented here – the myriad ways rationality is constitutive of performing scientific experiments, including the experimental intelligence required to identify and overcome contravening and confounding factors. We can find a litany of examples on display within the methods, critical discussions, and other sections of scientific studies. What these discussions exhibit beyond the basic and straightforward application of scientific rationality to the design,

implementation, and interpretations of results of scientific experiments is a rational ability for critical self-reflection upon the scientific reasoning and intelligent adherence to the canons and norms of rationality that are themselves embodied within the performance of a scientific experiment. And on some occasions, but especially within philosophical studies on these scientific practices of experimentation and theorization, we find disclosed the ability of reason to engage in critical reflection upon the arguments for and against rival understandings of the very canons of scientific enquiry and norms of rationality, along with the debates concerning the criteria for how and when to apply them. Scientific rationality therefore involves and relies upon both reason's ability to employ the norms and standards of rationality within experimental investigations of domains of empirical phenomena, and the rational ability to reflect critically on the norms and standards of rationality that govern the former experimental investigations of domains of empirical phenomena.

Significantly, the norms of rationality that are learned and efficaciously employed in all scientific thinking and acting cannot be established or rationally vindicated on the basis of any scientific experimental results. This is because norms of rationality are presupposed by all scientific experimentation and theorization and so also by any scientific image of the world or of humans that is reliant on scientific reasoning. Scientific investigations do not supply or vindicate the norms of rationality; rather, the manifest image of humans is the indispensable source for the norms of rationality and supplies the very criteria and grounds by which we can vindicate or revise the normative standards of rationality. Such vindications or revisions are independent from the scientific investigations and experiments that fundamentally rely on the normative space of reasons and their embodied efficacy.

Against this cursory account of rationality one might object that many of the forms of scientific reasoning mentioned here are rarely if ever explicitly thematized and actually articulated. But this is not an objection so much as a reminder to make clear that this account of rationality can only be correctly understood and interpreted as one that is informed and qualified by the treatments of embodiment, expertise, tacit knowledge, know-how, and intentional action of Merleau-Ponty, Polanyi, Ryle, and Anscombe; diverse threads that are often woven together in explicitly complementary ways by Charles Taylor, Alasdair MacIntyre, and many others, but especially by the radical enactive cognition theorists. The inescapable dimension of embodiment that keeps emerging in our treatment of scientific rationality brings us to the second feature of scientific experiments.

### *2.2. Embodiment*

In order to give some focus to the wide-ranging issue of embodiment, I shall enter into its significance by fleshing out some of its most salient

connections with rationality. We can start with the fact that human rationality is the embodied rationality of social animals. Humans are altricial mammals who are unable to exercise their rational capacities for intentional and voluntary action for many years after birth. Humans only learn how to exercise these capacities in virtue of the social scaffolding that nurtures, cares for, and educates humans into becoming animals who can exercise their rational capacities for linguistic, practical, and theoretical interactions with other humans. But even enabling and later engaging in embodied rational activities presupposes the rational transformation of the many embodied capacities we share with other animals, such as capacities for enactive perception, motivation, emotion, associative and social mimetic learning, and the palpably embodied haptic abilities for manipulating physical phenomena. For example, engaging in scientific observation and experimentation requires rationally transforming one's perceptual capacities to achieve sufficient observational acuity to select and discriminate intelligently among what is relevant versus irrelevant within observable data. Engaging in these scientific activities also involves the rational transformation of one's embodied capacities for motivation and emotion that enable the kinds of discipline, persistence, resilience, and passion required for the arduous painstaking work that comprises scientific experimentation. Experimental work is, after all, full of long tedious hours of trial and error accompanied by seemingly endless dead ends.

Furthermore, because humans are rational *animals*, they can neither exercise their rational capacities *ab initio* nor immediately rationally transform their embodied capacities for enactive perception, motivation, emotion, and haptic manipulation that constitute most embodied rational activities, like performing a scientific experiment. There is a long drawn out socially informed ontogenetic process of enablings and transformations of proto-rational and later rational capacities that is worked out through many phases of human development. And because development is essential to human embodiment, being socially dependent in myriad ways throughout life is thereby also essential to being embodied rational agents. To become sufficiently educated to have the proximate potentialities for becoming a scientist requires not only that all of our capacities for perception, motivation, emotion, language, intelligence, and will have been enabled and cultivated by the right caregivers who are provided with the ecological and social resources needed for engendering these basic human ontogenetic transformations. It also requires a vast educational infrastructure populated by competent educators that can prepare developing minds to become potential initiates into scientific experimentation and theorization. But even that is often not sufficient, for what is ordinarily required today is a still more advanced educational formation that can transform educated potential scientists into fully initiated and collaborating participants in normal science, and this depends on elaborate social institutions with instructors, mentors, and colleagues all working

together. Finally, the growing number of scientific experimental mega-projects (e.g., NASA, HGP, CERN, LIGO-Virgo) also depend on extraordinary international political and economic resources, cooperations, and the institutions and populations that make them possible, in addition to the publicly and privatively funded universities and other research institutions we ordinarily identify with normal science and its research.

In short, the essential embodiment of human persons is manifested in humans being developing and dependent rational animals. And scientific practices, including experimentation, are constituted by their own distinct forms of embodied human development and social dependencies. Once again, it is these personal-level developmental factors from the manifest image of humans that are indispensable to scientific practices and so to any critical reflection on the curricula and standards of scientific education and methods.

Embodiment also sets in relief the constitutive nexus wherein rationality and control are intertwined, for we exercise rational control both over our own enactive perceptions, motivations, emotions, desires, and beliefs and "also" over our own bodies and other bodies. I say "also" because I do not intend to suggest, as most philosophers of mind and other exponents of the discourse of "folk psychology" do, that we can fully understand what it is to exercise rationality – not to mention rational control over our perceptions, motivations, emotions, desires, and beliefs – apart from being embodied animals that exercise control over our own and other bodies in our surrounding environment. No fully satisfactory explication of what perceptions, motivations, emotions, desires, and beliefs are could be intelligible apart from the embodied psychological behaviors that are partially constitutive of human abilities for perception, emotion, desire, belief, and so forth.[6] For instance, while it is obvious that enactive perceptions are constituted by *perspectival* observations due to orientations, comportments, and other constraints of embodiment, even emotions, desires, and beliefs, like perceptions, are identified by their objects, and the objects of these capacities largely consist in the embodied objects of our environments and our enactive engagements with them. It is only through developmentally later transformations, via social, linguistic, and conceptual learning, that we eventually become enabled to have emotions, desires, and beliefs concerning objects that are interiorized, transcend physical objects, or, as Charles Taylor argues, constitute and create meaningful discourse beyond the ecological affordances of objects in our environment.[7]

### *2.3. Control*

The myriad illustrations of humans exercising rational embodied control over physical phenomena are endless. I shall limit the scope of this broad topic by focusing on how rational embodiment pertains to control within scientific experiments. Roughly, rational embodied *control* consists in the

ability *to make a difference* with respect to either the inception, and/or continuation, and/or cessation of the directed and purposeful movements or changes of one's own body and of other surrounding bodies in the ways one intends to make a difference with respect to what these objects' capacities afford for movement and change. Adult humans can ordinarily control whether and how they walk across a room insofar as they can intentionally initiate, continue, and terminate taking steps across the room. But if one's leg has been anesthetized or one suffers from tinnitus, vertigo, or other disabilities, it can be difficult or impossible even to commence walking across a room. Some events we either do not or cannot initiate, but we can nevertheless control either an ongoing flow or an outcome by modulating and influencing various factors. For example, when we try to inhibit a sneeze, reduce a fever by taking paracetamol, or steer a kayak out of a fierce river current.

Human bodily movements are characteristically, though not always, rationally guided, purposeful, and controlled bodily movements in contrast to mere mechanical and purposeless (which is not to say directionless) bodily movements. Rationally directed and controlled hand movements, among other haptic movements, are manifested in the complex ordered and purposeful activities that comprise making a fire or a loaf of bread, buttering toast with a knife, replacing a transmission, calibrating a laser, surgically installing an optogenetic optical fiber within the medial entorhinal cortex of a rodent, manufacturing and installing the "quadruple-pendulum system, supported by an active seismic isolation platform"[8] of the mirrors within the LIGO (Laser Interferometer Gravitational-Wave Observatory) interferometers in Hanford, Washington, and Livingston, Louisiana, USA. Clearly, performing a scientific experiment falls on this enormous list of embodied forms of rationally controlled engagements with the world, or umwelt as Rom Harré characterizes it. And without the discoveries made possible by these scientific experiments, humans would be oblivious to the hidden properties of nature.

> The umwelt is that region of the world which is available to a species by virtue of their capacities to register and explore it. The human umwelt is bounded at any moment by the human capacities for perception and the instruments currently available to extend them. The ontology of the umwelt was greatly illuminated by Niels Bohr. He realized that human beings could ascribe only dispositions to the world behind appearances. He also realized that those dispositions were *defined* by the available experimental equipment. They are, in the last analysis, Gibsonian affordances, not occurrent properties. . . . There is indeed a world beyond the observable – but it is an umwelt, and its properties, for the human species, are the affordances it has, as made humanly discernible through experimental apparatus (emphasis in original).[9]

A scientific experimenter attempts to exercise control over every known and relevant factor that can be controlled, while also mitigating or intelligently identifying and accounting for all of the factors that cannot be controlled or eliminated. Insofar as the experimenter – or often enough *experimenters* – can achieve the construction of a rationally controlled experimental context, they can thereby either allow nature to do whatever it may do, or they can direct and even force nature to disclose and manifest its powers. If this kind of rational embodied control were delusional or impossible, then we would have to discount countless scientific discoveries and theories grounded in experimental results. Like, for instance, the 1910 experimental results of Robert Millikan and Harvey Fletcher that purported to isolate and measure the charge of an electron by their ingenious oil-drop experiment. The performance of the Millikan experiment can now – through the developmental social ratcheting-up effects of innovations in scientific understanding, education, and technology – be taught to and reenacted by college physics students.[10] Briefly and simplistically, in the Millikan oil-drop experiment, aspirated and ionized oil droplets in an upper chamber fall into a lower chamber that has two parallel horizontal charged plates. Gravity pulls the oil droplets down, but the electric attraction and repulsion due to the oppositely charged plates can work together to pull the charged oil droplets up. By turning off and on the potential difference between the charged plates Millikan in 1910 could – and college students repeating the experiment today can – manipulate the movements of the charged oil droplets either to fall slowly under gravity resisted by drag or to move upwards by the additional contribution of electric force from the charged plates. It is this experimental *setup* that allowed Millikan to perform an experiment to measure the charge of electrons.

As Thomas Kuhn and many others have detailed, the experimental work of normal science can be directed to multiple ends, but it is rarely, if ever, conceived, designed, and implemented apart from a theoretical paradigm that inspires and channels the peculiarities of the structure of the experiment itself.

> The existence of the paradigm sets the problem to be solved; often the paradigm theory is implicated directly in the design of apparatus able to solve the problem. Without the *Principia*, for example, measurements made with the Atwood machine would have meant nothing at all.[11]

So also the Millikan experiment presumes theoretical accounts of gravity, electromagnetism, the drag force on the droplet due to the air, and so forth to design, manufacture, and employ two charged plates to manipulate the movements of ionized oil droplets by altering the voltage across the plates as well as the ability to isolate the relevant experimental factors from other difference makers. All of these critical considerations and

experimental operationalizations are at the heart of a rationally *informed* and *controlled* scientific experiment. Significantly, objections and concerns about the reliability of Millikan's results or the multiple sources of potential experimental error within his experiment have not challenged or undermined the ability of scientific experimenters to achieve rational embodied control over physical phenomena, like manipulating the movements of charged oil droplets. Instead, they have inspired the application of more critical reasoning and intelligence in the theoretical modeling, design, and execution of experiments.[12]

### *2.4. The Indispensability of Rational Embodied Control*

One could fill volumes detailing further the multitudinous ways the abilities for rational embodied control are constitutive elements in all scientific experiments, but the digest of thick descriptions I have expounded should be sufficient to illustrate why abilities for rational embodied control are *indispensable* for performing scientific experiments.

If scientific experiments are not *rational*, then scientific experiments and their results (a) cannot intelligently operationalize and assay theoretical paradigms, concepts, models, hypotheses, predictions, and so on, (b) cannot count as rational evidence that verifies, confirms, or falsifies predictions, hypotheses, models, theories, paradigms, and so on, and (c) so cannot be the truth-seeking, truth-tracking, and critically self-correcting activities we understand and hold scientific practices to be. But scientific experiments do afford us with these consequents and many more, so the antecedent is false.

*Embodiment* is the constitutive nexus uniting rationality and control in scientific experiments. This is why the thesis that scientific experiments need not be embodied is oxymoronic. Of course, this notion of scientific experiments presumes the truth of some form of critical and explanatory empirical realism and the falsity of idealism, but that is a pair of presumptions I and most plain persons, scientists, philosophers, and theologians willingly hold and have more than sufficient rational justification for holding. Consider nevertheless the absurdities that would follow from this oxymoronic thesis. If scientific experiments were not embodied but disembodied, then scientific experiments and their results would totally fail to be *empirical* and so would be indistinguishable from "thought experiments" in philosophy and mathematics; they might probe intuitions but they would not probe the recalcitrant mettle of nature. Furthermore, by failing to be empirical, scientific experiments would also essentially fail as empirical *tests* and so could not *assay* embodied observations, measurements, manipulations, or predictions concerning any mind-independent empirical phenomena. A scientific experiment that is neither empirical nor tests any empirical phenomena, because it is not embodied, is clearly absurd.

For the sake of completeness, consider further that if scientific experiments were not *controlled*, then scientific experiments and their results would fail to provide rational grounds for distinguishing them from lucky guesses, superstitions, conspiracy theories, and a host of falsified scientific theories. Indeed, if any scientific theories or predictions could be "falsified" on this supposition, then it would not be in virtue of any *controlled* scientific experiments, for there are none on this supposition. If scientists do not exercise causal control over physical phenomena, then why are photons flying back and forth along the arms of the LIGO interferometers? If scientists did not cause this, then scientists have not performed a controlled scientific experiment to detect gravitational waves. Similarly, if scientists did not cause the proton beams to fly through CERN's Large Hadron Collider, if they could not control the trajectory of them into ATLAS and CMS detectors to the extent that they understand their massive experimental apparatus to do just this, then scientists did not perform a controlled scientific experiment to identify and establish the existence of a Higgs boson. Clearly, scientists do exercise causally efficacious rational embodied control over physical phenomena, including the fundamental particles of nature.

In short, if one could establish that the manifest image of humans as agents with rational embodied control was false, then it would thereby also establish that truth-establishing scientific experiments do not exist, and this would undermine all scientific theorizing that is based upon data assumed to have been accurately acquired by the rational embodied control of scientific experiments. If the scientific image of humans truly discredits the manifest image of humans, then it also discredits the cornerstone of all scientific enquiry along with any scientific image of humans or the world that is derived from scientific enquiry.

Certain kinds of error theorists and skeptics might welcome this conclusion. They wish to affirm these antecedents and push back against my *modus tollens* arguments in defense of the abilities for rational embodied control required for scientific experiments. How should we respond? This scientific, if not global, skepticism will rightly be met with a volley of objections. The most fundamental objection we can raise is to ask upon what evidential or other grounds can anyone cogently establish that scientific experiments cannot be constituted by rational embodied control because humans do not have rational embodied control over any phenomena?

Appeals to the results of scientific experiments are not available either to motivate or to justify these skeptical contentions, since these skeptical conclusions presume scientific experiments are discredited. Similarly, skeptics' own criticisms of faulty and defective applications of rationality presuppose that rationality is the critical self-corrective ability detailed previously; we can only rationally concede the rational grounds of their critiques if we reject their skeptical rejections of rationality. Skeptical

responses to these basic challenges often try to turn the tables by arguing that there is a desperate need to make extraordinary radical revisions to all of our notions concerning the norms and standards of rationality. The problem is, any such "proposal" for radical revision remains literally unintelligible and inconceivable at this point, and this defect even infects any "grounds" or "arguments" proposed for entertaining the "plausibility" of a radical total revision of our epistemological and other notions. How can we even concede as "plausible" that which we have been given no plausible account of, and so cannot give any arguments for, and for any thesis which essentially contends that concepts like "rational," "truth," "plausible," and "argument" need to be eliminated or radically transformed in their basic meanings?[13]

More can always be said about arguments against and in defense of these radical skeptical and error-theoretic positions, but even wading this far into the shallow end of the pool of these debates is enough to disclose the gravamen underwriting the insurmountable difficulties facing these radical revisionist positions. For each positive argument they enunciate in favor of why some skeptical thesis is true, namely, that some domain of knowledge is fundamentally in error, they expose their own skeptical thesis and arguments to the retort that this new contention entails a self-defeating global skepticism that undermines the arguments for their skeptical thesis.

What I have prosecuted thus far is a distinctive form of transcendental argument against the claims that the scientific image of humans has discredited the manifest image of humans. I follow Charles Taylor's account of (a) what makes certain transcendental arguments valid, (b) why they remain open to revisions and further objections, and significantly for this chapter, (c) why they always leave us with unsettled metaphysical business.[14] The argument presented here establishes why the scientific image of humans cannot be at odds with the manifest image, for the only way we can get at anything that might justifiably be deemed a scientific image of humans or the world will be arrived at via performing scientific experiments. And scientific experiments are specific manifestations of the completely quotidian abilities of the manifest image of humans to exercise rational embodied control over physical phenomena. The scientific image of humans is one that needs to be of a piece with the existence of scientists and their scientific practices. I have argued that scientists and their scientific practices manifestly inhabit and depend upon the sociopolitical world of the manifest image of humans as agents that exercise rational embodied control. True, scientific images of humans certainly do enrich, interrogate, and sometimes revise significant aspects of our manifest images of humans. But true scientific images do not achieve this by presumptively dismissing manifest images in the problematic and self-defeating ways I have argued against.[15] True scientific images achieve such ennobling goals by explaining the subpersonal biological systems that undergird

our perceptions, emotions, and embodied movements, by challenging our prior, limited, and erroneous manifest and scientist images about physiological and psychological disorders, and by radically revising our views about the biological origins of organisms like humans and other animals.

This Taylorian transcendental argument brings out how enormous the descriptive and explanatory burden is for radical revisionists. It sets in relief the Olympian proportions of the challenge they must overcome, rather than the elementary school track meet they so often portray the manifest image to be. It concludes that the performance of scientific experiments would be unintelligible and incapable of securing facts and verifying scientific theories without the basic constitutive features of rational embodied control. But, as Taylor shows, transcendental arguments do not settle metaphysical questions; rather, they are indispensable prolegomena to our metaphysical investigations. So even if scientific experiments are unintelligible apart from rational embodied control and other thick descriptive notions drawn from true manifest and scientific images of humans, why should we countenance the existence of an ontological image of humans with real powers to perform experiments?

## 3. From Abilities to Powers

A number of argumentative gears are available for shifting from the conclusions of our Taylorian transcendental argument in defense of the indispensability of *abilities* for rational embodied control for performing scientific experiments to the question of what this commits us to ontologically. I start with the existence question and then turn to why these existing abilities should be identified with neo-Aristotelian causal powers.

### *3.1. The Existence of Abilities*

There are good arguments for why even scientifically inclined ontological naturalists should hold that these abilities *exist*. Ontological naturalism is committed to the existence of whatever is required to achieve effective and true scientific enquiries. Many ontological naturalists, following Quine, maintain that our ontology must recognize the existence of whatever is disclosed and required by our best scientific theories. For example, because scientific theories depend on mathematics, the ontological reality of mathematics must be acknowledged. Going beyond Quinean ontology, metaphysics still has more work to do than fill out ontological grocery lists, for acknowledging the indispensable existence of mathematical objects neither precludes nor settles debates over what mathematical "objects" are and what their mode of being might be.[16] In addition to mathematics, our scientific theories also depend on whatever is essential to the scientific practices that are indispensable to our scientific theories, and these practices include conducting rigorous scientific experiments

without which the armchair speculations of scientific theorizing would be indistinguishable from philosophy and mathematics. William Jaworski, drawing on Cartwright and others, argues:

> Empirical methods and techniques appear to provide important sources of ontological commitment as well. The idea is roughly that in constructing and executing experiments we are often implicitly committed to a range of assumptions that carry ontological commitments of their own but that might nevertheless remain unstated in the more canonical descriptions and explanations we give. If this is the case, then we need to expand the basic Quinean thesis to accommodate these further commitments. On this expanded understanding, ontological naturalism says that we are committed not only to the existence of the entities needed to make our best empirical descriptions and explanations true, but also to the existence of the entities needed to make our best empirical methods and techniques effective.[17]

In order for our scientific practices to be effective and arrive at true descriptions and explanations of empirical phenomena, we must be committed to the existence of the entities required for our scientific practices to be effective and arrive at truths. Our transcendental argument established that scientific experiments cannot be effective and arrive at truths without abilities for rational embodied control. Any true ontological naturalist image of humans is therefore committed to the existence of these *abilities*.

A second argument is based on the *Eleatic principle* that what exists is what plays a causal role or makes a causal difference.[18] The ability to exercise rational embodied control over physical phenomena can only make a causal difference in reality if this ability is real, like either an event-cause or a causal power whose causal manifestations make a difference in reality. If a scientist performing the Millikan experiment is *not* making a difference to the movements of the oil droplets by charging or discharging the plates by turning on or off the voltage; if instead the changing movements of the oil droplets are somehow inexplicably occurring and have no causal connection to the scientist's intentional action of turning on and off the voltage by moving her hand, which is flipping the switch, which is charging or discharging the plates, which is etc., *then* the scientist cannot know why some of the charged droplets of oil started to move upward *when* and *while* this process was occurring. In short, if scientists cannot confirm that their rational embodied control is causally efficacious in their experiments, then scientific experiments do not secure facts and cannot verify or falsify scientific theories. But we are correct to reckon scientific experiments secure facts and can verify or falsify scientific theories, because scientists' abilities for rational embodied control are causally efficacious in their experiments. And, because they are causally efficacious, these abilities exist.

### *3.2. Rival Conceptions of the Ontological Nature of These Abilities*

These two arguments establish the existence of the *abilities* defended by our Taylor-style transcendental argument. What is the ontological nature of these existing abilities? Neo-Aristotelians maintain that if these abilities exist, they exist as *real powers* of humans for rational embodied control over physical phenomena. Why hold that for these contentions to come out true, these *abilities* need to be *real powers*?

First, our Taylorian transcendental argument has cleared away from the metaphysical table the major ontological alternatives to causal powers insofar as the plausibility of these rival positions on causation and agency require the assumptions of physicalism, which – as we will see – these transcendental arguments undermine. Second, given the neo-Aristotelian setting of this chapter, and that space does not permit us to rehearse the extensive debates and arguments for why neo-Aristotelians defend and many others have converted to power realism in recent decades, a presumption in favor of an ontology of powers is already on the table. If any ability is real, then it is a power. It will nevertheless be worth surveying some of the major problems faced by those courageous souls who have tried to carve out an ontological place for mental causation and agency within the diminished ontological space and resources permitted by physicalism. Later we will address why neo-Aristotelian causal power realism does not face similar difficulties.

Unlike neo-Aristotelian causal power realism, most positions in the metaphysics of causation aim to downgrade or reduce the apparent reality of human agents with causally efficacious rational embodied control over physical phenomena. But these diminished accounts of causal agency are deeply problematic. Many face the *problem of deviant causal chains*, which shows that humans cannot exercise the right kind of ongoing causal control over physical phenomena required for intentional actions, like performing an experiment. The *disappearance of the agent problem* discloses that the standard causal story of action deprives the human agent of any active control over what the agent does, since it is event causes within the agent that determine what happens. The standard story "fails to cast the agent in his proper role. In this story, reasons cause an intention and an intention causes bodily movement, but nobody – that is, no person – *does* anything" (emphasis in original).[19] In philosophy of mind, all efforts to defend the reality of mental causation confront the *problem of causal overdetermination*. Since physical causes independent of any mental causes are sufficient causes of physical effects – like performing an experiment – there is no causal exigency for postulating mental causes.

In addition to problems with the philosophical coherence of these etiolated metaphysical theories of causation and agency, there are also fundamental difficulties with the assumptions of physicalism that underwrite

them. These assumptions lead many philosophers to agree with Derk Pereboom that "given our scientific understanding of the world, how could there exist anything as fabulous as an agent-causal power? It would appear that our natural scientific theories could not yield an account of a power of this sort."[20] Indeed, the major motivation for adopting ontological downgrading strategies in the first place is based upon a fundamental faith in an austere physicalism that purportedly some present or future theoretical physics can establish. The purported scientific support for physicalism leaves no place for real and causally efficacious rational embodied control, which is why defenders of the reality of mental causation within this paradigm face an uphill battle of trying to secure any form of mental causal efficacy over and above real physical properties and causes.

Against the assumptions of physicalism stands our Taylorian transcendental argument, which contributes to the existing battery of arguments that reveal that "physicalism" is ill-conceived.[21] In particular, these arguments demonstrate that the presumed scientific point of departure of physicalism fundamentally misrepresents and overlooks the indispensable features of the manifest image of humans that are required for the scientific practices of physics. Theoretical physics cannot put in question the reality of causally efficacious embodied rational control over physical phenomena without undermining the very scientific experimental results required to vindicate its scientific theories. No one should commence their enquiries concerning human agency with the self-defeating physicalist assumptions that theoretical physics has already established mental causation (probably) does not exist. Contrary to physicalism, the manifest image remains the point of departure for our philosophical enquiries concerning the ontological commitments required for human abilities for rational embodied control. These Taylorian transcendental arguments overturn the mistaken assumption that scientific theories rule out rational causal agency and that we must settle for downgraded conceptions of rational agency instead. They correct the physicalist's image of reality, which assumes a distorted vision of both the manifest and the scientific images of humans and the world.

### *3.3. Power Realism*

We have just presented arguments for setting aside the physicalist worries that motivate inherently problematic downgraded theories of causal agency. In this subsection, I sketch an account of causal powers that illustrates how powers fulfill the ontological, causal, and epistemological explanatory roles that abilities for rational embodied control play in our manifest, scientific, and ontological images of humans.

We cannot move into this metaphysical territory concerning the nature of powers to perform experiments independent from a host of other

presumed metaphysical commitments about what there is, what grounds what, what causes what, and so forth. But I also hope that my arguments intimate why none of these metaphysical issues can be confronted and settled independent from addressing critical questions concerning the ontological image of humans as psychological subjects who engage in ontological enquiries that draw on manifest and scientific images of humans and the world. Put otherwise, the truth of a neo-Aristotelian powers ontology is not going to be established independent from what we know about the roles and reality of powers as humans who exercise our own powers in concert with the co-manifestations of a panoply of powerful particulars in nature.[22] This point is not unique to neo-Aristotelianism, for the austere ontology of a neo-Humean mosaic also cannot be established independently from a neo-Humean epistemological error theory that justifies discounting aspects of the manifest and scientific images of humans and the world.

Even though we cannot rehearse the debates over powers, we do need to say something about the view of causal powers being presumed and how it supplies answers to the aforementioned three major problems that plague its rivals, problems that are apropos the question of whether scientists can perform experiments. There are a number of competing neo-Aristotelian accounts of causal powers, but only some of these debates matter for our purposes.[23]

First, because neo-Aristotelians hold that causal powers are fundamental, irreducible, first-order properties of reality, they reject "categoricalism," which is the view that fundamental properties are not powers. Second, power realism rejects Humean and other theories of causation that hold all causation consists in temporally successive independent events, that causation requires a necessary connection among events or the instantiation of an exceptionless generalization or universal law of nature. Power realism therefore rejects the standard causal story of action as well. Neo-Aristotelians defend a realist theory of causation consisting in simultaneous and reciprocal causal manifestations among causal power partners.[24] "[W]hen two causal partner-powers are mutually activated, their two manifestations occur *simultaneously* in one event, but they are two *different types* of activity."[25] It is the co-manifestations or co-activations of causal powers that make a causal difference in reality, not laws of nature; laws of nature are, at best, abstract descriptions of the regular, but defeasible, co-manifestations of causal powers.

Third, the co-manifestation of causal power partners is at the heart of the neo-Aristotelian conception of powers and causation, and it brings out the way different causal interactions or activities – which are often ongoing causal processes[26] – are comprised of different active and passive causal roles filled by different power partners.[27] Fourth, following more neo-Aristotelian power realists, like Anna Marmodoro, the manifestations of powers do not essentially consist in the giving or

production of another power; rather the manifestation of a power is an internal transition of one and the same power shifting from being in a state of potentiality to a state of activation or of acting, manifesting, and causing. Power partners are mutually activated whenever they are co-manifesting.[28] Fifth, strictly speaking the causal agents and patients of action and passion interactions are typically substances or powerful particulars that realize or exercise their powers in concert with their causal power partners.[29]

Sixth, one of the central explanatory strengths of power realism over rival explanations of causation is its elegant account of counterfactuals and the defeasibility of occurrences and its attendant arguments, which many believe have refuted most, if not all, attempts to explanatorily reduce powers or dispositions.[30] The co-manifestations or causal occurrences of reciprocal powers are always liable to being prevented, influenced, modulated, or otherwise altered by subtractive and additive interferences, finks, masks, antidotes, blockers, absences, and by any other counteracting confounds or more powerful powers.[31] This means in any individual case we need to identify and distinguish a power's canonical *way of acting* and so also its canonical power partners and their canonical *ways of acting*, which give us their canonical *ways of co-acting* or *co-manifesting*, from the *outcome* or *what happens* when these canonical co-manifestations of power partners are modulated or interfered with by the manifestations of other powerful powers.[32]

Seventh, given the varieties of causal activities and canonical active and passive causal roles among any multitude of co-manifesting powers, along with the variety of powerful powers that can interfere with or modulate the outcome of co-manifesting powers, neo-Aristotelian power realism is thereby committed to causal pluralism. This is significant since it also rejects most of the basic assumptions taken for granted by proponents of causal monism and sufficiency, which generate the aforementioned problem of overdetermination for mental causation.[33] For example, the account of event causation presumed by Jaegwon Kim's principle of explanatory exclusion, that "No event can be given more than one complete and independent explanation," does not consider two central features of neo-Aristotelian causal power realism. First, since any power's manifestations are defeasible, there can be a manifesting power that would be, *ceteris paribus*, a sufficient cause for an effect, but if a second power manifests it can prevent or modulate the manifestation-outcome of the first otherwise sufficient cause. Second, strictly speaking these two manifestation-outcomes are not the same, as disjunctivists rightly point out. And neo-Aristotelian causal power realists can explain why the outcomes or effects are not the same since they are the results of distinct nexus of co-manifesting powers. Neo-Aristotelian causal pluralism therefore endorses a quite different understanding of the causal exclusion principle and of the problem of causal overdetermination. An

effect, like a bodily movement, which results from the manifestation of nonrational instinctual causal powers, is simply a different effect from any bodily movements that results from rational causal powers whose co-manifestations with powers for bodily movement can override or overpower nonrational instinctual causal powers.

This means that rational mental causation is not essentially problematic for neo-Aristotelians, whereas it presents a notoriously insurmountable problem for anti-Aristotelians in the philosophy of mind who face the following standard dilemma. Either contend that the normativity of rationality and its genuine mental causation can be epistemologically naturalized and reduced to physical causes (where many philosophers, if not most, agree all promissory attempts to naturalize rational normativity by reducing it to causal co-variation have failed). Or, contend that reasons are genuine mental causes of physical effects and are distinct from the physical events that are already independent sufficient causes of the same physical effects. But this horn introduces the problem of overdetermination, which renders all mental causes superfluous. Neither horn of the dilemma can secure the rational embodied control required for scientific experiments detailed by our Taylorian transcendental arguments. That this dilemma faces every major non-Aristotelian position in the philosophy of mind provides one more example of the explanatory superiority of the neo-Aristotelian position over its rivals.[34]

Eighth, following Helen Steward, I distinguish between the *realization* of one-way powers from the *exercise* of two-way powers.[35] A negatively charged electron's one-way power for electromagnetic attraction is *realized* whenever its necessary conditions for manifestation obtain, but an agent empowered with a two-way power exercises its two-way power by $\varphi$-ing or refraining from $\varphi$-ing. When a scientist reenacting the Millikan experiment today intentionally and voluntarily flips a voltage switch in order to alter the movement of ionized oil droplets, she is *exercising* her two-way power for rational embodied control.

Ninth, powers are identified by their manifestations and so a two-way power exercised by an intentional and voluntary action is identified by the details of an accurate philosophical analysis of human action. This is another way of articulating Aristotle's heuristic in *De Anima* II.4 that we know natures by their powers, and powers by their activation or operations, and operations are known by their objects. The neo-Aristotelian approach to this two-way power is therefore significantly different from and arrives at a remarkably different account of human action as an *explanandum* and of its two-way power *explanans* than so-called agent-causation or source incompatibilism theories. The latter two, as their critics point out, are eclectic retreats or revolts (however one sees it) that remain captive to an essentially anti-Aristotelian ontology. When a human performs an intentional and voluntary action, that is, to put it simply, when a human *acts* she does not cause her action, and her action is not an effect

of her as an agent-cause. Rather, following Steward, Alvarez, Hyman, and others, her acting is her causing.

> To act is to cause some kind of change, the agent being the one that causes the change and the patient being the one that undergoes it, the kind of act depending on the kind of change. Agents and patients are individual substances, such as a particular cat or man or stone, or else particular quantities of a kind of material, such as a particular vial of poison or a particular ounce of gold. But "agent" and "patient" do not refer to different kinds of entities, but to complementary roles.[36]

On this neo-Aristotelian account of an agent exercising her two-way causal power for acting or refraining from acting, the disappearance of the agent problem does not even arise. For it is the agent herself that settles what she is doing, not some concatenation of causes happening within her.[37] Accordingly, whenever a scientist exercises her two-way causal power by acting or refraining from acting, she is causing or refraining from causing. And since her causation—like the other manifestations of causal powers—occurs in concert with the activation of reciprocal causal powers, whenever she is acting she is thereby also co-manifesting her exercised two-way causal power with other causal powers. By intentionally flipping the voltage switch on a power supply, she is causing the co-manifestation of coordinated passive causal roles of the movements of her fingers, hand, wrist, arm, and so on, each of which also thereby plays an active causal role in the process of her embodied rationally controlled flipping of the voltage switch. With respect to the voltage switch itself, its passive causal role of being on or off is being actualized by the active causal process of the scientist's embodied rationally controlled flipping of the voltage switch, which enables the switch's active causal role within the chain of active and passive causal roles and powers involving capacitors, inductors, varistors, transformers, and whatever else is employed for charging or discharging the plates within the lower chamber of the Millikan oil-drop experiment.

In sum, the neo-Aristotelian aims to get the correct account of the descriptive and normative features of human action without skipping out on or evading a serious metaphysical explanation of how human actions, as the exercise of causal powers, make a causal difference in reality. Many more ontological details and arguments would be required to outfit this picture properly, but I will turn now to the problem of deviant causal chains and conclude with an explanation for why this neo-Aristotelian causal power theory of human action is not beleaguered by this problem.

### *3.4. The Problem of Deviant Causal Chains*

Let us start with why the problem of deviant causal chains arises for the standard causal theories of human action, often called "the standard

story," a problem that many regard as a decisive objection against it.[38] The standard story holds that intentional actions are events, paradigmatically movements of the agent's body, that are caused in the right way by antecedent mental causes, such as by intentions or other pro-attitudes. We only identify the event of some bodily movement as an "action" because it was caused *in the right way* by its antecedent beliefs and desires. The problem for the standard story is explaining how the antecedent mental events can cause the bodily movements *in the right way* given its commitments to two theses about causation and action. First, there is no logical or categorial connection between the successive events of cause and effect. Second, there is nothing intrinsic or essential to the bodily movements that are actions that distinguish them from mere bodily movements. Given these standard story commitments, all attempts to explain this *in the right way* are open to counterexamples known as deviant causal chains.

Donald Davidson's famous example is that of a climber who desires to remove the dangerous weight of holding a fellow climber on a rope and who also believes that he could loosen his grip on the rope and remove this burdensome load; however, his belief and desire startle him so much that they cause his grip on the rope to be loosened. Clearly this bodily movement is not an intentional action, but since it was caused by the climber's belief and desire (or intentions on other versions), the standard story has no way to distinguish this bodily movement from bodily movements that are actions caused *in the right way*. Davidson admitted his own version of the standard story did not have the resources to meet this deviant causal chains objection, and while there is not a universal consensus, there is widespread agreement that this objection is fatal to the standard story's neo-Humean causal theory of action.[39]

As with the problems of causal overdetermination and the disappearance of the agent, this problem is relevant to the reality of the *abilities* for performing scientific experiments. Consider the difficulties that arise if one endorses the standard causal story as an explanation of such abilities instead of neo-Aristotelian power realism. Given the abject failure of the standard story to answer the deviant causal chains objection, this entails that the standard story fundamentally fails to explain any actions, including the intentional action of performing a scientific experiment. We have established, independently of rival ontological theories of causation, that performing a scientific experiment is an intentional action constituted by rational embodied control. But the standard story cannot distinguish the rational embodied control of actions from mere bodily movements, that is, the standard story cannot distinguish the controlled action of intentionally loosening one's grip on a rope from the uncontrolled bodily movement of one's grip being loosened caused by being startled by one's beliefs and desires or intentions. Consequently, the standard story fails to provide an ontology of causation that can explain how the *ability* to exercise rational embodied control can really make a causal difference

*in the right way* that constitutes the intentional actions of performing scientific experiments.

The problem of deviant causal chains does not even arise for the neo-Aristotelian causal powers explanation of human action. There are many other important points of difference, but I shall stick to three. First, neo-Aristotelianism starts by detailing a fundamentally different notion of action. Actions are intrinsically and essentially distinct from mere bodily movements. This is why, for neo-Aristotelianism, the climber's bodily movements that involved his grip on the rope being loosened by being startled are intrinsically distinct from an intentional action of loosening one's grip on a rope.

Second, as noted earlier, intentional actions are not caused by the agent or its powers, so actions are not effects of some extrinsic prior mental event-cause or agent-cause. Rather, the agent's exercising of his or her two-way power is the agent's manifesting its two-way power, and this manifesting is the agent's acting or causing. As John Hyman argues at length, "To act is to intervene, to make a difference, to make something happen, to cause some kind of change."[40] Consequently, there is no problem here of trying to explain how to get the action caused *in the right way*, since "actions" are not caused. An intentional action itself is a causing; an action consists in an agent's intentionally making a difference or causing some kind of change.

Third, neo-Aristotelians reject both of the aforementioned planks of the standard story. When powers co-manifest, they manifest via different reciprocal active and passive causal roles, and these co-manifestations constitute either one simultaneous event or one unified ongoing process or action-passion interaction among agents and patients. So there is not only a categorial connection between cause and action insofar as intentional acting is itself an intentional causing, but there is also a categorial connection between cause and being caused. And, on one neo-Aristotelian view, an effect simply is the *outcome* of a total nexus of reciprocal powers co-manifesting in their different causal roles as active and passive causes.

Someone might raise the objection that the problem of deviant causal chains has a different form for neo-Aristotelians, insofar as the manifestation of the climber's intention to loosen his grip could startle the climber so much that the manifestation of the power to startle overpowers the climber's intention and thereby becomes the dominating active cause in the loosening of the grip on the rope. This objection, however, misunderstands that actions are intrinsically actions, and insofar the agent's intentions are thwarted or prevented from manifesting, say, by a more powerful startle, then no "human action" occurs or a failed action of trying happens. Accordingly, a neo-Aristotelian powers ontology has a causal explanation for why its account of intentional action is committed to a form of disjunctivism. For "human actions" – like intentionally loosening one's grip on a rope – are individuated by the active-passive

causal constitution of the co-manifestation of reciprocal powers. If the active causal role is not fulfilled by the manifestation of a power for intentional action, then no human action has occurred. Consequently, the "human action" of intentionally loosening one's grip constituted by bodily movements that co-manifest as a passion-action event with the power for intentional action is fundamentally different from the mere "human behavior" of a startled grip being loosened. Since this latter human behavior is constituted by the co-manifestation passion-action event of the powers for bodily movements and being startled by one's thoughts.

A related problem for the standard story is that its exclusive focus on antecedent mental causes as the defining feature of actions[41] "makes it impossible for them to give any account whatever of the most salient differentiating characteristic of action: during the time a person is performing an action he is necessarily in touch with the movements of his body in a certain way."[42] As we have seen, *ongoing* causal control over phenomena is essential for performing scientific experiments, and it is part and parcel of the neo-Aristotelian explanation of activities and processes that they consist of the ongoing co-manifestations of causal powers. But the standard story fails to explain this quotidian feature of action and so also fails as a causal explanation of the ability to perform scientific experiments.

## 4. Concluding Remarks

I have argued, contrary to radical revisionist positions, that the scientific image of humans and the world cannot dispense with the manifest image of humans because our scientific image depends upon human scientists' abilities to perform scientific experiments. I started with a Taylorian transcendental argument that established the abilities to perform scientific experiments are simply instances of the manifest image of the human abilities to exercise rational embodied control over physical phenomena. The manifest image of humans is therefore indispensable to all scientific images of the world and of humans, which depend upon the discoveries and results of scientific experiments. But this transcendental argument does not give us an ontology; that takes another step. I then presented two arguments for why these abilities need to exist in order to fulfill their causal explanatory roles as indispensable to performing scientific experiments. Next I argued that these existing abilities are best explained by a causal powers ontology and showed why power realism does not face such insurmountable problems as overdetermination, disappearance of agents, and deviant causal chains, which confute the standard causal story of human action and elucidate why it cannot provide an ontological explanation of the abilities for rational embodied control.

One final worry concerning fundamentality merits a few concluding remarks. Even if the scientific image must concede that these causal powers

from the manifest image are ontologically indispensable, this chapter's arguments do not preclude the possibility that the scientific image might discover that human agents cannot be fundamental entities within the ontological image of the world. Human agency might be real, but it might only be a derivative mode of being that is ontologically grounded in the fundamental particles of physics.

While the neo-Aristotelian image of humans in the world does not ignore the dependency of human agency and other powerful particulars on basic ontological powers of the physical stuff of the cosmos, it also rejects the ontological thesis that only completely ungrounded entities can be real substances or fundamental entities. Following the Eleatic principle, it regards causation as an ontological guide to the existence of the basic substances and properties of reality, even if all properties are grounded in substances. The arguments of this chapter have shown that the question of what grounds what cannot be answered independently from establishing the *existences* of the *whats*. For all of the indispensable ways fundamental particles make an ontological difference in reality, we could not even discover and establish the existence of these basic bits and bobs as framing features of our scientific image of the world if human scientists did not have the causally efficacious scientific know-how, say, to collide beams of protons together to manifest these fundamental particles and their hidden powers. In short, establishing the existence of the fundamental particles of physics presupposes the existence of the real irreducible and ineliminable center of human agency that can exercise efficacious causal powers over and above whatever happens to be the dispositions of the fundamental particles that scientists cause to co-manifest in their experiments. Hence, even if it could be shown that fundamental particles comprise an ungrounded ground, this ontological image of an ungrounded ground could not exclude the basic irreducible existence and causal efficacy of humans as agents for real change in nature. And this is a scientific and ontological image of humans in the world that is perfectly compatible with the neo-Aristotelian manifest image of humans in the world empowered with the power to perform experiments.

## Notes

I would like to thank Rob C. Koons, Hasok Chang, William M. R. Simpson, Brandon Dahm, and Fr. Thomas Davenport O.P. for helpful feedback, comments, and corrections on earlier drafts of this chapter.

1. Wilfrid Sellars, "Philosophy and the Scientific Image of Man," in *Science, Perception, and Reality* (Ridgeview Publishing Company, 1963), pp. 1–40, p. 39.
2. Exponents of eliminative and reductive physicalism are the primary advocates of the radical replacement of the manifest image by the scientific image of humans. But radical replacement is also entailed by all those versions of nonreductive physicalism, like anomalous monism and realization functionalism, which Jaegwon Kim and others have demonstrated cannot consistently

maintain both physicalism and the real causal efficacy of reasons or rational agency. See Jaegwon Kim, *Physicalism, or Something Near Enough* (Princeton University Press, 2008). For eliminativist and reductionist views, see Daniel Wegner, *The Illusion of Conscious Will*, 2nd ed. (MIT Press, 2018); John Bickle, *Philosophy and Neuroscience: A Ruthlessly Reductive Account* (Kluwer Academic Publishers, 2003), ch. 3; P. S. Churchland, *Brain-Wise* (MIT Press, 2002), ch. 5; Paul Churchland, *Neurophilosophy at Work* (Cambridge University Press, 2007). For a helpful summation and critique of forms of reductionism employed in cognitive neuroscience, see A. Chemero & C. Heyser, "Methodology and Reduction in the Behavioral Neurosciences: Object Exploration as a Case Study," in *The Oxford Handbook of Philosophy and Neuroscience* (Oxford University Press, 2009), pp. 68–90. For detailed critique of reductive accounts of agency, see Erasmus Mayr, *Understanding Human Agency* (Oxford University Press, 2011).

3. Nancy Cartwright, *Nature, the Artful Modeler: Lectures on Laws, Science, How Nature Arranges the World and How We Can Arrange It Better* (Open Court, 2019), ch. 2.
4. Nancy Cartwright, *The Dappled World* (Cambridge University Press, 1999). See also *infra* nn. 23–24.
5. Helen Steward, *A Metaphysics for Freedom* (Oxford University Press, 2012), chs. 2–3.
6. Alasdair MacIntyre, "What Is a Human Body?," in *Tasks of Philosophy* (Cambridge University Press, 2006), pp. 86–103.
7. Charles Taylor, *The Language Animal: The Full Shape of the Human Linguistic Capacity* (Harvard University Press, 2016).
8. B. P. Abbott et al. "Observation of Gravitational Waves From a Binary Black Hole Merger," *Physical Review Letters*, 116.061102 (11 February 2016): 4.
9. Rom Harré, "What Is Real in Psychology: A Plea for Persons," *Theory and Psychology*, 2.2 (1992): 153–158, p. 154. See also, Rom Harré, "New Tools for Philosophy of Chemistry," *HYLE – International Journal for Philosophy of Chemistry*, 20 (2014): 77–91.
10. I must thank Fr. Thomas Davenport, O.P., for his detailed feedback on my presentation of the Millikan experiment, and for drawing my attention to a common discrepancy found in discussions of Millikan experiments. There are scores of online video demonstrations of the "Millikan experiment" that use power supplies with an adjustable voltage dial, but Millikan himself ended up opting for an on-off voltage switch. I shall be describing the experimental apparatus employed by Millikan in his experiment; however, nothing philosophically significant hangs on this.
11. Thomas Kuhn, *Structure of Scientific Revolutions*, 2nd ed. (University of Chicago Press, 1970), p. 27.
12. For an excellent discussion of the Millikan experiment, see Cartwright, *Nature, The Artful Modeler*, ch. 1.
13. See Hilary Putnam, *Representation and Reality* (MIT Press, 1988), p. 60.

> reference and truth are the fundamental notions of *the* fundamental exact science: the science of logic. Why don't the eliminationists speak of "folk logic" as well as of "folk psychology"? I once put just this question to Paul Churchland, and he replied, "I don't know what the successor concept [to the notion of truth – H. P.] will be." This is honest enough! Churchland is aware that the notion of *truth* is in as "bad shape" as the notion of *belief* from his point of view, and accepts the consequence: we must replace the "folk" notion of truth by a more scientific notion. But the innocent reader of Churchland's writings is hardly aware that he is also being asked to reject the classical notion of truth!

Similar objections can be raised against non-eliminativist error-theoretic forms of Humeanism. Stroud reads Hume as a kind of non-eliminativist error theorist wherein all our basic beliefs about causation, for example, are fundamentally mistaken (i.e., error theory), but we can do nothing to avoid having these beliefs about causation in nature (i.e., non-eliminativism); see Barry Stroud, *Hume* (Routledge, 1977), ch. 10 (esp. p. 248). It is worth nothing that others reject this error-theoretic interpretation of Hume; see Helen Beebee, "Hume and the Problem of Causation," in P. Russell (ed.), *The Oxford Handbook of Hume* (Oxford University Press, 2016), ch. 12. For error theory eliminativism on rational control for agents, see Richard Double, *The Non-Reality of Free Will* (Oxford University Press, 1991), ch. 8 and pp. 220–221; Gregg Caruso, "Free Will Eliminativism: Reference, Error, and Phenomenology," *Philosophical Studies*, 172.10 (2015): 2823–2833.

14. Charles Taylor, "The Validity of Transcendental Arguments," *Proceedings of the Aristotelian Society*, 79 (1979): 151–165, p. 165:

> Transcendental arguments thus turn out to be quite paradoxical things. I have been asking here what arguments of this kind prove, and how they prove it. They appear to be rather strange in both these dimensions. They prove something quite strong about the subject of experience and his place in the world; and yet since they are grounded in the nature of experience, there remains an ultimate, ontological question they cannot foreclose – for Kant, that of the things in themselves; for the thesis of embodied agency, the basic explanatory language of human behaviour. When we ask how they prove what they prove, we see another paradoxical mixture. They articulate a grasp of the point of our activity which we cannot but have, and their formulations aspire to self-evidence; and yet they must articulate what is most difficult for us to articulate, and hence are open to endless debate. A valid transcendental argument is indubitable; but it is hard to know when you have one, at least one with an interesting conclusion. But then that seems true of most arguments in philosophy.

15. There are number of reasons for why the manifest image cannot be a ladder we kick away once we arrive at the scientific image. First, because, like the manifest image, the scientific image is asymptotic ideal of finite human enquiries. Second, if the ladder metaphor is taken in an eliminativist way, then there is the *onus* of establishing that there is an eliminativist scientific image at the other end of the ladder, for example, like some radically revised and more explanatory notion of truth. So far, no plausible proposals even exist. If the metaphor is taken in a reductionist way, then the ladder is not really *kicked away*, unless some further argument can show why the manifest image is wholly or partially falsified and needs to be replaced. This is because most forms of inter-theoretic reduction involve theoretical take over, not the falsification of the less explanatory theory. But again, so far, even these reductionist proposals are mere explanatory promissory notes, that is, reductionist theorists' pipe dreams based on a positivist naturalism's *faith* in some scientific explanatory eschaton.

    The more fundamental problem is the fact that the manifest image is itself not a theory, even if theorists often confuse their own theories about commonsense, manifest images, or folk psychology, for what folk in fact think. So the very suggestion of theoretical reduction is out of place without some radically revised notion of reductionism that can overcome the cogent arguments of Wittgensteinians, Heidegger, Michael Polanyi, Charles Taylor, and Alasdair MacIntyre that no such theory, folk or otherwise, can be given that exhaustively thematizes our embodied coping and everyday tacit practices.

In short, the kicked away ladder promissory note has enormous explanatory burdens it has not faced. I thank Hasok Chang for raising this objection.

16. Jonathan Schaffer, "On What Grounds What," in David Manley, David J. Chalmers & Ryan Wasserman (eds.), *Metametaphysics: New Essays on the Foundations of Ontology* (Oxford University Press, 2009), pp. 347–383.
17. William Jaworski, *Structure and the Metaphysics of Mind* (Oxford University Press, 2016), p. 19.
18. Jaworski, *Structure and the Metaphysics of Mind*, pp. 29–32.
19. David Velleman, "What Happens When Someone Acts?," *Mind* 101 (1992): 461–481, p. 461. Velleman distinguishes the action theory problem of the disappearing agent from the mental causation mind-body problem, p. 469. See also Jennifer Hornsby, "Agency and Actions," *Royal Institute of Philosophy Supplement*, *55* (2004): 1–23; Steward, *A Metaphysics for Freedom*; Derk Pereboom, *Free Will, Agency, and Meaning in Life* (Oxford University Press, 2014).
20. Pereboom, *Free Will, Agency, and Meaning in Life*, p. 69.
21. Tim Crane and D. H. Mellor, "There Is No Question of Physicalism," *Mind*, 99.394 (1990): 185–206; Carl Hempel, "Reduction: Ontological and Linguistic Facets," in S. Morgenbesser et al. (eds.), *Essays in Honor of Ernest Nagel* (St Martin's Press, 1969), pp. 189–207; Robert C. Koons and George Bealer (ed.), *The Waning of Materialism* (Oxford University Press, 2010).
22. For arguments that only an active being could acquire causal concepts, see G. H. von Wright, *Causality and Determinism* (Columbia University Press, 1974), p. 52; P. M. S. Hacker, *Human Nature: The Categorial Framework* (Blackwell, 2007), ch. 3; S. Mumford & R. L. Anjum, *Getting Causes From Powers* (Oxford University Press, 2011), ch. 9.
23. For some of the relevant literature, see R. L. Anjum & S. Mumford, *What Tends to Be: The Philosophy of Dispositional Modality* (Routledge, 2018); Cartwright, *The Dappled World*; Travis Dumsday, *Dispositionalism and the Metaphysics of Science* (Cambridge University Press, 2019); Brian Ellis, *Scientific Essentialism* (Cambridge University Press, 2001); S. French, A., Bird, B. Ellis, S. Mumford, & S. Psillos, "Looking for Laws," *Metascience*, 15 (2006): 437–469; R. Groff & J. Greco, *Powers and Capacities in Philosophy: The New Aristotelianism* (Routledge, 2013); Jonathan Jacobs, *Causal Powers* (Oxford University Press, 2017); Anna Marmodoro (ed.), *The Metaphysics of Powers: Their Grounding and Their Manifestations* (Routledge, 2010).
24. Anna Marmodoro, "Aristotelian Powers at Work: Reciprocity Without Symmetry in Causation," in Jacobs (ed.), *Causal Powers*; C. B. Martin, *The Mind in Nature* (Oxford University Press, 2008); Mumford & Anjum, *Getting Causes From Powers*; Jaworski, *Structure and the Metaphysics of Mind*.
25. Marmodoro, "Aristotelian Powers at Work," p. 71.
26. Steward, *Metaphysics for Freedom*, ch. 3.
27. Marmodoro, "Aristotelian Powers at Work," pp. 72–75.
28. Marmodoro, "Aristotelian Powers at Work."
29. On the interrelatedness of both agents and events for causation, see Steward, *Metaphysics for Freedom*, ch. 8; Hacker, *Human Nature*, ch. 3; Erasmus Mayr, *Understanding Human Agency* (Oxford University Press, 2011), chs. 8–9; John Hyman, *Action, Knowledge, and Will* (Oxford University Press, 2015), chs. 2–3.
30. For an extensive summary of the argumentative case against such reductive simple, causal, and Lewis's reformed conditional analyses of powers, see Mayr, *Understanding Human Agency*, chs. 6–7, see also the references in *supra* nn. 23–24.

31. See references in nn. 23–24 and Stephen Mumford, "Laws and Their Exceptions," in Walter Ott & Lydia Patton (eds.), *Laws of Nature* (Oxford University Press, 2018), ch. 11.
32. See Nancy Cartwright & Pedro Merlussi, "Are Laws of Nature Consistent With Contingency?," in Ott & Patton (eds.), *Laws of Nature*, ch. 12, pp. 239–243.
33. Jaegwon Kim, "Mechanism, Purpose, and Explanatory Exclusion," *Philosophical Perspectives* 3 (1989): 77–108, p. 79. I thank Rob C. Koons for urging me to clarify my view on this problem.
34. On the hard problem of content against naturalized epistemology see Daniel D. Hutto & Erik Myin, *Radicalizing Enactivism: Basic Minds Without Content* (MIT Press, 2016). On the problem of overdetermination, see Kim, "Mechanism, Purpose, and Explanatory Exclusion"; Jaworski, *Structure and the Metaphysics of Mind*.
35. Steward, *A Metaphysics for Freedom*, pp. 155–156. On two-way powers, see also Anthony Kenny, *Will, Freedom and Power* (Blackwell, 1975); Maria Alvarez, "Agency and Two-Way Powers," *Proceedings of the Aristotelian Society. New Series*, 113 (2013): 101–121; Hacker, *Human Nature*, chs. 3–7; Mayr, *Understanding Human Agency*.
36. Hyman, *Action, Knowledge, Will*, p. 42.
37. See Steward, *A Metaphysics for Freedom*, pp. 62–66.
38. See Mayr, *Understanding Human Agency*, ch. 5; Steward, *A Metaphysics for Freedom*, pp. 55–69.
39. Donald Davidson, "Freedom to Act," in *Essays on Actions and Events*, 2nd ed. (Oxford University Press, 2001), p. 79. For a helpful comparison of Davidson's and other versions of the standard story with Anscombe's rival account of action, see Frederick Stoutland, "Introduction: Anscombe's *Intention* in Context," in Anton Ford, Jennifer Hornsby, & Frederick Stoutland (eds.), *Essays on Anscombe's Intention* (Harvard University Press, 2011), pp. 1–22.
40. Hyman, *Action, Knowledge, Will*, p. 33.
41. Steward has demonstrated that this focus on the necessity of mental antecedents to action is itself problematic; see Steward, *A Metaphysics for Freedom*, pp. 66–69.
42. Harry G. Frankfurt, "The Problem of Action," *American Philosophical Quarterly* 15.2 (1978): 157–162, p. 158.