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BOOK REVIEWS

Are backwards-infinite causal sequences possible?

Alexander R. Pruss, **Infinity, Causation, and Paradox**, Oxford University Press, 2018, 224 pages, Print ISBN-13: 9780198810339. DOI: 10.1093/oso/9780198810339.001.0001

The book's main claim is, roughly speaking, that it is metaphysically impossible for anything to be affected by infinitely many causes. Pruss calls this kind of view *causal finitism*, of which there are different versions, depending on both the kind of causal relation (e.g., partial causation, full causation) and the relata (e.g., events, substances, tropes) mentioned in its formulation, and also on how the relata are individuated. Part of Pruss's interest in causal finitism has to do with its bearing on reasoning about the existence of a first cause, as mentioned in some cosmological arguments.

> If causal finitism is true, then there cannot be backwards-infinite causal sequences, and hence there must be at least one uncaused cause. There is also some reason to take this uncaused cause to be a necessary being. (p. 4)

In Chapter 2, the arguments for causal finitism concern three kinds of *backwards-infinite causal sequences*: (i) uncaused ones, having no item outside the sequence causing any of the members of the sequence, (ii) "dense causal sequences [...] where between each pair of items there is an intermediate cause" (p. 32), and (iii) ones with an item outside the sequence causing every member of the sequence. These arguments rely on considerations about explanatory priority, a distinction between *derivative causes* and *fundamental causes*, and metaphysical grounding.

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For example, Pruss (pp. 27–28) argues that since causation is a type of dependence, a backwards-infinite causal sequence (BICS) is a vicious regress of dependences, and thus is metaphysically impossible. He argues (pp. 30–31) that a BICS involves circularity in explanatory priority, since it can be divided into disjoint subsequences each of which would be explanatorily prior to the other. Pruss also mentions that one could use a Principle of Sufficient Reason to argue for the conclusion that *vicious regresses are metaphysically impossible*, "on the grounds that vicious regresses involve something being unexplained, namely why the whole regress obtains" (p. 29). This would go against the Hume-Edwards Principle, a version of which states roughly that *causally explaining every item in a collection* suffices for causally explaining the whole collection. Finally, as a simplified example (p. 32) of a derivative instance of causation: a button press *derivatively* causes the burglars to be alerted, as it does so by causing the light to shine, which causes the burglars to be alerted. Pruss uses the principle that *derivative instances of causation must (of metaphysical necessity) ultimately be grounded in fundamental instances of causation* to argue that an infinite sequence of "intermediate causes between an initial cause and a final effect" (p. 32) is metaphysically impossible, ruling out dense causal sequences.

The major line of argument (chapters 3–6) for causal finitism considers a number of imagined paradoxical situations that, on Pruss's view, are metaphysically impossible. These involve infinitely many objects, infinitely many events, infinite physical magnitudes, fair lotteries with $\aleph_0$ possible outcomes, as well as reasoning involving classical probability theory, classical decision theory, non-measurable subsets of the space $\mathbb{R}^3$, a weakened version of the Axiom of Choice, and various principles about epistemic and practical rationality. Pruss aims to give a single, unified explanation of why all of these paradoxical situations are metaphysically impossible. He argues that the source of these paradoxes is their common feature of *infinitely many causes contributing to a single effect*, and thus that causal finitism best explains why they are metaphysically impossible. A repeated pattern of reasoning is the following, where ψ is some particular paradoxical situation.

P_1: If causal finitism is not true, then ψ is metaphysically possible.

P_2: ψ is not metaphysically possible.

$\therefore$ Causal finitism is true.

We can highlight only a few simple instances of ψ in the space allotted here.

Thomson's lamp undergoes an ω-sequence of switchings between *on* and *off* from 10am to 11am, and the description assumes that the lamp is either *on* or *off* at 11:00. Benacerraf [1962] showed that the description does not decide the lamp's state after the sequence of switchings. Surprisingly, Pruss argues that

> [...] Benacerraf's solution is in tension with the Principle of Sufficient Reason. For even if there is no contradiction in the lamp's being on at 11am, there seems to be no explanation as to why it's on (and if it's off, there is no explanation for that). (p. 2)

He writes that Benacerraf's solution

> [...] is the start of a resolution, but it is not a complete resolution. After all, there is at least *some* reason to believe the Principle of Sufficient Reason (PSR) which holds that every contingent fact has an explanation. But in Benacerraf's solution nothing explains why the lamp has the state it does at the end of the scenario. A solution that requires denying PSR has some cost. (p. 43)

If anything here is in tension with a PSR, it is *the assumption that the described situation is metaphysically possible*, rather than Benacerraf's solution.

Grim Reaper paradoxes, as discussed by Benardete [1964], involve an ω^*-sequence (i.e., the reverse of an ω-sequence) of events in time. In Pruss's version, there is an unlit lamp, and at each time in the ω^*-sequence, if the lamp is then *off*, it is switched *on*; otherwise it is not switched. A contradiction can be derived if the lamp is *on* after the sequence, and also if the lamp is *off* after the sequence. Shackel [2005] argues that the description is contradictory for purely logical reasons, but Pruss blames the contradiction on "infinitely many things impacting causally on one target state" (p. 47). In this case the relevant instance of P_1 appears to be false; even supposing that its antecedent holds, ψ seems to be not even logically possible.

In a *countably infinite fair lottery* (CIFL), a natural number x is selected fairly, and then for each $n \in \mathbb{N}$ one must guess, to win or lose \$1, whether $x \geqslant n$. For any particular n, one should guess that $x \geqslant n$; but such a guess wins only finitely many times, losing infinitely many others. Pruss writes that a CIFL

> [...] would yield a very simple Dutch Book against a rational agent: a series of gambles each of which is clearly rational to take, but which together give a sure loss. (p. 66)

In a related case, natural numbers j, and then $k \neq j$, are selected fairly. For only finitely many $n \in \mathbb{N}$ is $n < j$, and for infinitely many $n \in \mathbb{N}$, $n > j$, so it is nearly certain that $k > j$. But by parallel reasoning, it is nearly certain that $j > k$. CIFL situations do not strike the reviewer as evidence for causal finitism, but they do point to some of the limitations of classical probability theory, and give counterexamples to the principle that *if each bet in a collection is rational to take, then it is rational to take the whole collection of bets*.

In Chapter 5, supposing that causal finitism is false, Pruss tries to show that one could use information about a past ω^*-sequence of independent, fair die rolls to define a strategy for guessing the result of future rolls that betters "the best strategy that does not use past information" (p. 94). Chapter 6 uses the Banach-Tarski construction to define Dutch books for bets about points randomly and uniformly chosen in $\mathbb{R}^3$. The chapter also uses a version of the Axiom of Choice, restricted to families of non-empty countable pairwise-disjoint sets of reals, to define Dutch books for bets about the results of ω-many independent, fair, indeterministic coin flips, as represented in the space of all binary ω-sequences. Chapter 7 sketches some possibilities for refining formulations of causal finitism. Chapter 8 discusses whether casual finitism provides evidence that it is metaphysically necessary that time and space are discrete, arguing that one can

> [...] interpret the causal import of quantum physics in a way that is compatible with causal finitism but does not substantially change the physics of the theory. (p. 172)

Chapter 9 argues that, assuming that causal loops are metaphysically impossible, causal finitism implies that it is metaphysically necessary that there is a first cause. Pruss also argues that

> [...] there is good reason to take this first cause to be a necessary being. This results in a cosmological argument similar to the Kalām argument. (p. 181)

There are some questionable applications of rearrangement principles, which state roughly that *if a situation is metaphysically possible,*

then so is the one resulting from a particular rearrangement of its items. Pruss often assumes that such rearrangements preserve causal powers.

> There is [...] one controversial choice that many of our arguments will require, and this is a picture of objects and their activities as having a causal nature that is carried along with their rearrangement. When one rearranges a lamp switch from one location in spacetime to another, the rearranged switch continues to have the same causal powers, and when put in the same relevant context (say, a lamp) these causal powers will have the same effects. If intrinsic properties are what can be carried along with rearrangements, then I am taking causal powers to be intrinsic properties.
>
> This is a very intuitive picture of causal powers. It is, nonetheless, in conflict with widely held Humean views on which causal facts supervene on the global arrangement of matter in the universe. (p. 9)

It is a virtue of the book that some mathematics is brought to bear on issues in analytic metaphysics. But before taking all of these paradoxes as evidence for causal finitism, other avenues of resolution, such as non-real-valued theories of probability that use infinitesimals and have σ-additivity, need much further exploration and development. Even if many of these paradoxes are misdiagnosed and better resolved in other ways — in which case they do not provide much support for causal finitism — the book gives clear, self-contained presentations of several dozen interesting situations involving infinity. Chapters 4, 5, and 6 are especially worth reading, even independently of the other chapters, for accessible discussions of paradoxical situations concerning classical probability theory and classical decision theory.

References

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