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What to do when you encounter Funky Causes in the (historical) Wild

Abstract:

This chapter explains how the rise of the Mechanical philosophy during the seventeenth century contributed to the transformation of the traditional, Aristotelian schema of four causes into the dominance of efficient causation as the paradigmatic cause by the time of David Hume. But the chapter simultaneously shows that the mechanical philosophy also gave rise to a number of problems internal to it, as diagnosed by Newton and Newtonian natural philosophers, that facilitated more careful analysis of the nature of causation.

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Introduction

At the start of the seventeenth century, which coincides with the development of an intellectually fertile period known as 'the scientific revolution' and 'early modern philosophy,' a number of thinkers (e.g., Bacon, Descartes, Galileo, etc.) polemicized against the suitability of most of the four familiar Aristotelian (viz, final, formal, efficient, and material) causes. This was part of a more general attack on scholastic natural philosophy. In what follows, I first explain how the success of this polemic leads into a plausible narrative in which David Hume culminates and himself effectuates a process of ruthless elimination: efficient causation simply became what we now call 'causation.' I then complicate this narrative by backtracking into the seventeenth century and by showing that there is a much richer story to be told about the fate of causation during the scientific revolution. I then close with a suggestion for a number of new research projects related to this thicker historical understanding. This chapter is, thus, useful background to the chapters of Fletcher and of Frisch on causation in physics to those chapters engaging with the metaphysics of causation and of mechanism.

Hume revisited

But first let me flesh out the natural narrative that centers on Hume. Hume offers a blistering attack on formal, final, and simultaneous causes in the youthful (1739) *A Treatise of Human Nature* (hereafter: Treatise).[1] Of the four Aristotelian causes, this left only efficient causation standing. In fact, it seems evident that in his early work Hume modelled causation on the template of the then ruling mechanical (scientific) philosophy with its emphasis on contact between and regular succession of cause and effect (see Schliesser 2009; Schliesser & Demeter 2020).

In the Treatise, for Hume a cause had to be temporarily prior and contiguous to its effect "where all the objects resembling the former are plac'd in like relations of priority and contiguity to those objects, that resemble the latter." This gave rise to the so-called regularity thesis of causation. In it causation is nothing beyond the temporal and spatial priority of objects that precede their purported effects. Crucially, it does not involve any reference to power or necessity or hidden source of activity. Commitment to such hidden powers is a feature of both Aristotelian and Newtonian natural philosophies (amongst others).

In fact, as scholars have noted, in the Treatise, Hume's wording is *also* compatible with the idea that causation is, in fact, a projection of necessity by the human mind and the effect of custom (Kail 2010: Marušić 2014). In the Treatise, Hume's treatment of causation is explicitly at odds with Newtonian action at a distance (which denies temporal contiguity and requires simultaneous causation) (Schliesser 2009; Hazony & Schliesser 2016).

In the more mature first Enquiry (1748; hereafter EHU), Hume first dropped thespatial contiguity requirement that is part of the account of causation in the Treatise. He then also invented, as Menzies and Beebee note with surprise in the *Stanford encyclopedia of philosophy* ("surprisingly enough,") the modern conception of causation by offering a counterfactual definition of it, "We may define a cause to be an object followed by another, and where all the objects, similar to the first, are followed by objects similar to the second (Menzies & Beebee 2020). Or, in other words, where, if the first object had not been, the second never had existed." (EHU 7.29) This definition proves, once again, that lack of logical rigor need not prevent fertile insight. Be that as it may, in the second quoted sentence from

[1] I cite Hume's works by paragraph number as these can be found at WWW.Davidhume.org

the Enquiry, causation seems to be constituted by an explanation in terms of a counterfactual conditional.

The abbreviated account of the elimination of three of the four Aristotelian causes by Hume which only left 'efficient causation' standing offered in the previous three paragraphs is not wholly misleading. But this chapter will complicate the story along multiple dimensions in order to show that final causes survived Hume's criticism and that efficient causation was made compatible with programs we do not associate with the scientific revolution at all. First, take, for example, the status of final causes: Descartes, Boyle, and Bacon agreed that final causes have no place in physics, and it is natural for us to think this represents the consensus of Enlightenment opinion. For, Spinoza, Diderot and Hume polemicized in rhetorically powerful ways against final causes *tout court*. However so-called 'general' final cause(s) – also known as (God's) 'providence' – remained respectable among many leading natural philosophers and scientists even through the nineteenth century (Osler 1996). If anything, the more ordered nature was revealed to be, the more plausible Deism and so God's ordering of nature seemed to leading figures in the scientific revolution (including Newton and Euler (Schliesser 2021). And while Descartes and Newton expressed rare agreement with each other that 'local' final causes should be banished from physics, Leibniz defended their use to account for least action principles in (say) optics (McDonough 2009 & 2020). As late as J.C. Maxwell (1831 – 1879)), the cautious heuristic use of them in physics was explicitly advocated (Stanley 2012). It goes beyond my remit to discuss to what degree teleology is still lurking in contemporary physical sciences.

Second, the attack on Aristotelian causation in the scholastic edifice also opened the door to a number of doctrines that emphasized the total reliance of all instances of apparent causation on God's (hyper)agency only. So, for example, reviving a doctrine developed within Islamic *kalam*, and associated with Al-Ghazali, Malebranche, who thinks of mechanical philosophy as providing a model of intelligibility, claimed that "there is only one true cause because there is only one true God; … the nature or power of each thing is nothing but the will of God; … all natural causes are not true causes but only occasional causes." For occasionalists, God is the one and only true cause and other apparent instances of causation are the occasion (hence the name) for God's activity. In addition to Malebranche, it is natural to read Berkeley as a defending occasionalism (Lee 2020), and so inspiring Hume's response

A natural route to occasionalist views was the positing of the passivity of matter by the new mechanical philosophy alongside a rejection of all the 'occult' qualities to be found (purportedly) in Scholastic philosophy. This combination of commitments seemed to require a source of motion at creation and a source that maintained motion through the passage of time.[2] From here the step to doctrines that required God's superintendence of all affairs was fairly small. In addition to occasionalism, in some circles, divine concurrence (the view that all effects are caused by God and natural creatures) became popular (Schliesser 2012).

Because the passivity of matter – that is, motion could not be self-caused but required some external impulse -- was a widely held view among adherents of the new sciences, some scholars read Newton's discovery of the law of universal gravitation as either requiring, as Locke thought, God to endow matter with special qualities at creation (also known as 'superaddition') or necessitating God's direct involvement in all physical/gravitational interactions (Downing 1998). This interpretation of Newton as licensing the activity of 'god of the gaps' was offered, with a knowing nod to Cicero, by Toland in his (1704) *Letters to Serena* in order to ridicule it and to argue for a more 'active' conception of matter

[2] Views (like Spinozism) that posited the existence and preservation of eternal motion seemed to be begging the question (Schliesser 2012).

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(Schliesser 2020). Newton's views on action at a distance are highly contested in the secondary literature, but recently the scholarly consensus has shifted toward suggesting that he endorsed action at a distance without being able to explain how it operated.[3]

Newton revisited

It is worth looking more closely at Newton's philosophy of nature because Newton revealed the limitations of the mechanical philosophy's conception of causation some of which also cause trouble for Hume's (later) views. In discussing Newton's significance to the development of causation, there is an understandable tendency to focus on the inverse square law of universal gravitation. This violates the mechanical philosophers' model in which contact between very small corpuscles explain observed phenomena. For, a typical mechanical philosopher – e.g., Beeckman, Descartes, Huygens, Boyle -- creates a hypothetical model, a machine with pulleys and levers (etc.), that can make observed phenomena intelligible (Roux 2017). This model illustrates how a phenomenon is possible by reducing it to efficient causes, that is, the interactions of bodies. This emphasis on hypothetical explanations, which are probable in character, also exhibit a deep strain of skepticism about the very possibility of truly grasping nature's innards as it were. (The skepticism would have been felt by the historical actors who thought that knowledge is certain and un-revisable in character.) Spinoza's *natura naturans* and even Kant's *ding-an-sich* are the enduring expressions of this strain of skepticism (even while allowing that Kant is much less a mechanical philosopher).[4]

The scholarly fascination with the status of action at a distance is, thus, readily explicable because it violates the very model of intelligibility taken for granted in the mechanical philosophy. As Newton notes in the General Scholium (first published in the 1713, second edition of the *Principia*), universal gravity "operates, not according to the quantity of the surfaces of the particles upon which it acts, (as mechanical causes use to do,) but according to the quantity of the solid matter which they contain, and propagates its virtue on all sides, to immense distances, decreasing always in the duplicate proportion of the distances." In what follows I show that even on its own terms the mechanical philosophy's account of causation had generated significant internal problems and that Newton refutes it without having to appeal to action at a distance (which may be thought question-begging). That is, if we pay attention to the details of the history of physics, we'll discern innovations in the metaphysics of causation.

Before I get to that, it's worth emphasizing that one attractive feature of the mechanical philosophy is that it invites research into a foundational question: the (mathematical) laws of collision of perfectly hard (or elastic) bodies in a closed system (so excluding outside interferences). In his (1644) *Principles of Philosophy*, Descartes offered some (not entirely plausible and potentially mutually inconsistent) examples of this, which he claims could be derived from the laws of motion (Clarke 1977). This became an open research question that was only solved independently by Huygens, Wallis, and Wren in the late 1660s. Their solutions were especially noteworthy because they articulated the same mathematical rules while disagreeing over background metaphysics. It seemed an autonomous area of scientific consensus was born (Jalobeanu 2011).

But while mechanical philosophers treated collision as the model of intelligibility, problems were, as I hinted above, lurking in plain sight. First, as Henry More wrote Descartes, and Locke argued in the

[3] For an overview, see Henry (2017). For discussion Schliesser (2021b).

[4] The adherence to variants of Principle of Sufficient Reason (or some such causal principle) in one's explanations is, thus, not an act of intellectual hubris, but a self-limitation of the knower when it comes to fundamental ontology.

Essay (2.23.28), there is something wholly unintelligible about the way (Cartesian 'degrees of') motion is supposed to be transferred from one body to the other at an instant (Jalobeanu 2011). Second, in collisions it seems that the impacted, unthinking, lifeless, passive bodies 'know where to go' after impact. For, the quantity of motion gained by one body is compensated by the quantity of motion lost by the other. Relying on Galilean relativity, in Huygens' rules, the quantity of velocity is exchanged (Belot 2006). But why the impacted body obeys this rule is unclear. That there is a deep connection between conservation principles and such symmetry is now well established, but why this would be so, if one exclusively focuses on the nature of impact, is a mystery from *within* the mechanical philosophy.

At this point, one natural thought is to treat the laws of nature as primitive and thereby grounding explanations for things that follow from them or are derived from them. And, in fact, at *Principles of Philosophy*, Part II, article 37, Descartes himself treated the laws as so-called second causes (with God being the first or original cause; Hattab 2000). What Descartes means here is by no means obvious, and it is tempting to treat laws as 'primitive' to this day (Maudlin 2007). Others (Bacon and Newton) have been read as suggesting that such laws are productive and so (a new version of, and) like formal causes (Kuhn 1977; Stein 2002; Biener & Schliesser 2017).

Of course, if these laws of nature are grounded in God's immutability, it is also tempting to treat them, as Toland and Berkeley proposed, as instrumentally useful book-keeping fictions. This helped set up Reid's claim that in physics the search for causes is fruitless and that one should focus on discovering laws of nature: "He [Newton] saw, that all the length men can go in accounting for phenomena, is to discover the laws of nature, and therefore, that the true method of philosophizing is this, from real facts ascertained by observation and experiment, to collect by just induction the law of nature, and to apply the laws so discovered, to account for the phenomena of nature." (quoted from Ducheyne 2006.)[5] It's but a small step to a variety of nineteenth and twentieth century positivism. Reid's position follows naturally from Hume's response to the mechanical philosophy. Let me explain.

Hume's 'positivism' revisited

The mechanical philosophers were not so naïve to think that models that relied on mere impulse or matter in motion, could create hypothetical models of sufficient complexity to provide hypothetical explanations of the phenomena. This is especially challenging because the mechanical philosophers also posited a homogeneous matter. So, more principles seem required to account for observed diversity. To get around this problem, in addition to matter and motion, the mechanical philosopher posited size and shape not merely as *effects* of motion, but also as key explanatory factors in the hypothetical models of visible phenomena. This can be seen in Descartes, Gassendi, and Boyle, whose "The Origin of Forms and Qualities according to the Corpuscular Philosophy" (1666), it's natural to take as a canonical statement of the mechanical philosophy. So that the mechanical philosophy is committed to privileging (to echo a felicitous phrase by Biener & Smeenk 2004 & 2012) geometric features of bodies.

What this means, and this is familiar enough, is that in addition to focusing on collision, mechanical philosophers posit a hidden world of true causation, or powers, that generates either through emergence/expression or through causation the world familiar from visible or sensible qualities. (These powers may be primary qualities or part of a hidden essence, but that is irrelevant for what follows.) Hume noticed that this explanatory model is fragile: "The powers, by which bodies operate, are entirely unknown. We perceive only their sensible qualities: and what reason have we to think,

[5] Reid did endorse substance or agent causation (by minds).

that the same powers will always be conjoined with the same sensible qualities?" (David Hume Abstract 15-16; see also Treatise 1.3.6) When Hume, thus, diagnoses, what came to be known as the 'problem of induction,' or the lack of solid grounds for our inferential practices, he focused on two (related) problems: (i) one concerns the connection among sensible qualities, and (ii) the other concerns the connection between hidden qualities and the visible/sensible qualities. In both cases, our only source for there being such a connection is the very empirical practice we are trying to explain or justify.

This is, in fact, why Hume's philosophy of science is so deflationary: all any science can track are the relations that obtain among visible qualities (the *locus classicus* is Cassirer 1910 [1923]). These relations can be grouped together and given names ("elasticity, gravity, cohesion of parts, communication of motion by impulse") and be treated as "causes" of the phenomena, but these names do not signify or explain features of hidden powers. In Hume's philosophy of science, science remains at the surface of experience. Hume made the point explicit in a note added to the Treatise: "If the Newtonian philosophy be rightly understood it will be found to mean no more. A vacuum is asserted: That is, bodies are said to be plac'd aftersuch a manner, as to receive bodies betwixt them, without impulsion or penetration. The real nature of this position of bodies is unknown. We are only acquainted with its effects on the senses, and its power of receiving body."

Newton's criticism of mechanical philosophy

Now, the position attributed here to Hume on the Newtonian philosophy, was not Newton's own view of his science. I offer two observations. First, even leaving aside the inverse square law and its universal scope, Newton's experimental work on gravity demolished a key feature of the mechanical philosophy: size and shape are irrelevant to understand terrestrial gravity. I quote from Pemberton (1728: 60):

> It will be proper in this place to observe concerning the power of gravity, that its force upon any body does not at all depend upon the shape of the body; but that it continues constantly the same without any variation in the same body, whatever change be made in the figure of the body: and if the body be divided into any number of pieces, all those pieces shall weigh just the same, as they did, when united together in one body: and if the body be of a uniform contexture, the weight of each piece will be proportional to its bulk. This has given reason to conclude, that the power of gravity acts upon bodies in proportion to the quantity of matter in them. Whence it should follow, that all bodies must fall from equal heights in the same space of time. And as we evidently see the contrary in feathers and such like substances, which fall very slowly in comparison of more solid bodies; it is reasonable to suppose, that some other cause concurs to make so manifest a difference. This cause has been found by particular experiments to be the air. --1.2.24 [emphasis added]

Pemberton (who was the editor of the third, 1726 edition of the Principia) goes on to give Boyle's famous vacuum experiments with falling feathers and stones as evidence for this argument. This shows that mechanical causes alone (e.g., the "shape," size (the "figure"), and texture (feathers vs stones) of colliding bodies) cannot explain the phenomena of falling bodies in a vacuum. In fact, Pemberton uses Boyle's experimental work on the vacuum to refute Boyle's mechanical philosophy! That is, mechanical causes are neither necessary nor sufficient to explain ordinary physical phenomena. The Newtonian idea of mass ("quantity of matter") is explanatory more basic.

Now, in the *Principia*, references to Boyle's experiment got added only to the (1713) second edition in two highly prominent places: Cotes added a reference to it in his editor's introduction and Newton added a reference to it in the General Scholium at the end of the book. In both cases Boyle's

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experiment is used as a kind of illustration for the claim that without air resistance falling bodies are equally accelerated and for the plausibility of positing an interstellar vacuum. That is, if one reads the *Principia* superficially (by looking at prominent material at the front and end), it seems as if Newton and Boyle have converging natural philosophies (Schliesser 2013).

Of course, neither Pemberton nor Newton rely exclusively on Boyle's vacuum experiment to make the point that shape and size (or geometry) is not a significant causal factor when it comes to gravity. The key work is done by pendulum experiments with different metals. Newton drives the point home in Book III, Prop. 6 of Principia, but he is referring to material described in Book II. (Smith 2017) These experiments show that quantity of matter is more fundamental than shape. And, crucially, shape and size and quantity of matter need not be proportional to or proxies of each other. This fact was by no means obvious, and at the start of the *Principia*; even Newton offers, as Biener and Smeenk (2012) have highlighted, a kind of geometric conception of quantity of matter in his first definition before suggesting that 'quantity of matter' is proportional to weight (and indicating his pendulum experiments as evidence thereof).

What's important here is that even if Newton had been wrong about the universal nature of the inverse square law, he had showed empirically that the mechanical philosophy cannot account for the experimentally demonstrated features of terrestrial (and planetary) gravity. The mechanical philosophy is not a natural way to understand Galilean fall—the paradigmatic achievement of the new scientific philosophy. Thus, Newton shows that the mechanical philosophy's emphasis on just one kind of efficient causation, by way of contact, is not sufficient to explain the system of nature.

To be sure, Newton, too, accepted a kind of homogeneous matter, but rather than its size and figure, he showed that an abstract quantity (mass) is more salient. Of course, how to understand mass in Newton's philosophy opens new questions, for it should not be taken as a property of matter, but rather as *a measure*. (Belkind 2017)

This gets me to Newton's second important deviation from the picture presented of Newtonian natural philosophy by Berkeley, Hume, and Reid. The Principia is designed to teach one how to establish the true causes of accelerations of motions. However, forces themselves are abstract mathematical quantities and are measured independent of any commitments regarding their physical sources (Smeenk & Schliesser 2017). Again leaving aside questions over action at a distance, Newton also leaves hanging how to understand how an abstract mathematical quantity can interact with or cause other abstract mathematical quantities or bodies in motion. The debate over action at a distance overshadowed this more basic conceptual and metaphysical problem about the nature of causation.

Conclusion: funky causes

Let me close with three final connected observations. First, by focusing on the role of the mechanical philosophy in facilitating the reduction from four kinds to one kind of cause, I have partially obscured the way seventeenth century natural philosophers explored a whole range of other 'funky' causes. By 'funky causes' I mean those causes that do not fit naturally in a classification of the four Aristotelian causes.

Let me mention four more prominent of these funky causes are: (i) eminent causes (familiar from Descartes' *Meditations*), where qualities or properties of the effect are already contained in the cause.

Crucially, the cause and the effect are fundamentally unalike or differ in nature.[6] This is structurally analogous to (ii) emanation, which historically is often introduced to explain God's creation without having to treat God in time. This is derived from a neo-platonic account of emanation, which relates a pure or perfect cause with an impure or imperfect imitation of it. The perfect cause is said to emanate a property to the imperfect effect so that the effect "participates in" or has an inferior version of the property or accident. So, for example, there are passages in Newton, where immutability and eternality are immediately transferred from the cause (God) to an effect (space and time). Thus, for Henry More, an emanative cause is an immediate cause which is co-present with its effect. As More writes, "a Cause as merely by being, no other activity or causality interposed, produces an Effect" (quoted in Jalobeanu 2007)

Then there are (iii) immanent causes, which aim to capture the idea that some effects take place within the cause of the effects. In recent metaphysics such causes are understood as (free and) moral agents (Zimmerman 1997). But in Spinoza, immanent causation is a feature of the one and only substance, who is not well understood as a moral agent (Melamed 2006).

The most controversial funky causes were those that (iv) were simultaneous with their effects over potentially enormous distances as one can find in forms of cosmic sympathy (and universal gravity). 'Sympathy' was used as a kind of place-holder for apparent simultaneous cause and effect relations that seem to operate over enormous distances. In fact, the very possibility of sympathy presupposes what I have called the 'likeness principle:" that is, that sympathy takes place among things that are in one sense or another alike within a single being/unity/organism to be contrasted with the antipathy (ἀντιπάθεια) of un-alikes (Schliesser 2015). As noted above, Hume goes after the latter with an argument that, if successful, would suggest that the existence of simultaneous cause-effect relations would undermine the very possibility of succession, and so no motion (or time) would be possible, "and all objects must be co-existent." (Treatise 1.2.3.7-8)

Second, since Hume only one notion of causation predominates (be it the regularity, counterfactual or manipulative view) in which the homogeneous causal-effect structure is fairly restrictive, but what can enter into the relata is rather permissive. This predominance re-opens the door to new kinds of causes in, say, metaphysics (Hawthorne & Nolan 2006; Jenkins & Nolan 2008) or philosophy of biology (Haig 2020), that can be thought of as the modern counterparts of early modern funky causes and that aim to track differences that make a difference not well served by such homogeneity.[7]

Third, it is, thus, no surprise that as Scholasticism is rejected, we see a diversity of other causes during the early modern period. For, if we want to distinguish and classify the great variety of differences that, in a sense, make a difference even Aristotle's four causes may seem too few. I suspect the historical path dependency of this fact -- a great variety of differences that make a difference were labeled a 'cause' -- has made it so elusive to offer a unified, semantic analysis of causation. Historically there have been many paradigmatic causes that really fit in different boxes. And so our contemporary, ingenious analysts can always generate a counter-example or find an intuitive challenge to any attempt to offer a hegemonic definition or analysis. The heterogeneity of natural differences that

[6] Structurally that's very close to a formal cause, but the formal cause can be highly abstract entity or feature whereas the eminent cause need not be so. (Confusingly an eminent cause can, in scholastic jargon, cause formally.) In addition, the content of a formal cause often is similar in nature to the effect (or features of it).
[7] Another way to track differences that make a difference not well served by such homogeneity is through probabilistic causation. (See this volume <>.)

make a difference is presumably why neo-Aristotelian approaches are a recurring temptation (Groff & Greco 2013).

Eric Schliesser, December 11, 2023[8]

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