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Einstein in Athens

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Why Aristotle, why now, and why in the one area of study where his thought has been most vociferously rejected—why in science? These questions hover over the new essay collection *Neo-Aristotelian Perspectives on Contemporary Science.* The editors anticipate a negative reception, acknowledging in the introduction that "for the philosopher or scientist who has yet to explore this burgeoning branch of contemporary philosophy, the existence of such anthologies as this one may at first seem surprising (or even perverse)." In the foreword, Thomist philosopher John Haldane wonders if the book is not like "exploring astrological perspectives on astronomy."

They are right to suspect suspicion. Aristotle occupies a unique place in our modern consciousness. His thought, especially his elevation of teleology—a way of explaining things in terms of purposes and ends—was used as a foil by the founders of the modern scientific project. As the founders' thought has been passed down to us—third-hand, fourth-hand, and eventually as folklore—Aristotle has become a caricature, a bogeyman, a naïve denizen of the demon-haunted world. Of course, an old astrologer could be simply forgotten. But the modern scientific project defined itself in opposition to Aristotle; his mortification is its cornerstone.

> *Neo-Aristotelian Perspectives on Contemporary Science*
> By William M. R. Simpson, Robert C. Koons, and Nicholas J. Teh (eds.)
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Perhaps for this reason, the authors write conservatively, with the essays structured around rather narrow questions relating to the many theories, sub-fields, and -isms in philosophy of science. However, despite the collection's academic veneer, it's easy to see the great ambitions that lie just below the surface. According to the collection's editors—philosophers William M. R. Simpson of the University of St. Andrews (Scotland), Robert Koons of the University of Texas at Austin, and Nicholas Teh of the University of Notre Dame—a core tenet of "neo-Aristotelianism" is that the causes of natural motion are "powers" that are inherent in particular beings. "Beings" here can mean ordinary objects or "things," but living organisms are the prime example of beings for both Aristotelians and neo-Aristotelians.

The ascription of powers to individual beings is a radical rejection of modern physics, which locates causality in fundamental forces and fundamental particles. Physics sees individual beings, the things of the world around us, as like eddies in a river, arising from underlying immutable causes and only *appearing* to have a persistent being of their own. What permits these neo-Aristotelians to turn against this doctrine, which has been responsible for so much scientific and technical progress in the modern world?

The answer is that the last century of science has partially recapitulated Aristotle's teachings on nature, for the most part unwittingly. Since roughly the turn of the twentieth century, the scientific enterprise has focused not only on the elemental, but increasingly also on large-scale phenomena: solids, fluids, organisms, ecosystems, human behavior, and computing machines. Scientists have often maintained that these systems cannot be understood solely in terms of action at the lowest levels of organization. Thus one hears of "systems theory" or "the theory of complex systems," of "holism," "irreducibility," "downward causation," "information theory," and other musings from scientists that assert, to quote the physicist Philip Anderson, that "more is different"—that "the ability to reduce everything to simple fundamental laws does not imply the ability to start from those laws and reconstruct the universe."

These challenges have unknowingly echoed Aristotle. For Aristotle's science was concerned primarily with the difficulties that arise when we try to discern the causes of beings, of *wholes*. A return to his ideas, then, is no mere conceit of the fusty halls of academic philosophy, but a clamor coming from science itself. Seen in this light, the claims in *Neo-Aristotelian Perspectives on Contemporary Science* do not seem quite so radical. Indeed, one could claim that the authors are attempting to make more explicit what many scientists have been dancing around for a century.

That this trend, and especially its connection to Aristotle, has gone largely unrecognized by scientists is due to several factors. First, science and the philosophy of science have become increasingly departmentalized and siloed, not only from each other but even within disciplines. Second, fewer and fewer students are engaging in any meaningful way with historical texts. Third, practicing scientists are facing increasing demands to turn out original research that attracts funding, leaving little time to reflect on perennial questions about nature. And so scientists return again and again to the same Aristotelian themes—parts, wholes, causes, purposes—reinventing the wheel without gaining traction on the critical question over causality.

Unfortunately, *Neo-Aristotelian Perspectives* is unlikely to help the scientific community resolve this question for itself. The book is written by and for philosophers of science. The essays are well-argued and often thought-provoking. But the authors' otherwise laudable humility, coupled with their academic language and jargon, make it hard for the non-expert to connect with their arguments. And most importantly, they do not engage enough with Aristotle himself—but Aristotle, perhaps more than any other philosopher since, saw what was at stake in the difficulties in which natural science perpetually finds itself. We may benefit, then, from exploring the book in light of Aristotle himself, as well as the broader themes of Greek natural science, in order to see why Aristotle's teachings perennially recur in modern science.

The most important thing to unlearn about Aristotle is that he was not "pre-scientific," as we have come to believe since the early moderns rejected him. A return to Aristotle does not then imply an attack on science. Rather, it entails a revitalization of the once lively debates within Greek natural philosophy, a return to the nourishing roots from which the modern scientific enterprise sprung, even if it often defined itself in opposition to them.

Aristotle was himself a latecomer among the Greek naturalists, and his teachings on nature almost always begin as a response to others who came before him. Among these thinkers were atomists and materialists, who believed the world was ruled by either chance or necessity, or some of both—in short, adherents to ideas that closely resemble those that dominate modern science. When read correctly, Aristotle can therefore seem fresh, even contemporary, and a number of recent authors—for example James Lennox, Richard Hassing, and Allan Gotthelf—have begun to revivify his teaching for modern audiences. Others, such as David Bolotin and Christopher Bruell, have published in-depth studies of Aristotle's books on nature to recover parts of his teachings that had been overlooked for millennia. This scholarship is too large and complex to explore here, but we can bring out a few themes that show how directly Aristotle's teaching on nature speaks to contemporary science. To do so, we must first turn to Aristotle's predecessors—usually called the "pre-Socratics" because they came before Socrates—so that we can understand Aristotle's rejection of them.

Aristotle was not pre-scientific, but the cultural place of science in his time differed radically from ours. Greek society as a whole *was* pre-scientific, at least in the sense that most Greeks did not believe that there was such a thing as nature understood as a discrete and knowable realm. For the average Greek, the world was inscrutable and chaotic, to be viewed only dimly through the works of poets like Hesiod, whose story of the world's origin was called *Theogony*, "genesis of gods." Gods did not represent, as we moderns often presumptuously claim, an alternative means of explaining the world, but rather signified man's inability to do so: In the *Theogony*, the first thing to come into being, the source of all that comes after, is Chaos.

But there were also philosophical schools who argued that the cosmos had an origin that was accessible to reason, to science. This understanding of nature-as-rational-origin can be seen in the fact that the words for nature in both Latin (*natura*) and Greek (*physis*) mean not only "the way things are" but also "birth." Only the former sense, of being-in-fact, is still with us today, however, reflecting our tacit acceptance of an intelligible nature and relative agnosticism toward particular accounts of its coming into being. If the theories of the Big Bang, quantum foam, or evolutionary biology are overturned, we will not be overly troubled, because our acceptance of the existence of nature does not rest on our particular theories about the origins of things. Our confidence in the existence of a knowable nature permits the easygoing stroll through different theories of causation that we see in *Neo-Aristotelian Perspectives*, but this attitude does not do justice to the sense of urgency with which the Greeks approached these questions.

For the Greek philosophical schools, uncertainty about the becoming of the world meant an uncertainty about the status of nature itself, and that left the door open to Hesiod's Chaos. This uncertainty, and what it meant about how one should lead one's life, was of more than theoretical concern. These philosophers, especially those who openly contemplated the sun and investigated the things beneath the earth, were generally viewed with suspicion by their fellow citizens. Socrates' execution for impiety is only the most famous example of persecution. It was a matter of some significance what one taught about the world.

Socrates famously turned away from natural science, which he was enamored with in his youth. Dustin Sebell's 2016 book *The Socratic Turn: Knowledge of Good and Evil in an Age of Science* shows how this turn was driven by Socrates' concerns over the feasibility of natural science. In the *Phaedo*, Plato depicts Socrates explaining to his interlocutor how, as a young man, he "thought it splendid to know the causes of everything, why it comes to be, why it perishes and why it exists." But by asking precisely these sorts of questions, Socrates explains, he became "blind" to things he previously thought were obvious, such as how beings come to be from constituent parts—for instance, how men grow by eating and drinking.

His confusion grew to such an extent that now he will not even permit himself to say that he knows how "two" is created by the addition of one thing to another. Such childish examples are perplexing, even aggravating to the modern reader, but are far from trivial.

All scientists confront the same types of questions in their particular fields: Is there a discrete break or jump from parts to wholes? How can one be many, or many become one? Can we account entirely for a being by the actions of its constituent parts? Is more different? Evolutionary biologists, for instance, debate whether species are real, discrete entities or just ephemeral aggregates of individuals. Socrates' playful way of stating these problems is all the more provocative for its simplicity, but it also points toward his solution. The appalled reader will say, as Socrates' contemporary accusers did, that he is playing with words or that the argument is merely semantic, as if the meaning of words is unimportant to knowledge. But that is Socrates' strength. He sought to "investigate the truth of things by means of words," hence the characteristic Socratic questions, "what is justice?" "what is virtue?" and so forth. His provocative word play is a stress test for the linguistic toolkit that we rely on for all our rational investigations, even, or especially, into nature.

There is continuity between Socrates, his student Plato, and Plato's student Aristotle. But unlike Socrates and Plato, Aristotle left to posterity a hefty corpus on natural science. In his writings on nature, Aristotle, like Socrates, engages the natural scientists that came before him on their failure to account for the arrangement of the world as it is, for beings as we commonly understand them. And because there is a striking overlap between the pre-Socratic accounts of nature and the science of today, this confrontation is as relevant now as it was then.

Today, we have not one but two physics. Most people who are familiar with popular science are aware of the inability of physicists to reconcile quantum theory with the theory of relativity. Aristotle similarly divided the pre-Socratics into two schools, which strikingly resemble the two sides of today's tension. The first section of *Neo-Aristotelian Perspectives*, "The Philosophy of Physics," echoes Aristotle's critiques of the two schools—though the authors do not mention, and are perhaps unaware of the parallel—and updates the critiques to apply to modern physical theories. The second section of the book, "The Philosophy of the Life Sciences," then goes on to explore biology from an Aristotelian perspective. We will look at each of these parts in turn.

The pre-Socratic philosopher whose teaching resembles general relativity was Parmenides. Aristotle's works on nature give special attention to Parmenides and his followers, the Eleatics. The Eleatics taught that there is only one being, the Whole, and that it is immobile. All independent components of the Whole—all things and their movements—are just appearances.

Edward Feser, in his contribution to *Neo-Aristotelian Perspectives*, draws a parallel between this teaching and the idea of the "block universe," which is based on the theories of Einstein and his teacher Hermann Minkowski. The block-universe concept holds that we must understand time as a fourth dimension tied up with the three dimensions of space, so that the universe is like a four-dimensional block that contains all of space and time—past, present, and future. Minkowski would refer to this four-dimensional block as "world," because the mathematical formulation suggested that all of time is already established, just like space. Our common-sense notion that space is static, allowing us to move around within it, whereas time "flows," taking us along with it, is illusory. Just as the universe doesn't have an "up" or "down," so likewise there is no past or future, except in the sense that it seems that way to us. Much like for Parmenides there is only the Whole, for Minkowski and Einstein there is only the "world."

Feser's critique of the "block universe" borrows key moves from Aristotle's responses to Parmenides, though because he does not explicitly engage with them, it is unclear to what extent he is aware of the borrowing. In the beginning of the *Physics*, Aristotle explicitly distinguishes Parmenides and his disciple Melissus from other thinkers whom he calls "students of nature" (*physiologoi*). Parmenides and Melissus were not students of nature, according to Aristotle, because they denied motion, relegating it to mere appearance: "To investigate whether Being is one and motionless is not a contribution to the science of Nature." The teaching that change is an illusion is not a teaching on nature, according to Aristotle, because it does not explore the origins or birth of things. Aristotle says he sees no requirement to engage seriously with this teaching in the *Physics* (remember, *physis* means both "nature" and "birth"), just as the geometer is not required to engage with those who reject his premises. (As we shall see, Aristotle nonetheless does briefly engage with Parmenides later in the *Physics*.)

Feser's essay is constructed as a series of ducks and dodges that allow the Aristotelian idea of change or motion to survive the various challenges of the block universe's severe determinism, in which the future is already fixed. It isn't until the end of the essay that Feser hits on the most forceful point, the one that most closely resembles Aristotle: Even if the universe is really a four-dimensional block, "there would be nothing about its nature that requires that a block universe of precisely that sort, or any block universe at all for that matter, exists." Just as Parmenides' denial of motion is not an explanation of the origins of things, so the block universe is not an explanation of why we have *this* universe rather than some other one. The theory that explains the universe as a whole cannot explain the particulars. But note how Aristotle's original critique is more forceful than Feser's: Those who do not examine coming-into-being, and thereby fail to explain the world as it is, do not examine nature.

This should be a sobering call to today's scientists, for Parmenides' reasoning was sound in many respects, and our thinking today strongly resembles his. Like all Greek philosophers, Parmenides believed that something cannot come to be from nothing, and likewise, being cannot be destroyed. For Parmenides, it followed that things cannot come into being at all, for that would require either that something come from nothing, or that something come from something else that already is, thereby destroying it. Thus, beings and becoming are impossible, and the only being is the Whole.

If this sounds hopelessly arcane, keep in mind that there is a modern version of this idea: the conservation of energy. Energy—and, interchangeably, matter—cannot be created or destroyed, so all things, all *particular* things, are just rearrangements of what is already there. What's permanent is the whole of energy and matter, whereas things and the coming to be of things are mere permutations. We, like Parmenides, don't give things or the coming to be of things first-class status in modern science.

Is Aristotle then able to offer a positive account of change to replace Parmenides' rejection of it? Aristotle does put forward a theory in the *Physics* that he claims can overcome the problem of Parmenides. Although nothing comes into being from non-being *simply*, things do come to be from their privation—light from dark, doctor from non-doctor. Aristotle also offers another way to solve the difficulty. This is his much better known theory of *actuality* and *potentiality*. Things do not come to be from their privation, but rather become actual from what already existed potentially, such as oaks coming from acorns.

Aristotle, however, leaves us with an ambiguity. His teaching of actuality and potentiality is commonly taken to be a doctrine. (Edward Feser, for one, takes it this way—his essay aims to defend it, and deploys it against the block universe.) Yet Aristotle's writing here is cryptic. He claims, when offering his account of privation, that the difficulties raised by Parmenides can be solved in "this way alone." But he then turns around and offers the account of actuality and potentiality. So is there one way to dispense with Parmenides' difficulties, or two?

Despite the fame of the actuality and potentiality theory, my own interpretation is that Aristotle really did believe that the account of becoming from privation was the *only* way to solve the problems posed by Parmenides. This is because privation can answer the perplexity of becoming from non-being, whereas actuality and potentiality cannot. Yet, while privation can answer Parmenides, it still cannot offer a satisfying account of change, because it means that anything can come to be from anything other than itself: A dog could come to be from a horse. Actuality and potentiality solve this latter problem, but only for the case of something coming from something else, most notably for a living thing coming from a seed or embryo. Potentiality does not tell us how something can come from nothing, and thus does not tell us how the *first* things came to be.

This question of the origins of first things sets up much of Aristotle's following work in the *Physics*, but rather than take this up, we should instead note the implications for his confrontation with Parmenides. With his bizarrely weak formulation of becoming from privation, Aristotle concedes a great deal to Parmenides. Surely an idea like "non-doctor" cannot be a true principle of natural change? Surely Aristotle is engaging in word games here? If my interpretation is right, Aristotle's concession is not only to Parmenides, but to his intellectual grandfather, Socrates. By re-casting Parmenides' problem in terms of semantics, Aristotle reveals our deep ignorance about the first origins of the cosmos.

Indeed, if these theories seem inadequate to you as a science of natural motion, you're in good company. Aristotle's account of actuality and potentiality was ridiculed by early modern scientists like Francis Bacon, and we have been laughing at it ever since. Thus, even if we cannot simply accept Parmenides' austere determinism, it is not so easy to offer an account of change that replaces it. When a close friend passed away, Einstein, a month before his own death, wrote to the family saying, "For people like us who believe in physics, the separation between past, present, and future has only the importance of an admittedly tenacious illusion." If this would not wholly comfort you in your bereavement, it is enough to say that—as I believe Aristotle himself obliquely aimed to show—we remain in search of a satisfying account of the coming to be and passing away of things.

Relativity, with its block universe, is only one of our two physics. Perhaps the other physics, that of quantum particles and their properties, might be able to give us an account of particular things.

Quantum mechanics arose out of the materialist program, the quest to explain the world through fundamental particles and forces. Just as we found an ancient correlate to Einstein and Minkowski in Parmenides, so we can find a correlate to the modern particle theorists in the materialist schools of Greek natural philosophy. Aristotle affirms that these schools are "students of nature" because they, unlike Parmenides and the Eleatics, did try to account for motion and particular beings, rather than abolish them.

The materialists located the rational basis for all things in the unchanging properties of elements. Then as now, they taught that each element has a finite set of powers or forces, and that the interactions between complementary forces, similar to our positive and negative electrical charges, are the basis of motion. And, then as now, they got hung up on how to bridge from these fundamental things to the everyday things as we know them.

Their attempts can sound eerily familiar. Empedocles, for instance, taught that the fundamental forces were Love and Strife. Before the species existed as we know them today, from a mysterious mixing of Love and Strife the parts of animals came together in all sorts of chance configurations. Over time, the non-advantageous combinations, like cattle with the heads of men, died out, creating the world as we know it. The resemblance to Darwin is unmistakable.

Just as we do today, Empedocles felt it necessary to mix determinism (the account of Love and Strife) with chance (the coming together of animal parts). Today, nearly every scientific discipline relies on chance, on statistics, to leap the divide from the fundamental forces and particles to the higher-order phenomena of systems—organisms, ecosystems, human behavior.

But most scientists do not believe that the probabilistic components of their models speak to the way things really are. Rather, these models are thought to capture aggregate behavior that is so complex that it seems random. All the water molecules in a water balloon, for instance, move according to deterministic laws, but to understand pressure, it is enough to describe the molecules' aggregate motion statistically.

The question of whether chance is present in reality, or only in our models of it, is nowhere more acute than in quantum mechanics. Briefly put, quantum theory offers a probabilistic account of how fundamental particles behave. For example, it describes a particle's motion by modeling a distribution of possible paths it may take, rather than a single, deterministic path it will take. The question this raises is how these multiple possible paths become the single path we actually observe.

The most intuitive explanation, at least from a classical view, is that—like the statistical model of water molecules in a balloon—the probabilistic account of a particle's path does not describe how the world really is, but is only an approximation for some underlying process whose mechanics are not directly observable. As in most scientific disciplines, when we speak of chance, we mean uncertainty on the part of the observer, not a foundational principle of motion.

The famous exception to this pragmatic view of chance is the Copenhagen interpretation, which says that the indeterminism found in quantum equations is a real, fundamental property of matter. But what *is* this indeterminate state? It is not, as is sometimes alleged in the copious popular literature, a kind of *randomness.* It is not Chaos, in Hesiod's sense. Remarkably, Werner Heisenberg identifies this indeterminate state with Aristotle's doctrine of potentiality, calling it "a quantitative version of the old concept of 'potentia' in Aristotelian philosophy." Heisenberg was keenly aware of the philosophical difficulties we have been discussing all along. As a good student of nature, he sought a rational explanation of the world as we find it. Refusing, as Parmenides did, to deny coming-into-being, he instead had recourse to potentiality, and thus to teleology, when trying to explain how the observable world arises from quantum phenomena.

Many thinkers since Heisenberg have attempted to negotiate a path from fundamental to everyday things without invoking either chance or teleology. Theorists have floated ideas like "emergence," "self-assembly," and "strange loops," but none has really coalesced into a science—and they cannot avoid the odor of metaphysics. Some have openly courted this impression. Jakob von Uexküll, with his talk of "biosemiotics," and Jan Smuts, with "holism," were among the most interesting.

The only field where such spookyness is entirely respectable is computer science. The conflation of computers with living things, a commonplace in the discipline, can seem profound—the first face painted on a cave wall must have seemed profound as well—and all the more so due to our companionship with these uncanny machines. The sense that computing machines can seem alive while clearly being mechanical led the biologist Ernst Mayr to claim that animals "act purposefully because they have been programmed to do so," as if this somehow helps us to avoid teleology. One might ask: programmed by whom?

The work of Alan Turing, which inspired these analogies, does not license the frivolous application of computing terminology to questions of causation. He showed that software, not hardware, not *material*, was the important component of computing machines. His understated writings are powerful precisely because of their insistence on the radical unimportance of matter. In doing so, he perhaps unknowingly pointed back to the fundamental problem that we and the Greek materialists struggle with. If beings are not wholly constrained by the material of which they are composed, then what *does* constrain them?

In their contributions to *Neo-Aristotelian Perspectives*, Robert Koons and Alexander Pruss take up this question by looking at the "many worlds" theory, which offers a radical answer to how we get from quantum chaos to the definite things of the world as we see it. In order to explain how the multiple possible paths of a traveling particle become the single actual path we observe, "many worlds" claims that the particle actually does traverse every possible path—but in separate, parallel universes, of which we inhabit only one.

The problems with this view are directly analogous to those caused by the block universe. The many-worlds theory doesn't help us much with *this* world. As Koons says, "any consistent story of the world (no matter how fantastic) would count as equally *real*."

Koons then makes a radical claim worthy of Aristotle: that we can use the doctrine of natural beings and their forms to constrain the profusion of possible quantum worlds. We must "open up the possibility," says Koons, that not only fundamental forces but organisms and whole things "are also *ontologically fundamental*," that they are "dependent on" but not "fully explainable in terms of" elemental things. Beings are not eddies in a river of quanta, but have co-equal status as objects of the sciences. Their inherent powers constrain the quantum profusion of worlds. If this sounds incredible, note that the Copenhagen interpretation makes a similar claim: It says that what causes the myriad possible paths of the particle to "collapse," or actualize, into a single path is an act of measurement—an observer.

But Koons does not leave it there. He acknowledges that if whole objects exert power over quantum phenomena, "it will be hard to resist the temptation to move still farther away from" the many-worlds theory. Why posit fundamental indeterminacy at all if the objects of the universe have causal powers of their own?

The claim that the things of the everyday world are as fundamental as elementary particles seems incredible today—yet it is precisely what appeals to us about theories like "emergence," "cybernetics," "self-organization," "top-down causation," and so on. Each purports to give a scientific grounding for our intuition that the things we experience around us—most importantly ourselves—are beings in their own right. Aristotle was the first and still greatest scientist to posit such a theory. The contributors to *Neo-Aristotelian Perspectives* do not do full justice to Aristotle's teaching on this matter, though of course that is not the goal of the book. And his teaching is difficult, resting on notions like "form" and "teleology" that are anathema today. But the book points us in the right direction by insisting throughout multiple essays that Aristotle's elevation of biology as a fundamental science is correct and valuable, and worthy of study.

The essay by David S. Oderberg comes closest to describing why this is. Biology, of all the sciences, shows why we need the idea of form—and of teleology, which is explained less well in the book. Form, says Oderberg, "is what we *must* have if unity is to be explained." Form in this context means the look of a thing, but also the more substantial concept that distinguishes, for instance, one species from another. Just as we can explain a great deal about a living thing by what species it belongs to, so Aristotle classified form as a fundamental mode of causality. The other three causes were the material, the originating source of motion, and the end or purpose of a thing. So just as physicists found that they needed the concept of matter as an explanatory vehicle, so biologists found form to be essential—even if neither can be said to have discovered the existence of these things, simply speaking.

Indeed, Aristotle's doctrine of the four causes is still taught in undergraduate and graduate curricula on evolutionary biology and animal behavior, but students typically know them as Nikolaas Tinbergen's four questions. Some scientists—Colin Pittendrigh, Ernst Mayr, Jacques Monod, among others—have used the term "teleonomy" to describe an organism's purpose or function while avoiding the baggage that comes with Aristotle's "teleology," even though they're really the same thing.

Oderberg's essay is helpful because it captures something of the mental inversion that Aristotle achieves in his works. Perhaps what we mean by "matter" is just that which is necessary for the things of the world to be. Perhaps what we mean by "chance" is that which impinges on the purposeful motions of natural beings. In this sense, beings, things, have precedence over the concepts of natural science. Aristotle shows that material and chance can only be understood in light of particular beings with purposes. This arrangement helps to explain why modern scientific theories are proliferating rather than consolidating. We are explaining more and more of the world, not with theories of everything but with theories of each kind of thing.

Nancy Cartwright referred to this trend as "the dappled world," the title of her 1999 book: "the claims to knowledge we can defend by our impressive scientific successes do not argue for a unified world of universal order, but rather for a dappled world of mottled objects." The contribution to *Neo-Aristotelian Perspectives* from Xavi Lanao and Nicholas Teh is a defense of Cartwright, but they, like all contributors to this collection of essays, may have been better served by focusing on Aristotle himself. A "dappled world of mottled objects" sounds lovely, so why are we not content to sit back and enjoy the manyness of the world? Aristotle gives us a pithy, and terrifying, explanation: Some people may be blind to the type of thing that is "known through itself," blind to beings, and thus content to explain, or explain away, the most manifest objects with meaningless abstractions.

In 1947, Einstein told a *New Yorker* interviewer, "How can an educated person stay away from the Greeks? I have always been far more interested in them than in science." But the Greeks can illuminate science as well. Their insistence that science should be a rational account of the origins of things, of the world as it actually is, stands up well in our current moment, in which the promise of grand theories of everything leaves us poised to deny the existence of the things that surround us and motivate our passion for a rational account in the first place. We would do well to read them, and re-read them.

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