

## Two Dogmas of Rationalism

Rationalism and empiricism were both inspired by the scientific revolution—but with different emphases. Empiricists were most impressed by the new experimental method: the idea that all scientific results are ultimately supported by observation (via “the senses”). Rationalists, by contrast, were more impressed by the mathematical form of those results—hence, their amenability to formal constructions, derivations, and proofs.

What follows is an attempt to expose two covert “dogmas”—tendentious yet invisible assumptions—that underlie rationalist thought, both modern and contemporary. Though neither term is perfect, I will call these assumptions *positivism* and *cognitivism*. For historical continuity, my focus will remain on science.

### 1. Positivism

As I intend the term, positivism is a metaphysical assumption—a view about the essential structure of the world as such. Picturesquely, it is the view that reality is “exhausted” by the facts—that is, by the true propositions. (Note that ‘positive’ and ‘propose’ stem from the same root.) Thus, an elegantly austere expression of positivism is the opening line of Wittgenstein’s *Tractatus*: “The world is everything that is the case.”

Now, this needn’t mean that there are no things, properties, or relations, but only that these are intelligible only as constituents of true propositions. Things-bearing-properties and things-standing-in-relations just *are* facts—the facts that  $F(a)$ ,  $R(a,b)$ , and so on. In the same spirit, but the formal mode: if to be is to be the value of a bound variable, then to be is to be an argument for which the value of some propositional function is ‘true’.

Clearly, if this equation is intended as an essential conception of the world, then it requires an independent understanding of propositions. That understanding is invariably discursive: a proposition is something that could (in principle) be said—that is, articulately “pro-posed” or “put forward” by somebody as the content of an explicit claim. And that articulability, in turn, is cashed out in terms of finitely specifiable interpreted formal systems—of which natural languages are approximations, and the symbolic notations of mathematics and logic are exemplars.

The germ of this idea goes back to the dawn of modern science and rationalism. Thus Galileo said already in 1623:

Philosophy [that is, physics] is written in that great book, the universe, which is always open, right before our eyes. But one cannot understand this book without first learning to understand the language and to know the characters in which it is written. It is written in the language of mathematics, and the characters are circles, triangles, and other figures. (*Il Saggiatore*, §6)

It isn't the "book" image *per se* that's significant here, but how Galileo intends it. For astrologers and alchemists had long undertaken to decypher the "book of nature"—by which they meant finding and decoding covert signs and hidden messages about other things that they were independently interested in.

Galileo, by contrast, is not looking for meaning in the world, but rather for the world's own intrinsic structure—not just in space, but also in time. Thus, he achieved an unprecedented abstraction in allowing the length of a line to represent elapsed time, the slope of another line to represent rate of acceleration, the area of the enclosed triangle to represent distance traversed, and then being able to prove, geometrically, a general relation among them. That's the point of saying that the universe *itself* is an open book, written in the language of mathematics (geometry).

But, though Galileo spoke of a "language", and achieved an important innovation in abstract representation, he did not have our conception of a formal system, with syntactical rules and arbitrary symbol types. Thus, if you systematically permute his "characters"—lines, circles, and triangles, say—the constructions won't work.

So it was more nearly Descartes who could first understand and defend positivism. For he showed that a symbolic formalism—algebra—could express "analytically" (formally) the axioms, theorems, and proofs of traditional geometry. Therefore, his doctrine that the essence of the real world is extension amounts to the claim that reality as such is formally describable in principle. And that, close enough, is the idea that later became dogmatic positivism—an idea that Newton, Leibniz, and many others, then greatly extended the scope and plausibility of.

It remained to Kant, however, to appreciate that positivism is a substantive metaphysical thesis, and so to argue for it—at least as regards the empirical world. For the transcendental deduction of the categories is nothing other than an attempt to prove that there can be nothing to the empirical world except such as can be the content of a judgment.

Now, to those thinking backward from the twentieth-century, deeming Kant a hero of positivism may come as a surprise. For the Vienna school—the so-called *logical* positivists—often defined themselves in opposition to Kant. But their objection was not to Kant's positivism—they took that so much for granted that they no longer saw it as a substantive thesis, never mind in need of proof. Rather, they protested the transcendentalism, and, especially, the idea of synthetic knowledge *a priori*. Encouraged by recent developments in physics and mathematical logic, they held that all synthetic knowledge is *a posteriori*, and all *a priori* knowledge is analytic.

Thus, they also thought of themselves as rehabilitating a scientific empiricism. But that could never have been an empiricism in the eighteenth-century sense, because impressions and ideas can't support the logical form required for the predicate calculus, nor could association based on similarity and constant conjunction ever amount to valid inference in it. Yet, if sensory impressions are epistemologically forfeit, what remains of empiricism after all?

Remarkably, it was several decades before Sellars brought the issue to focus, and pointed the way out. If experience is to provide rational grounds for empirical knowl-

edge, then it must itself already be in “the logical space of reasons”; that is, it must already be conceptually articulated with the logical form of the factual. That left it to McDowell to extend the argument beyond experience to the entire world, insofar as it is knowable at all. “The realm of the conceptual”, he says, “is unbounded on the outside”—a self-conscious reformulation of Wittgenstein’s positivist slogan.

## 2. Scientific know-how

The ‘everything’ in “everything that is the case” means both ‘all’ and ‘only’. It’s not just that all facts (and their constituents) are included, but also that nothing else is. The world is *exclusively* things bearing properties and standing in relations. In the present section, I will question this latter “nothing but” clause. That is, I will try to show—specifically in connection with empirical science—that there must be more to the world than what is the case.

As empirical, science depends essentially on learning or finding out about the world by way of observation, measurement, and, above all, experiment. As Sellars showed, if the results of these endeavors are to be intelligible as evidence—for or against theories, for instance—then they must themselves be in the space of reasons. In other words, only facts (true propositions) can be rationally probative.

Gathering evidence, however, is not the only way of learning or finding out about the world that is essential to empirical science. Scientists must also, for instance, learn or find out *how* to make or perform the observations, measurements, and experiments that yield that factual evidence. Yet, if that is so, then that learning-how cannot itself be just more evidence-gathering, on pain of regress. On the face of it, therefore, what is learned or found out about the world, in learning or finding out how to do something, must be different in kind from learning or finding out what is the case—that is, the facts. But it will be worthwhile to spell this out.

The result of learning or finding out how to do something—how to gather credible evidence, say—is (or at least includes) what Ryle called knowing-how, as opposed to knowing-that. These are alike, of course, in that they are species of knowing—that is, ways of being onto the world, and vulnerable to error. So, to cement a case against positivism, two points need to be secured: first, that empirical know-how embodies genuine knowledge of the world; and second, that what is known in such know-how is not exclusively factual.

Empirical scientific know-how is a cultural-historical achievement: it is the product of great effort by many individuals over many years. That implies not only that it is difficult to develop, but also that not just anything will work. Reliable laboratory procedures are highly constrained; and just how they are constrained is what must be learned or found out, by the relevant community, in learning or finding out how to design and perform them. The same point can be cast comparatively, in terms of learning or finding out what will work better, as opposed to not so well. But what will work or not in actual practice, or work better than something else, is a function of the world. Therefore, in learning what will and won’t work, or what will work better—that is, in acquiring the relevant know-how—scientists are learning something about the world.

It remains to show that what is known in such practically acquired know-how is not exclusively factual. Insofar as the skillful know-how of empirical technique is embodied in a cultural-scientific heritage, it must be handed down to each succeeding generation—from experts to novices. But this handing-down cannot be entirely verbal: the heritage of expert practice cannot be reduced to a text. Rather, as every science teacher knows, the students must themselves “practice”, in the sense of performing hands-on exercises. First, they watch while the tutor demonstrates, and then they try it themselves, repeatedly, under critical supervision. As their skills improve, the exercises get harder, and the standards go up. No amount of lecturing or assigned reading can substitute for such first-hand laboratory experience—which is why science education always includes both. Thus, phenomenologically, what is known in know-how cannot be reduced to verbally articulable facts.

It might be held, however, that the phenomenology is not decisive. Perhaps the limited articulability of practical skills merely reflects a limitation of available vocabulary and/or other linguistic resources. It could be, in other words, that a more refined and developed scientific language would enable scientists to make their practical know-how fully explicit, even though they can’t actually do that now. Then educational science labs wouldn’t really be necessary—lectures and textbooks would suffice after all.

But this suggestion merely moves the bump in the rug. For language itself is an essentially skillful capacity—one that has to be learned and that, once learned, embodies knowledge of the world. To take the simplest example, learning to tell a duck when you see one is (part of) learning how to use the word ‘duck’—an instance of verbal know-how that embodies, as we might put it, knowing what a duck looks like. Without a great deal of such learning, students wouldn’t even be able to read the textbooks, never mind use what they read in their own future practice. Thus, supervised and ever more sophisticated laboratory exercises are indispensable not only for training the hands and eyes, but also in teaching the very language and vocabulary in which empirical work can be described and reported.

Yet, if such prerequisite skillful know-how, linguistic or otherwise, embodies a kind of worldly knowledge that cannot itself be expressed in words or formulae, then what is known of the world in that knowledge-*qua*-know-how is not facts. I tentatively conclude, therefore, that empirical scientific know-how constitutes a counter-example to metaphysical positivism.

Why only tentatively? Because the argument so far has presupposed a fundamental distinction, the credentials of which have not been established. In introducing know-how as a species of knowing, I pointed out that it is vulnerable to error, and elaborated by noting that, in practice, not just anything will “work”. These are hardly controversial claims. Yet, in a discussion of the essence of science as science—that is, as knowledge—they cannot simply be taken for granted. Before this issue can properly be addressed, however, several other points will need to be spelled out. For the moment, therefore, we are left with an unanswered question: How is experimental failure to be understood?

### 3. Scientific laws

By positivist lights, scientific laws are facts. That is, statements or mathematical formulations of them state or formulate facts. And, from one point of view—the point of view from which these statements or formulae merely tell us what is, was, or will be the case—no one could disagree. Yet even positivists agree that laws are not ordinary facts. The present section will consider the ways in which laws might be extraordinary.

The usual view is that statements of laws do not specify merely what happens to be the case, whether locally or globally, but rather what must be the case, always and everywhere. Thus, what's extraordinary about laws is that they are necessary facts. This doesn't mean that they are anything more than (or other than) facts, but only that they are a special kind of fact.

The idea that necessity is the distinctive feature of a kind of fact is also implicit in standard systems of modal logic. If a proposition is to be represented as necessarily true, its formula will begin with a “necessity operator”, typically printed as a small box prefixed to the relevant clause. What's important is that this operator is not separate from the formula—situated to the left of it, like Frege's “assertion sign”—but rather part of the formula itself. For that is what represents the necessity as belonging to fact being formulated, or, as we might also say, to the propositional content of the proposition expressed.

What alternative could there be? Note first that the very question is an index to a sort of blindness. Part of what distinguishes a dogma from a general belief, or even conviction, is the extent to which it leaves no imaginable space for alternatives. For, once the spell is broken, coherent alternatives may not be that hard to find.

Consider, by way of preparation, the difference between negation and denial. Both have to do with opposition or contrariety, but they are not the same. Negation is a logical operator that, in the simplest case, transforms a given proposition into another with the opposite truth value. Denial, on the other hand, is what Austin called an “illocutionary act” by which (for instance) a speaker takes a stand against some specified proposition. Thus, one can explicitly “oppose” some given assertion in either of two ways: one can negate the asserted proposition, and assert that contrary proposition instead; or one can leave the proposition itself unchanged, but deny it instead of asserting it.

Suppose, now, we look at “modalizing” in the light of those alternative ways of “opposing”. It is immediately clear that conventional approaches to modality all follow the model of opposing an assertion by negating the asserted proposition. That is, they all understand the “modalization” of an assertion as an assertion of a modalization of the propositional content originally asserted. This is not only the only alternative compatible with positivism; it's the only alternative positivists can see. But, as the example of denial suggests, it's not the only intelligible alternative.

For, just as denial is a distinctive illocutionary stand that effectively opposes an assertion, we can easily imagine—or invent—distinctive illocutionary stands that effectively modalize assertions. So, for instance, the illocutionary counterpart to “I

assert that necessarily  $p$ ” might be something like “I insist (or require) that  $p$ ”. Likewise, the explicit stand of “allowing” or “declining to reject” might be the illocutionary counterpart of asserting possibility; and so on.

Now, some may find this an alien or even bizarre suggestion. So, before proceeding, I would like to say a few soothing things about its strengths and weaknesses. First, it does not prevent the articulation of a modal logic, though it does impose an important limitation on that logic: nested or embedded modalities are ruled out. The reason is that illocutionary acts must, *qua* acts, have widest scope. They cannot be within the scope of any others and still themselves be acts. For instance, one cannot say: “I assert that I assert that  $p$ ” without equivocating on the word ‘assert’. The first occurrence is an explicit performative—an acting or doing—whereas the second, as embedded, can only be a characterization of something done.

On the other hand, subject to that limitation, all of classical modal logic can be recast in performative terms. Thus, there are clear performative notions of contradiction and entailment, as *logical* relations among illocutionary acts or stands. For instance, a speaker cannot, without self-contradiction, both affirm and deny the same proposition; and that contradiction is clearly between the acts, not the contents (which, by stipulation, are the same). Similarly, the performance “I insist that  $p$ ” surely entails (in a performative sense) affirming that  $p$  and allowing that  $p$ . (Note that these obvious points couldn’t even be made if logic were restricted to propositions.)

Finally, it’s worth mentioning that the logic of performatives extends beyond acts or stands directed upon propositions. For we also affirm and deny, insist on and repudiate our faith, our love, our loyalty, our responsibility. Simultaneously affirming and denying any of those would likewise be a performative contradiction. And affirming, say, one’s loyalty to something entails standing up for it, much as making a promise entails an undertaking to keep it. Again, one can insist or require—as a condition of staying in it, perhaps—that a job or personal relationship live up to certain understandings or essential values; and that entails not only allowing it to have the character in question, but also disallowing it not to.

Scientific laws do, of course, have propositional contents. Our concern, however, has been with their distinctive modal character, and, in particular, whether it must be understood as built-into to those contents. The main obstacle to thinking otherwise, I claim, has been the apparent absence of any intelligible alternative. But, drawing on speech-act theory, I have tried to bring a cogent alternative into view. This alternative is logically limited in that it does not allow for embedded modalities. But that limitation is irrelevant when the topic is scientific laws, since their modal character always has widest scope (laws do not contain embedded modalities).

What I have not done, however, is offer any considerations in favor of this new alternative as an understanding of lawlikeness; nor am I yet in a position to do so. Accordingly, this section, like the last, ends with a question that cannot be taken up till later. What advantage could there be to treating the distinctive character of laws on the model of performative acts or stands?

## 4. Cognitivism

Cognitivism—the second dogma of rationalism—is an assumption not about the world, but rather about the mind. It is the view enshrined in Descartes’s definition of us as thinking things—which has evolved into the idea that reason is to be understood in terms of cognitive operations on cognitive states.

A cognitive state is something with propositional content (such as a mental representation) together with a cognitive attitude toward that content (such as deeming or wanting it true). So, paradigm cognitive states are knowings and willings—or, in more anemic contemporary terms, beliefs and desires. A cognitive operation is a modification of a given body of cognitive states in accord with a procedure that is reliably truth- and/or success-maximizing—in other words, a rational inference. Thus, the most straightforward cognitivist view, common to Hobbes and Fodor, is that cognitive states are just sentences *in foro interno*, and that reasoning is but reckoning (= computation). As with positivism, Kant was the first to spell the idea out with clarity and precision.

More recent versions have liberated the core theses of cognitivism from extraneous modern commitments to mind-body dualism, mentalist internalism, and even basic individualism. Quine, Davidson, and Dennett, for example, have argued that cognitive states and processes are determinate only relative to the interpretability of manifest behavior (both verbal and non-verbal). This is still cognitivist, however, inasmuch as what the interpretations attribute are cognitive states and processes, subject to an overall constraint of rationality.

More recently still—though with roots in Hegel and Dewey—Brandom has argued that cognitive states and processes cannot be ascribed to individuals in isolation at all. Rather, the former are to be understood ontologically as norm-governed social statuses, defined in terms of interlocking social commitments and entitlements. And reasoning itself is correlatively explained (with a bow to Sellars) as making moves in a socially normative “game of giving and asking for reasons”. Finally, the governing norms themselves are grounded in systematic social sanctions on deviant behavior. It’s not that individual thought and ratiocination *in foro interno* are denied, but rather that they are reconceived as derivative internalizations of the more basic public practice.

All of these variants, however, betray a pinched and shallow conception of human life and personhood. Though this is clear in many ways, I will try to illustrate it via a consideration of individual integrity and responsibility. For concreteness, I begin with a comparison of Brandom and Nietzsche on promising.

Brandom, of course, understands promising as undertaking a socially instituted commitment or obligation, and thereby conferring similarly constituted entitlements on others. (*MiE*, 163–5) Those entitlements include not only innocent reliance on the promiser to make good, but also invocation of communal sanctions if she does not. Needless to say, such an institution, if consistently sustained, is of great value, both to individuals and to organized society as a whole.

Nietzsche sketches a similar though less developed account in *The Genealogy of Morals* (early in the second essay). He is rather more colorful than Brandom in his

characterization of social sanctions (“mnemotechnics” he calls them), but the effect is the same. Promising and many other valuable institutions, he agrees, are made possible by socially imposed norms—or, in his more vivid phrase, the “social straightjacket” of “slave morality”. By such means, the naturally erratic animal, man, is made regular and calculable, even to himself.

What sets Nietzsche apart, however, is that this account is only preparatory for another and quite different understanding of what promising can be and mean: the self-responsible exercise of an autonomous protracted will—the act of a sovereign individual with the *right* to make promises. Social sanctions, while prerequisite for the genesis of this capacity, are left entirely behind in its maturity. A will that endures the vagaries of the world by its own willful law is no mere inculcated habit or persisting desire, no social institution or status, but something new that has emerged out of them, and transformed the possibilities for mankind. Or so, at any rate, Nietzsche claims.

Brandom and cognitivists more generally have no room for any such phenomenon. Indeed, social pragmatism just is a more sophisticated account, not only of slave morality, but of Plato’s marketplace, Heidegger’s *das Man*, and Kuhn’s normal science. The point here is not to endorse any of their particular alternatives, but only to suggest that something important is at stake—something incompatible with cognitivism, something that can be indicated by terms like ‘integrity’ and ‘responsibility’, something therefore related to courage, loyalty, and the ability to love, and something that, as I will argue later, is essential to science.

## 5. Scientific understanding

Despite a hoary tendency to assimilate them—as old as the word ‘*episteme*’, and still conspicuous in Kant—understanding is not the same as, nor any species of, propositional knowledge. Indeed, it is not a propositional attitude at all, but something quite different that is, in fact, prerequisite for them. Though I think this is obvious, there’s also an easy argument for it. One cannot have a cognitive attitude toward a proposition that one does not understand, but one can certainly understand a proposition without having any attitude toward it at all.

If understanding is not a cognitive state in any canonical sense, then what is it? In science, the gold standard of understanding is the ability to explain. In all scientific explanations, what is explained is shown to be compatible with (often entailed by) its particular boundary conditions, given what is possible and necessary in general. Accepting the connection between modality and lawlikeness, this clearly subsumes familiar deductive-nomological explanations as a special case.

But not all scientific explanations are deductive-nomological. There are also explanations cast in terms of functional organization, statistical selection processes, causal mechanisms, rational decision making, and so on. What these have in common is showing how the actual can be seen or grasped in the light of the modal. While I maintain that this connection with modality is quite general, I must here confine myself to a single illustration—an explanation in terms of functional organization. The most famous such explanation in science may be the double-helix account of DNA replica-

tion. But I will stick to something more mundane: an explanation of how a pendulum clock works—that is, how it keeps and shows the time.

One doesn't explain the working of a clock in terms of the physics of rigid bodies—even though one does (and must) take for granted that most of its internal parts are rigid. And, of course, one needs to assume (what only physics explains) that the period of a pendulum is (nearly) constant. But, what matters for understanding the clock *as a clock* is not so much the physics as the particular configurations, arrangements, and interactions of all those physical parts.

A brief account might go like this (preferably with an actual clock or picture to point at). Given that the pawl is connected as it is to the pendulum, its two ends *cannot but* rock up and down once per swing; given the shapes and relative positions of the pawl and ratchet wheel, the latter *can* advance one—but *only* one—notch per rocking of the pawl; given that, plus the torque that *cannot but* imparted to it by the weight on the chain passing over a sprocket on the same shaft, the ratchet *cannot but* so advance; and, given all those, plus the way the ratchet shaft is geared to the hands, and the constant period of the pendulum (plus a few other things), the hands *cannot but* rotate at certain constant rates—thereby keeping and showing the time.

Now, even though various laws of physics are presupposed in that account, none are actually cited—nor need they be, since they are not what provide the relevant insight. Nevertheless, as my emphases indicated, the notions of what can, can only, and cannot but occur, given the mechanical configuration, play a crucial role. The reliable ability to keep time depends on the possibility and inevitability of the interactions that enable it. (There is no explanation in mere recital of what happens to happen.) Thus, even in a mechanical or engineering explanation, without any mention of laws, an ability to see the actual in the light of the modal is fundamental.

So far, we have examined understanding through the lens of explanation—on the grounds that, in science, the ability to explain is the “gold standard”. But understanding as such does not presuppose the ability to explain. If explaining is showing how the actual can be grasped in the light of the modal, then understanding by itself is just grasping or being able to grasp the actual in that light. What we need, to spell this out, is to discharge those metaphors. In the present context, “grasping the actual” means noticing, or at least tracking, some nontrivial pattern or structure of relationships in the phenomena. And grasping that pattern or structure “in the light of the modal” means appreciating that it is possible and/or necessary, in a way that others, superficially similar to it, would not be.

That formulation, it bears mentioning, is intended to accommodate the fact that not all understanding is articulate. Obviously, for example, our understanding of our own words and sentences cannot itself presuppose an explicit account expressed in that same vocabulary and grammar. Yet it does presuppose grasping them in the light of norms and proprieties of usage—which are the relevant sort of modality. And, indeed, a great deal of our everyday and scientific understanding is largely inarticulate—and no less legitimate for it.

All of the foregoing, however, leaves a surprising question about understanding quite unanswered: Why does it *matter*? If understanding is qualitatively distinct from knowledge, then why is the latter alone not sufficient? What does understanding add?

## 6. Science without the dogmas

When God died—by most accounts, sometime in the nineteenth century—so did the only conceivable guarantee that there is any complete true description of the world, or even any language in which such a description could be formulated. In other words, the cognitivism implicit in the very idea of an omniscient intellect was modern rationalism's only compelling basis for the metaphysics of positivism. Yet forfeiting these familiar anchors might seem to float objective truth and understanding free of any solid mooring in "how things really are"—and, perhaps worse, out to sea on some "post-modern" relativism. In this epistemic debacle, science too would be at stake; for it is nothing other than the systematic pursuit of general objective knowledge and understanding.

The appropriate response is not to denigrate scientific objectivity, but rather to reconceive it in thoroughly post-theological—hence, post-rationalist—terms. But that will mean rethinking epistemology from the ground up. So I will close by trying to sketch how that might go (tying up my earlier loose ends along the way).

The essential move must be to understand truth itself as a distinctively human achievement. Before there were people, there was no such thing as truth (at least, not on Earth). By this, I don't mean just that there were no truth-bearers—sentences, cognitive states, or whatever—but that there was no truth for anything to "bear". So, for instance, though it may be true *now* that there were frogs a million years ago, it was not true a million years ago that there were frogs *then*. Truth and objectivity as such had to be opened up and enabled by people; and that happened a lot more recently than a million years ago. Until we can understand them as in this way our own, philosophy will have yet to recover from the death of God.

Material truth is nothing without falsehood. The crucial opening up, therefore, was really of the true/false dichotomy. We ask, accordingly: what else has to be in play to make that opposition intelligible? One obvious prerequisite is that distinct, formally compatible claims can nevertheless conflict—that is, be such that not all can be true. That's what forces and gives sense to the acknowledgement that at least some are materially false. So our question becomes: How can logically compatible scientific claims be nevertheless scientifically incompatible? What kind of *non*-logical constraint is there on the mutual compatibility of, say, empirical results?

The empirical findings of a science are clearly constrained, in their relations to one another, by the laws of that science—as a simple example illustrates. If you and I each measure the speed of the Mississippi River, but at different times and places, we could get quite different answers and still both be right. But if we measure the speed of light in a vacuum, no matter when or where, any discrepancy at all will show that at least one of us got it wrong. The difference, of course, is that a law of physics says the speed

of light is a constant, whereas there are no such laws for the speeds of rivers. This is how, at the most basic level, experimental failure is to be understood.

But the positive side of that same point is equally fundamental. If substantially different measurements and experiments consistently give results that are related just as the laws require, then they are mutually supporting. And, importantly, it's not just the results that support one another, but also the respective techniques and procedures by which they are obtained. Perhaps it is a *cliché* by now to point out that theories are "holistic"; but it is less often noted that this essential holism must extend also to established scientific practice—including, in particular, the inarticulate know-how, and even the specialized equipment, on which researchers invariably rely.

For, ultimately, it is only such integrated theoretical-practical "packages" that can confront nature in a way that might genuinely fail. If there are no experimental results, obtained by recognized means and expressed in the terms of the theory, then that theory is detached from any external constraint. Yet, if the theory, in turn, does not impose constraints of its own, expressed in that same vocabulary, then what happens in the laboratory is irrelevant to it. It's only via the potential collision between these two sets of constraints that anything can actually go wrong. And only if something actually could go wrong, can the fact that it doesn't be of any significance.

The constraints imposed by a scientific theory are its laws. If, however, these are construed merely as further propositions, added to those accepted on the basis of experiment, then all you get is a larger set of propositions—possibly inconsistent. But a set of propositions, consistent or otherwise, is utterly inert. And, adding "necessity" to some of their contents can't change that. Propositions themselves, whatever their contents, don't do anything at all.

It is only people—in our case, scientists—who act or take stands. It is they, and only they, who do anything with propositions; and what they do depends in part on the "status" they accord them. In particular, if scientists accord some propositions the status of laws, then they will not put up with, will not credit, incompatible empirical claims (as the speed-of-light example illustrates). In other words, to take a proposition as a law just is to insist or require that empirical results be compatible with it. And that is why I suggest that the "modal character" of scientific laws might be understood better in terms of performative stands, than in terms of propositional operators.

By the same token, if the essence of understanding is the ability to grasp or see the actual "in the light of the modal", and explanation is making that ability explicit, it becomes clear why they matter to science. For that ability is nothing other than the success condition on the foregoing insistent stands. In the most basic case, explaining just is *showing* how actual empirical results are compatible with modal laws—which is to say, showing how they are intelligible.

Yet, science is intrinsically hard—and precisely because it must make itself hard, to be what it can be. If it is to yield non-trivial knowledge and understanding, it must assiduously maximize what I called the potential for "collision" between theoretical and empirical constraints. Only by leaving itself wide open, as wide as it can, to such threatening difficulties, can it ever claim to have discovered anything by discerning a

narrow path that avoids them. Only on these terms can meeting the above “success condition” amount to anything epistemically substantial.

Taking—nay, not just taking but actively pursuing—this fundamental risk, a risk even to career and profession, demands something like personal responsibility and integrity—if not of all scientists always, at least of some scientists sometimes. For the ultimate threat is not merely to this research project or that, but to the whole integrated “package” in terms of which alone it and many others are scientifically viable. History shows that this threat is not idle.

The elaborate institutional structure that makes such a threat so much as possible is what gives sense to determinate scientific claims—that is, to assertions that can be determinately true or false. And giving sense to that distinction, exclusively in terms of our own resources, is what I mean by the *human* opening up and enabling of truth. As I have tried to show, however, those necessary resources are incompatible with the modern assumptions of positivism and cognitivism. I conclude, therefore, that, inasmuch as science itself flourishes, neither dogma of rationalism can survive the death of God.