

# Metaphysical Problems of Physics

## Lecture 9: Necessity and Causality

Erik Curiel<sup>†</sup>

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Those who make causality one of the original *uralt* elements in the universe or one of the fundamental categories of thought,—of whom you will find that I am not one,—have one very awkward fact to explain away. It is that men’s conceptions of a Cause are in different stages of scientific culture entirely different and inconsistent. The great principle of causation which we are told, it is absolutely impossible not to believe, has been one proposition at one period of history and an entirely disparate one another and is still a third one for the modern physicist. The only thing about it which has stood, to use my friend Carus’ word, a  $\kappa\tau\tilde{\eta}\mu\alpha$  ἐξ ἀεί,—*semper eadem*—is the *name* of it.

– Peirce

*Reasoning and the Logic of Things*, Lecture 6

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<sup>†</sup>**Author’s address:** Munich Center for Mathematical Philosophy, Ludwig-Maximilians-Universität; Black Hole Initiative, Harvard University; **email:** [erik@strangebeautiful.com](mailto:erik@strangebeautiful.com)

# 1 Chakravartty's *A Metaphysics for Scientific Realism*

## 1.1 Where He's Coming From: The Intoxicating Thrill of Realism

### Background to Realism

1. Preface, p. XIII:

The essence of the controversy between realists and antirealists concerns the possibility of having knowledge of the unobservable, and this possibility is most strongly contested by varieties of empiricism.

Not a bad gloss so far as capturing the facts on the ground goes—which goes only to show what limp and useless things those facts are. The unhealthy and misguided obsession with “observables” and “unobservables”—“things that one can [or cannot], under favourable circumstances, perceive with one’s unaided senses” (p. 3)—in the attempt to understand scientific knowledge is deeply entrenched in philosophy.

2. *Ibid.*, p. XII:

The metaphysics of realism has lagged behind its epistemology, and one of the best reasons for addressing the former is to facilitate better the latter.

Clarification and progress in metaphysics can come before an understanding of epistemology, and so *a fortiori* before a comprehension of what is epistemologically warranted. One cannot invoke even a Fichtean power of pure intellectual intuition that grasps the world in itself without mediation—for that is to assume it has epistemic warrant. This is another common, unhealthy and misguided trope in philosophy: that clarification of concepts can usefully be accomplished before one gains empirical knowledge and understanding in the salient area, indeed, that such clarification is a necessary precondition of acquiring such knowledge and understanding. Indeed, he later comes right out and says it (*ibid.*, ch. 1, p. 17):

[T]here is a sense in which the metaphysics of science is a precursor to its epistemology. One cannot fully appreciate what it might mean to be a realist until one has a clear picture of what one is being invited to be a realist about.

3. *Ibid.*, p. XIV (my emphasis):

[O]ne of the implicit themes of this book is that some disputes between realists and antirealists, not to mention disputes between realists with different philosophical predispositions, are destined to remain unresolved due to an irresolvable lack of shared *assumptions*.

*N.b.*: it is not shared *evidence* that stops the parties at dispute from reaching agreement but shared assumptions. *Ad loc.* (my emphasis):

If one *feels any pull* in this direction[, *viz.*, realism], then it is crucial that one have recourse to an internally consistent and substantive position.

It is feeling, predilection, sentiment that makes one vulnerable to the seductive (bewitching?) powers of realism, not objective evidence and compelling argument. None of this is necessarily a bad thing; rather, it makes clear that Chakravartty may hold a sensible view of these matters: realism is something like a Carnapian framework, the adoption of which is a pragmatic choice, not the rational decision driven by compelling argument to assert a proposition whose truth-value can be evaluated on the basis of objective evidence. Another possibility, less sensible, is that he agrees with van Fraassen (2002), and takes realism to be a “stance”, in the sense of something like a (p. 17) “combinations of epistemic “policies” with respect to the methodologies one adopts in order to generate factual beliefs.” He does not come out and say this explicitly, but the discussion of van Fraassen in ch. 1, §§4–5, strongly suggests he does in fact endorse this view.

### Taxonomy

Table 1.1. *Scientific realism and antirealisms*

	The ontological question: mind-independent reality?	The semantic question: theories literally construed?	The epistemological question: knowledge?
Realism	yes	yes	yes
Constructive empiricism	yes	yes	observables: yes unobservables: no
Scepticism	yes	yes	no
Logical positivism/empiricism	yes/no/?	observables: yes unobservables: no	yes
Traditional instrumentalism	yes	observables: yes unobservables: no	observables: yes unobservables: no
Idealism	no	no	yes

*Ibid.*, ch. 1, p. 10

### Semirealism and Causal Connection

1. ch. 2, p. 29 (emphasis his):

Theories can be interpreted as making many claims about the nature of reality, but at best one has good grounds, or epistemic warrant, for believing some of these claims. Only some aspects of theories are likely to be retained as the sciences march on. I will refer to any approach that takes this advice seriously as a form of *selective scepticism*.

2. entity realism and structural realism as traditionally promulgated have irremediable problems, but each has a central virtue to be retained in a superior form of realism:

**entity realism**

- a. virtue (ch. 2, p. 31): “there is considerable evidence to support the idea that when one manages to forge significant causal contact with entities, they are retained when theories involving them change over time”
- b. entity realism goes astray, however, in eschewing belief in parts of theory other than entities, in particular, theoretically characterized properties that “connect” entities to experimental instruments, *viz.*, *relational* properties

**structural realism**

- a. virtue (ch. 2, §2): we can know structure
- b. goes astray in requiring that “structure” be characterized entirely by “higher-order” relations, *viz.*, structure is a property of relations among first-order properties, those latter being what traditionally characterize the nature or essence of an entity; and such structure is all we can know; in doing so, one cannot avoid Newman’s objection

3. this is all to be cured by *semirealism*:

- a. ch. 2, p. 39 (emphasis his): “identify structure *with* relations between first-order properties”  $\Rightarrow$  a *concrete structure*
- b. ch. 2, pp. 41–42 (emphasis his):

The first-order properties whose relations comprise concrete structures are what I will call *causal* properties. They confer dispositions for relations, and thus dispositions for behaviour on the particulars that have them. Why and how do particulars interact? It is in virtue of the fact that they have certain properties that they behave in the ways they do. Properties such as masses, charges, accelerations, volumes, and temperatures, all confer on the objects that have them certain abilities or capacities. These capacities are dispositions to behave in certain ways when in the presence or absence of other particulars and their properties. The property of mass confers, *inter alia*, the disposition of a body to be accelerated under applied forces. The property of a volume on the part of a gas confers, *inter alia*, the disposition to become more highly pressurized under applied heat, and so on. It is the ways in which these dispositions are linked to one another – that is, the ways in which particulars with various properties are disposed to act in consort with others – that produce causal activity. Causation, ultimately, has to do with relations determined by dispositions, conferred by causal properties.

- c. ch. 2, p. 47 (emphasis mine):

The structures to which realists should commit, echoing the most persuasive insight of ER [entity realism], involve properties and relations that are essential to describing *our* causal connections to the world.

- d. in sum, semi-realism:
    - i. holds on to selective skepticism
    - ii. allows belief in relational aspects of theories
    - iii. elides the difference between “structure” and “nature” (*i.e.*, first-order properties), allowing belief in the latter, so avoiding Newman’s objection
    - iv. provides principled grounds for deciding which parts of theories to have greater and lesser epistemic commitment to
4. A few questions and remarks before we dive into discussing causation proper:
- a. Are we not part of the world? (“properties and relations that are essential to describing *our* causal connections to the world”)
  - b. What *are* our “connections” to it?
  - c. How “direct” a role do the causal properties involved have to play in “causal connections” to count as “essential”?
  - d. Do they involve, for instance, the strong nuclear force? The cosmological constant? Each of those plays crucial roles in fixing the properties of the macroscopic world that allow us to do things like build instruments and perform experiments.
  - e. Naive focus on (ch. 2, p. 41) “relations between relata, first-order properties, in [the form of] mathematical equations in which the variables name kinds of properties” easily leads one astray: volume is not a property of gas, but of an object that contains the gas; it thus cannot be conceived of as a causal property in the relevant sense based solely on attention to the gas laws
  - f. In any event, not all properties central and fundamental to science, properties that we seem to have extraordinarily good evidence for, are causal in the relevant sense *at all*—entropy, *e.g.*

## 1.2 Causal Realism and Causal Processes

### prefatory remarks

1. give the dude some props: he recognizes the need to elaborate and defend a detailed metaphysical underpinning to his proposed form of realism, and eagerly embraces the task
2. he is keen to minimize metaphysical commitments that empiricists would balk at, so his heart is in the right place
3. his account of causation is *principled*, in so far as it is driven by specific epistemic requirements (ch. 4, pp. 94–95):

The notion of objective causal necessity, if tenable, serves an extremely important explanatory function for those apt to wonder: it allows the realist to distinguish between the causal regularities on which the detections and manipulations of semirealism depend, and merely accidental series of happenings.

**causal realism** ch. 4, p. 93:

1. “[C]ausation is objective, meaning that it is something that occurs in a mind-independent, external world, as opposed to something that is merely subjective, a feature of one’s thoughts or perceptions alone”
2. “[C]ausation involves some sort of necessity with respect to the connection between causes and effects. . . . [T]here is more to causation than mere constant (or probabilistic) conjunctions of events.”

**causal processes**

1. traditional accounts of causal realism, according to which causation is a relation between events, fail to address the trenchant arguments Russell (1919) marshalls against them, on the charge of incoherence (contiguity, regress, lack of a mechanism)
2. to negate the force of Russell’s arguments, deny that causation is a relation among events, and focus instead on causal properties (ch. 4, p. 107, emphasizes his):

Though misleading, however, the traditional picture is not in the wrong ballpark entirely. The problem with it is that it privileges the role of events in giving an account of causation, and this pays insufficient attention to the precise metaphysical details. Focusing on events has the unfortunate consequence of obscuring the role played by those properties of things one takes to explain their behaviours. . . .

Descriptions of causal phenomena in terms of relations between events are useful for many purposes, but it is not events *qua* events that “do the work” of causation. Events commonly feature in descriptions of causation *because* they incorporate causal properties of objects. Referring to events as the relata of causation makes sense of much of our phenomenal experience simply because, as it happens, these things harbour the ontological ingredients, causal properties, that are ultimately responsible for causal phenomena.

3. now we need to be more precise about what causal properties are and how they function as the agents responsible for causal phenomena, how they play that role (ch. 4, p. 108):

[A] causal property is one that confers dispositions on the particulars that have it to behave in certain ways when in the presence or absence of other particulars with causal properties of their own. . . . Causal phenomena are produced by the ways in which particulars with properties are disposed to act in concert with others. . .

[I]n causation, objects with causal properties are engaged in continuous processes of interaction. Dispositions borne by objects in virtue of their properties are continuously manifested in accordance with the presence and absence of other objects and properties. Objects with causal properties are thus in a continuous state of causal interaction, a state in which relations between causal properties obtain.

4. the contiguity and regress objections are dispelled (ch. 4, p. 110):

Series of discrete events are here replaced in the description by a continuous alteration of properties, each conferring dispositions for behaviour on the objects possessing them. Thus, worries about temporal contiguity between discrete, successive events are replaced by an acknowledgment of continuous processes of causal interaction. The search for events to serve as proximate cause and effect is replaced by the understanding that candidates for these things simply constitute convenient or conventional divisions of the continuum of happenings into otherwise arbitrary time slices, themselves inhabited by numerous causal interactions.

5. on the objection that one needs a causal mechanism (ch. 4, p. 111):

This demand for a causal mechanism, I suggest, is partially addressed by the metaphysics of causal properties. With respect to mechanisms, the most a causal realist (or anyone for that matter) can say is that causally efficacious events incorporate objects with property-conferred dispositions, and the occurrence of subsequent effects can thus be understood in terms of manifestations of the relevant dispositions of the objects involved.

### questions and remarks

*ad hominem:*

1. how is one to individuate causal properties? it seems on the basis of the disposition they are associated with; the “same” physical quantity, however, can play more than one role in physical interactions (mass as measure of inertia versus mass as measure of gravitational attraction versus mass as measure of susceptibility to gravitational attraction versus mass as measure of atomic structure versus mass as measure of catalytic capacity versus . . . ); can the “same” property have different dispositions?
2. are some shared dispositions “more causally fundamental” than others (mass as measure of catalytic capacity, *e.g.*, compared to mass as measure of atomic structure)? how can we make sense of this epistemically? we are asked to believe in concrete structures, which are composed of properties, and we may have stronger or weaker epistemic warrant for belief in different concrete structures—but now it seems we are driven to assign different epistemic warrant for different dispositions determined by the same causal property in the same concrete structure

based on physics:

1. he claims (ch. 4, p. 110) that his account can “provide an account of causation not merely in cases of causal change, but also in cases involving static states of affairs that some think should be diagnosed as causal also”; I cannot for the life of me figure out how in fact the account will handle the simplest kinds of static case, such as swinging a yo-yo in a circle

2. many processes that we *prima facie* want to think of as causal are not characterized by the continuous propagation or change of the physical quantities that are used to formulate the equations of the relevant theory; a good example is the propagation of optical information in the electromagnetic field (“the way light encodes what we see”): it is not tracked or defined by the propagation or continuous change of any quantities associated with the electromagnetic field, such as intensity, polarization, momentum, angular momentum, energy, temperature, entropy, wave velocity, group velocity, phase velocity, . . . (see Born and Wolf 1999 and Stein 2004)
3. in any event, it is extremely difficult—to say the least—to make sense of the idea of “a continuous alteration of properties, each conferring dispositions for behaviour on the objects possessing them” for fields, such as the electromagnetic field, in the first place
4. the difficulties of doing so in the context of quantum mechanics and general relativity are exponentially greater (see, *e.g.*, Curiel 2000)
5. he seems to be thinking entirely of the physics of simple classical systems such as billiard balls and containers of gas; can one claim to be a realist if one’s account is specifically constructed so as to accommodate our least fundamental theories—and seems to accommodate *only* those theories—theories we know to be in important senses just *wrong*? this worry is substantiated by footnote 3 on p. 112 of ch. 4, where he raises *extremely* important questions—how are processes to be identified, how modeled, how manipulated—and then cites only Pearl (2000), Spirtes, Glymour, and Scheines (2001) and Woodward (2003), all works that explicitly refuse to engage with any fundamental physics

## 2 Peirce’s “The Doctrine of Necessity Examined”

### 2.1 Where He’s Coming From: The Salubrious Invigoration of Pragmatism

See Curiel (2020).

Peirce (1905a, p. 332, emphasizes his) proposes the following as the essence of *pragmatism*, his fundamental philosophical program:

[A] *conception*, that is, the rational purport of a word or other expression, lies exclusively in its conceivable bearing upon the conduct of life; so that, since obviously nothing that might not result from experiment can have any direct bearing upon conduct, if one can define accurately all the conceivable experimental phenomena which the affirmation or denial of a concept could imply, one will have therein a complete definition of the concept, and *there is absolutely nothing more in it*.

1. he is characterizing “conception”, *viz.*, the *action* of conceiving or the state of performing that action, *not* “concept”, which is either the result or the vehicle of the act of conception



2. Peirce characterizes the outcome of an experiment by the *experience* that results from it—Peirce’s notion of “experience” is a difficult one, and much hinges on determining exactly what he means by it; at a minimum, it involves the idea that the significance of each human’s cognition and activity lies in the fact that it is embedded in a larger web of socially constitutive structures and processes; this gives a clue to how to begin to approach the question: what can it mean for the “purport” of an “expression” to have a bearing upon the conduct of life, in so far as language is one of the strongest constituents of the web’s infrastructure? how can the meaning of expressions (construed, presumably, broadly) shape or guide action?
3. the use of ‘conceivable’ in characterizing the idea of “conception”: a problematic circularity? what is the modality here, in the universal quantifier “all conceivable”: causal, metaphysical, logical, epistemic? that which, as Aristotle would have said, is required to “bring about the good” (which we will call ‘beneficent modality’, for lack of a better term)? if epistemic, as seems likely at least in part, then is it qualified by the present, actual epistemic state of humans, or is it an ideal “convergence to the truth in the long run” epistemic possibility? if beneficent, which, also seems to be at least in part the case, then is it the good of humans as they are now or as they would be in a perfected state (*e.g.*, the ideal epistemic state adverted to in the previous question)?

## 2.2 The Doctrine of Necessity

## 3 Invitation to a Short Essay

I invite you to write me a short discussion (no more than 2 pages, *i.e.*, no more than 1000 words) on any issue discussed in any of this week’s three readings. You can raise further questions, propose answers or interpretations, or whatever seems of most interest to you. If you get it to me by the start of next lecture (6. Jul), then I will return it to you with my comments the following week.

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