**On Causation: with Special Reference to Hume**

 There is a standard account of the nature of causality that treats it as a relation between discrete events characterized by a unique but familiar form of non-logical necessity capable of supporting law-like generalizations about observed sequences of events. According to this account, causes are events that are uniformly precede other events, so that the cause is always observed prior to the effect and the effect unfailingly observed subsequent to the event designated as its cause. This account is not the only account of the nature of causation devised by philosophers, but it is the one that has dominated philosophy since the rise of the New Science in the seventeenth century.

According to this account when treated realistically, causation is always *efficient* causation involving some sort of direct, external influence of the cause on the effect, most often designated as an *influxus physicus*.[[1]](#footnote-1) During the time of Hume, there were two kinds of causes that were generally posited by philosophers: bodies and minds. Bodies were thought to cause changes in other bodies by means of direct contact, and their interactions resolvable into interactions between even smaller bodies, so that all change can ultimately be accounted for in terms of the interaction of simple bodies (“uncuttable” atoms) characterized by a few simple mathematical properties: solidity, mass, motion and rest. On this account, all gross bodies, their states, and their observable properties and effects are understood to be to be the mass consequence of an untold number of interactions among these simple bodies and thus, in principle, to be capable of *explanatory reduction* to the laws of mechanics governing the interactions of those simple bodies.

Minds were also conceived of as efficient causes, directly influencing the body in the production of voluntary action by a special kind of *influxus physicus*. The mind or soul, the seat consciousness and rationality, was seen as directing the body by means of its volitions, or acts of will, capable of producing changes in the passive, unthinking material body by a form of direct influence, just as the body was capable of directly influencing the mind in the production of sense-experience. Although there was a great deal of controversy and speculation about the nature of this influence, called mind-body interaction, the general consensus among philosophers, in agreement with Descartes, was that the *fact* of interaction was so well attested to by our experience that the mystery of interaction had merely to be accepted even if it could not be further explained. Evidently, the form of causal influence involved was unique, and for that reason mysterious, but no less so than, say, gravitational influence or magnetic attraction, which were nevertheless universally accepted as facts of nature. Since I have already discussed the latter form of causation elsewhere, here my concern will be with the former, i.e. body-body causation.[[2]](#footnote-2)

It was this picture of causation, and its applications within his own time, that Hume attacks in the *Treatise* and the *First Enquiry*. In so doing, he follows (and, indeed, borrows extensively) from Malebranche and Berkeley, who also attack the notion of causal interaction understood in the manner just sketched. It is also this account of causation that Kant attempts to defend (at least in part, *sans* realism) in the *First Critique*, specifically in the *Second Analogy*. Most historians of philosophy hold the view that Hume’s critique of this view still stands, and that Kant’s attempt to defend the notion of causal necessity, even in a mitigated and merely psychological fashion, fails. That we still care about this is perhaps because, despite all the changes that have happened in philosophy and natural science since the eighteenth century, most of us still find ourselves committed to this basic picture of things. In this paper, I want to suggest that there is an alternative to what has, through mere familiarity and constant repetition, become the received view about causation and draw some implications, both about the historical sources of the debate about causation in Early Modern Philosophy and the importance of Hume’s arguments against the picture of causation sketched above. It so doing, I hope to “de-center” Hume and his perspective in the philosophy of causation.

 I

In his *Recherché*, Malebranche opposes two concepts of nature: the scholastic/Aristotelian and that of the New Science.[[3]](#footnote-3) On the first, nature is a realm of substances with substantial forms, which endow them with natures with essential properties that are the foundation for the dispositional properties by means of which they manifest that nature in observable surface properties. Where causation is concerned, among those dispositional properties are those that endow substances with casual powers and potentialities for change. On this view, causal interaction between substances involves the application of a causal power by the cause, which is always an agent, to the patient, with a resulting change in the patient, called the effect.[[4]](#footnote-4) On the view associated with the New Science, especially Galileo and Descartes, nature is composed of complex substances, all the behavior of which can be accounted for in terms of simple substances possessing only quantitative properties interacting according to the mathematical laws of mechanics. In turn, causation is what I have described above: a necessary relation between events ordered in time as earlier to later and governed by natural law. The job of the natural scientist is to discover these laws and apply them to the description and transformation of nature *and nothing more*. Natural science is thus freed from the skirts of metaphysics and bids fair to replace philosophy altogether as the sole source of our knowledge of nature.

Of course, the latter only follows if this conception of things proves adequate to its own ends, which is precisely what Malebranche, Berkeley, Leibniz and Hume propose to challenge and replace with some anti-realist account of science: Malebranche and Leibniz with Occasionalism/Pre-established harmony, Berkeley and Hume with something like Instrumentalism. Kant, in turn, wants to preserve the objectivity and necessity of Newtonian physics without, however, rescuing scientific realism about nature considered in itself: Kant’s theoretical philosophy rules out the possibility of our knowledge of *noumena*, though for all we can know what science says about the world could be true after all. What unites all of these philosophers, however, is their common endorsement of the New Science and its account of nature. None of them shows the least inclination to consider the Scholastic account of nature as worth retaining, even in part. It is this common commitment, I suggest, that leads to the apparently intractable epistemological problems surrounding the notion of causality revealed by Hume’s critique of causal claims and the notion of causal necessity, which in turn motivates their unpalatable alternatives to causal (and thus scientific) realism. More than this, I propose to lay the blame for this precisely where it belongs, at the feet of the New Science itself and to argue that the metaphysical inadequacy of its picture of nature strongly argues the need for a rapprochement between the New Science and the Aristotelian account of nature. I shall then sketch how this might be accomplished with regard to the subject of causation.

 II

The New Science, as fully articulated in the eighteenth century, conceives of the external world as a system of bodies in motion, ultimately reducible to simple substances (*mikra*) possessing a few quantitative properties and interacting in accordance with mechanical laws of nature.[[5]](#footnote-5) These laws, it was held, were universal and exceptionless. Indeed, Kant regarded this as the hallmark of all law properly so called, and therefore modeled the moral law, not on statute law as had traditionally been done, but on Newton’s laws of motion. These universal laws were therefore conceived of as *necessary* principles governing the behavior of all bodies in the external world in all circumstances without exception. At the same time the New Science, in principle at least, reduced all change of whatever kind to change of place – for the New Science, all motion (from the Latin *motus*, the generic word for change) is *local motion* or change of place. All causes, then, are ultimately to be understood as causes of local motion, at the last among atoms, by means of which changes in the physical microstructure of bodies are affected – the only sorts of real changes countenanced in the New Science. Events, then, are change-producing interactions among bodies, whether complex or simple, involving law-governed changes in the motions of those bodies themselves or their *mikra*.

 The difficulty with all this is that the concept of motion in the New Science seems a poor fit with the notion of law-governed causal necessity. Change, on this view, is always at bottom a consequence of the initiation of local motion as a result of contact between bodies. Yet motion and rest, on the view before us, can at best be conceived as *persistent states* of bodies and these have no independent ontological or causal status. Unlike Aristotelian potentialities, the late medieval *impetus* (motive force, a power of movement transferable from one body to another), or qualitative properties, motion and rest as persistent states of body can only characterize bodies as moved, or as not moved, never as *causes* of motion. While we can use the mechanical laws of physics to describe and predict the behavior of moving bodies as a consequence of their interaction with one another, unless we suppose that these mathematical laws themselves somehow exert causal force over concrete events in the real world, there is clearly an explanatory gap in the account of cause and change in nature presented by the New Science.

 It is precisely here that philosophers like Malebranche, Berkeley, and Hume find the entry point for their attack on causal realism. Malebranche, accepting the Galilean and Cartesian interpretation of physics, supposes that material things are essentially geometrical in character, ultimately reducible to extension and its modes, and argues that geometrical entities of this sort cannot possess any causal powers. Although physicists continue to talk about “forces,” “powers,” “causes,” “effects,” as though these were real things and descriptive of real processes occurring in nature, such terms are merely holdovers from the Aristotelian physics of substantial forms and occult qualities, and can have no clear meaning within the conceptual scheme of the New Science. Since we ought never, especially in the exact sciences, to use terms without a clear meaning and reference, such terms should either be eliminated from science altogether, or used without ontological commitment. In either case, causal realism will have to be abandoned and scientific realism along with it.[[6]](#footnote-6)

 Both Malebranche and Hume argue that we have no apprehension of causes understood as necessary connections between events occurring in experience. Hume goes to the root of the problem by using a real world analogue of the New Science’s account of change – the interaction of two billiards balls, which we can treat as atoms writ large – to illustrate this. If we examine our experience of seeing one billiard ball “move” a second one through contact, all we actually see is one billiard ball already in motion roll up to a second billiard ball at rest, make contact with it, and then see the second billiard ball begin to move. That’s all. We have no impression of “cause” or “necessary connexion” of any kind in this experience, and thus have no impression to which to tie the meaning of these terms. We thus have no idea of “cause” or “necessary connexion” in this context and talk of such things is literally meaningless on the empiricist account of meaning according to which the meaning of a term has to be cashed out in terms of actual or possible experience.[[7]](#footnote-7) Hume goes on to argue that we can have no inferential justification for belief in causes or causal connections in nature, either on the basis of *a priori* proofs based on conceptual analysis or on induction from past observations. These arguments are familiar enough that there is no need to rehearse them here, nor indeed would it be to my purpose to do so.

 Having dispatched the illusion that we have any impression or idea of “cause,” or more accurately, of causes of motion as this notion is understood in the New Science, Hume has also undermined any realistic interpretation of the New Science as actually descriptive of nature as it is in itself. Like Berkeley before him, Hume embraces a purely instrumentalist account of science that carries with it no ontological commitment and treats science as merely a means of prediction and control of our experience, one for which we have no guarantee of its objectivity or permanence. Indeed, both Malebranche and Berkeley contend that, to the extent that science tells us anything about reality, it simply tells us what laws God has decreed in order to govern the order of events in nature as we experience it, not about processes occurring in the noumenal world, while Hume remains agnostic about this matter. In order to account to our unshakeable, instinctive tendency to believe in causes and rely on induction, Hume proposes his famous psychologistic account of the origin of the idea of causal connection. Experience shows us, says Hume, that there is nothing more to our experience of causal processes than constant conjunction of events in experience. As a result of repeated observations of event A followed by event B, we begin to anticipate the occurrence of B upon seeing A. After a while, this anticipation turns into a settled habit and becomes thus irresistible for us. This psychological irresistibility becomes interpreted, through Humean projection, as a feature of the sequence itself, at least by philosophers and scientists. The necessity of causal sequences, then, is merely an illusion and our belief in that necessity merely an error. The true necessity lies elsewhere, in the nature of our psychological makeup.[[8]](#footnote-8)

 Hume’s positive account of the origin of the belief in causes is rather less compelling than his arguments against the received view of causation rooted in the New Science. Hume constantly claims that belief in causes is merely a matter of “custom and habit,” but it is surely more than this, even on his own account. Customs and habits, after all, are local, changeable, and often idiosyncratic, whereas Hume’s own account treats belief in causes as natural, inevitable, and universal among human beings. More than this, he insists that we are (so to speak) “hard-wired” by nature to interpret experience in terms of necessary causal sequences, and that there is no alternative to acquiescing in this common human illusion, against which skeptical cavils, no matter how seemingly irrefutable, can carry no weight outside the philosopher’s closet. Nor need we feel any scruple about doing so, since nature will accept no correction from reason and it thus lies outside our power to believe otherwise than we do.

 Even so, there is at least one aspect of Hume’s account that remains troubling, at least to me. In order for this ingrained habit of belief in causes and causal necessity to develop, it has to be the case that there are a great many, virtually exceptionless regularities in experience capable of not merely *producing* but also *gratifying* expectations concerning the course of future experience. If not, then the habit will not be produced or will be focused on just a few elements of experience. Further, these expectations have to be largely consistent with each other, since otherwise they will produce conflicting expectations and cease to claim our allegiance, in accord with Hume’s own account of the waxing and waning of belief. These are fairly strong conditions for the formation of such a “habit,” and hardly to be expected on the basis of mere chance alone, especially over an extended period of time. They are too surprising and significant, then, to be regarded merely as “original existences” – Hume’s idiom for surd facts. Indeed, such reflections naturally lead us to a very non-Humean supposition: that the best explanation for regularities in experience is something prior to or outside of experience that accounts for this otherwise highly improbable fact.

 It is here, perhaps, that we find the entrée for Kant’s attempt to find a middle path between causal realism and Hume’s illusion theory, one that at least preserves the objectivity of the New Science and endows it with some kind of internal necessity without trying to revive scientific realism. In the *Second Analogy*, Kant emphasizes that we routinely draw a distinction between causal and non-causal sequences in experience, a distinction that we can even extend to certain cases of “constant conjunction” in experience.[[9]](#footnote-9) The regularities that we identify as causal ones are those whose temporal ordering, while reversible in the imagination, are irreversible in experience. That these sequences are reversible in imagination shows that it is not a consequence of the nature of the things imagined that determines the temporal order in which these events occur in experience. At the same time, something must account for the uniformity, regularity and reliability of these sequences as we experience them. Kant proposes that what distinguishes those sequences that we identify as causal sequences from non-causal ones is that the former and not the latter are governed, because produced by, the mind in accordance with a rule. The proffered explanation is also, in a transcendental sense, a psychological one. However, unlike Hume’s account, Kant’s account endows the causal sequence itself with necessity and objectivity in experience by suggesting that it is the product of *a priori* structures of the mind without which no coherent experience is possible for any experiencer. Thus, the operation of the mathematical laws in physics is no mere product of chance habit but is instead built into the very conditions of the possibility of coherent experience. More than this, they are necessary in the further sense that they are not subject to change or alteration – so long as coherent actual experience occurs, these laws will be in force. They thus bid fair to be *a priori* synthetic principles, knowable by pure reason yet guaranteed to be applicable to experience if and for as long as there is any *coherent* actual experience.

 Most philosophers believe that Kant’s arguments for this position, insofar as they are not merely statements of an attractive alternative to Hume, fall far short of clarity or conviction. In any event, Kant’s position certainly falls a good deal short of causal realism, and thus of anything like the scientific realism espoused by Galileo, Descartes, Newton and most modern scientists and philosophers. At the same, it is hard to see how we can get much further than Kant’s position within this philosophical paradigm. What we really need is an alternative to this entire way of thinking, one inspired by the despised Aristotelian paradigm so vehemently rejected by proponents of the New Science. Such an alternative will provide two things for us. First, it will reveal that the apparently general philosophical problems about the nature of causation and causal connections in nature are merely apparently so and really just a puzzle generated by the attempt to take the New Science as the foundation of, or surrogate for, traditional metaphysics. Second, it will offer a way of conceiving causal connections that actually solves these problems and shows how extramental natural processes can be characterized by their own inherent necessity. In this way, it will also lay the groundwork for a chastened or mitigated scientific realism sufficient to the aims of science itself, though not to those who want to replace metaphysics or philosophy with some version of reductionistic physicalism.

 III

 Many years ago, Elizabeth Anscombe suggested that understanding the concept, and therefore the nature, of causation requires that we cease to focus on “cause” and “effect” as *nouns* and instead focus on the *verbs* we use to identify and name causal processes.[[10]](#footnote-10) Indeed, the words “cause” and “effect” are quite meaningless when they are used to designate events or even objects merely as temporally successive in experience: at most, they can designate one thing or event as cause and another thing or event as effect based simply on temporal priority or regular succession, which appears to reduce every causal judgment to the status of a *post hoc* fallacy. It is not surprising, then, that the connection between these things or events by means of which these things or events acquire these names seems incomprehensible. Perhaps all this indicates, however, is that when we focus on the concept of “cause” as such we are looking in the wrong place. Following Anscombe’s suggestion, it might be more illuminating to focus on causal verbs naming causal processes. Anscombe’s list includes *scrape*, *push*, *wet*, *carry*, *eat*, *burn*, *squash*, *make*, *knock over*, and *hurt*; there are many others.

 What is the alternate, Aristotelian or Scholastic account of causation that I think is superior to that adopted by proponents of the New Science and apparently demolished by Hume? I have already stated it above. Causation consists in the state-of-affairs in which an agent applies a causal power to a patient and thereby produces a change in that patient, called the effect. In event terminology, an instance of transeunt causation is a single, continuous, transtemporal event that begins with the application of the causal power by the agent to the patient and ceases when the effect has been produced.[[11]](#footnote-11) This application of causal power by the agent to the patient resulting in a change in the patient or effect is a single event, not two temporally successive events united by some mysterious “causal relation” or “necessary connection.” It is continuous and transtemporal inasmuch as it is temporally extended, i.e. occurs over a period of time rather than at single moment in time, and possesses *duration*, i.e. is infinitely divisible in time but without proper parts or stages. By contrast, causal sequences or processes do have proper parts, i.e. interrelated stages consisting of a series of interdependent instances of causation or discrete mechanisms, each of which provides a necessary condition for the next one in the series and results in a final outcome.

On this account, the exercise of a causal power on the part of the agent is simultaneous to the affection of the patient occurring in the production of the effect. While there is a priority of the cause over the effect, the priority is not temporal but instead the sort of metaphysical priority that I have elsewhere characterized as the EOG relation.[[12]](#footnote-12) The account given here is similar to the Scholastic notion of a *per se* cause, one according to which cause and effect are related in such a way that the effect requires the continuous operation of the cause in order to exist. This is traditionally contrasted with the *per accidens* cause, which while necessary for the coming-to-be of the effect is not required for its continuous existence. On the account I am giving here, however, even the operation of the *per accidens* cause in producing its effect involves *per se* causation, so that on this view all real, productive, or efficient causation is *per se* causation.[[13]](#footnote-13)

Consider a chicken making chicken-tracks while walking in the mud.[[14]](#footnote-14) In this case, the chicken, through stepping in the viscous mud, produces the characteristic marks in the mud we call chicken-tracks. Here, then, the chicken is the agent, who through the act of stepping, applies a causal power to the mud and thereby produces a change in it with each step, i.e. the chicken-tracks we subsequently observe, as the effect of each act of stepping. Although we first observe the chicken stepping in the mud and only then observe the chicken-track after it lifts its foot, in fact the stepping and the track-making are simultaneous and indeed one and the same event looked at from two different points of view: the first, that of the avian agent and the second that of the muddy patient. The production of the effect (the chicken-track) begins with the stepping of the chicken in the mud and ceases only when the act of stepping does, at which point the making of the track is completed and the chicken-track thus comes to be. In this context, “step” functions as a causal verb, designating the act by means of which the chicken as agent by stepping causes the chicken-track in the mud as its effect.

We can multiply examples and will, but let me pause here to note that, on this account of causation, there is no reason to deny that causal “connections” are perfectly observable in many cases and are in fact observed by us, as our use of causal verbs testifies. When I see someone pushing a table across the room, I see him or her exerting force on the table and thereby *causing* it to move; the person is the cause, through the act of pushing, and the moving of the table is the effect. Again, I watch the gardener saw the limb off the tree. The gardener, as agent, produces the effect, which is the severed limb, through the act of sawing. In turn, the gardener’s sawing of the limb is the same state-of-affairs as the limb being sawn, beginning with the first draw of the gardener’s saw across the bark of the limb and terminating with that limb’s complete detachment from the tree. Again, consider the frustrated college professor who, having read one too many student papers in which “conscious” is used in place of “conscience” kicks his metal wastebasket across the room and produces a large dent in it. We can see the professor’s foot make contact with the wastebasket and its subsequent denting prior to its flight across the room. The professor is the agent cause who, through his act of kicking, produces the dent as an effect. A further example, a favorite of Aquinas’s and his standard example of causation, is a fire heating a pot of soup. The soup begins to grow warmer as soon as it is placed in the proximity of the fire and continues to stay warm so long as the fire continues to burn; however, if the fire goes out or the pot is taken away from it, the soup immediately begins to cool.

In the same way, we can see causal relations in many cases, though never “the causal relation” between events postulated by the New Science. I can see that a brick is propping open a door and thus causing it to stay open when it would otherwise close, or a table holding up a tablecloth that would otherwise collapse on the floor. These relations between things are just as visible as the ordinary spatial and temporal relations that all of us (including Hume) suppose that we are directly aware of in experience.[[15]](#footnote-15) That the wind rustling through the trees is making the branches move or that the water in a bubbling brook is causing the reeds to move are just as visible as that this fence is in front of that building, that Fred is taller than Mort, or that the flashing of the left turn-signal on a car is routinely followed by the car’s taking a left turn.

The point is that the exercise of causal power takes the form of an **act** on the part of the agent that produces, gives rise to, or brings the effect into existence, one that is simultaneous to and continuous with the production of the effect, and designated by one of the many causal verbs with which natural language is replete. If “causes” and “causal connections” are unobservable, that is only because we are treating second-order, theoretical concepts as though they were first-order, descriptive ones that refer to a uniform entity in every case. Causes are observable, but the concept “cause” is an abstract, generic notion and stands to observable causal acts of pushing, kicking, stepping, hitting, shattering, propping open, holding up, and so on as that of color stands to red, green, and blue. Understood in this way, the analysis of “cause” then focuses on the question of what all of these causal activities share in common by means of which they are all collected as species of a common genus *that does not exemplify itself*. Just as “color” is not the name of a color, neither is “cause” or “causation” the name of a particular kind of cause or of a particular kind of causal relation. If we suppose this, we are on wrong track and it is no wonder that our quarry eludes us.

The difficulties about the notion of cause raised by Hume can plausibly be explained and defused by seeing them as the result of this kind of mistake. Hume hypostasizes “cause” and treats it as a particular kind of thing that acts as a *tertium quid* that relates (or alternatively, *is* the relation between) cause and effect considered as discrete, temporally separated events and constitutes the basis for designating those events as “cause” and “effect.” If nothing of the kind exists, it is not surprising that it cannot be observed and that instead, we apprehend a yawning gap in our understanding precisely where we expect to find fundamental illumination, resulting in profound perplexity. For the same reason, our attempts to inferentially justify claims about “causal connections” and “causal necessity” will likewise fail to bear fruit.

Hume, however, is not altogether to be blamed for this error. Quite the contrary, he inherited it from the New Science itself, which attempted to reduce all change to change of place and all causes of change to causes of local motion. Eschewing “metaphysical” accounts of motion, the New Science posited motion as a surd fact and restricted itself to accounting for changes in motion by reference to descriptive natural laws from which, given certain values for the parameters in a mathematical equation, such features as velocity, direction, acceleration, and so on, could be successfully deduced and predicted. Without any account of the nature of motion or of its causes, however, there was no way to account for real change occurring in the external world. It was recognized that initiation of motion from rest or changes in position, direction, acceleration, etc. in moving bodies was preceded by contact between those bodies and other bodies, but contact is merely the limit of proximity for two things, i.e. their surfaces touching one another at least one point, a fact incapable of accounting for any subsequent change in the body that we observe to change in accordance with mechanical physical laws. Only an *act* of the first body on the second could account for this. Being unable to account for motion in the first place, it is no surprise that the New Science was unable to account for changes in motion and thus for change in general, however well it was able to predict those changes using the mathematical laws of physics. The New Science thus has no room for causal realism and, for the same reason, provides no basis for scientific realism. It is only natural, then, that even a cursory philosophical examination of its tenets leads to skepticism about its claims and instrumentalism with regard to their interpretation. The New Science thus proves to be self-undermining as a surrogate or replacement for metaphysics. Further, as the history of science shows, it also proves insufficient for the needs of science itself.

 IV

Newton’s account of gravitation as involving action at a distance without an intervening medium or mechanism was excoriated by his critics as a relapse into “Scholasticism.” What was gravity, after all, but an occult quality incapable of mechanical explanation? Newtonians never ceased, down to the dawn of Relativity Theory, to seek some medium (e.g., the fabled *ether*) for the propagation of gravity waves through absolute space in order to avoid this embarrassment. In the eighteenth century, electricity was still regarded, even by Benjamin Franklin, as a kind of subtle fluid flowing through bodies, the non-vital concomitant of medicine’s animal spirits. Heat, too, was regarded as an inherent caloric fluid in combustible things until Benjamin Thompson (Count Rumford) was able to refute the caloric theory of heat at the end of the eighteenth century.

By the first quarter of the nineteenth century, Newtonian physics was so well established, and the controversy over Aristotelianism so far forgotten that Maxwell could introduce the idea of irreducible natural forces into the very heart of physics, where it remains to this day.[[16]](#footnote-16) Yet what are these forces – electromagnetism, gravity, and later the strong and weak nuclear forces – except so many occult properties, unobservable in themselves and posited only to explain the phenomena taken to be their observable effects, and our conceptions of those forces modified to fit the demands of theory? For the concerns of the present paper, the point is that there is no need to strain at the gnat when one has already swallowed the fly. An account of the initiation of motion as an instance of *per se* causation ought hardly to be objectionable given the widespread acceptance of “theoretical entities” in physics. Let me now go on to suggest one such account.

While I have argued that many instances of causation are observable, this need not be the case for all causes. When a chicken steps in the mud, a professor kicks his wastebasket, a gardener saws the limb off a tree, or the rustling wind moves the tree branches, we directly and straightforwardly see the cause produce the effect in sense-experience. In other cases, however, causal judgment involves inference, at even at the first-order level. I see smoke coming over the hill, and rehearse in my head the Nyaya syllogism:

1. There is fire on the hill.

2. Because there is smoke.

3. Wherever there is smoke, there is fire.

4. Like in the kitchen.

5. Therefore, there is fire on the hill.

Since I have directly seen fire producing smoke in the past (“in the kitchen”) and have in all other cases noted that smoke is produced by fire, I confidently endorse the causal generalization that where there’s smoke, there’s fire and its application in the current instance, even without confirming this experientially. Here we have a successful instance of first-order causal inference.

 We move to second-order inferential judgment, thus to a more properly scientific perspective on causality, when we begin to ask about exactly what happens when, say, a man kicks his wastebasket. A kinesiologist and a metallurgist can jointly account for this by explaining the process by means of which the leg generates the force that the foot applies to the wastebasket and the effect that the application of this force to the wastebasket produces in causing the dent. A chemist can carry this down to the next level, by providing a more fine-grained account of this event in terms of molecular activity. The physicist can then carry this account down to the atomic level, and even beyond this down to the level of the *mikra* if such there be, or if not, down through a non-terminating series of ever more fundamental units of explanation. Here we talk about the causal mechanisms involved in the causal process that takes what we call the cause and connects it, by a series of interconnected steps each of which provides a necessary condition for the next, to the effect as the final outcome of that entire process.

 In the case of changes in state in moving bodies, however, we are supposed to have an example of direct causal influence involving the application of forces to bodies through contact, although the notions of “body” and “contact” in this context prove to be somewhat open-ended. In order to avoid the gap that Hume exploits in order to press his causal anti-realism, we need to find a way to model the initiation of changes in motion (either from initial rest to motion or to account for changes in position, acceleration, direction, and so on) that treats it as a case of *per se* causation. To model this sort of change requires that we account for the initiation of motion in bodies by reference to the nature of body *generally* considered. This requires, in turn, the attribution of “occult qualities” to bodies in order to make such a model possible.

For example, if we take Hume’s billiard balls, we have two bodies of an identical nature. Like all bodies, each billiard ball will possess the properties of extension, impenetrability, and elasticity. Given the first property, each body will occupy a determinate volume of three-dimensional space in a Euclidean universe. Given the second, billiard balls will be such that it is physically impossible for them to occupy the same volume of space at the same time. Given the third, each billiard ball will resist deformation by the application of external force and thus strive to return to its original shape. Thus, a billiard ball already in motion changes place by successively occupying different positions in space. When it encounters another billiard ball at rest on the pool table, it attempts to occupy the place currently occupied by the ball at rest. Since both billiard balls possess impenetrability with respect to each other, the first ball cannot occupy the same place as the billiard ball currently at rest. At the same time, since both balls possess similar natures, each thus possesses the capacity for motion and thus to be moved/set in motion by an external cause, such as another billiard ball already in motion. When a ball in motion encounters one at rest, there occurs an interaction governed by their common nature taken in the context of other relevant factors. In this case, that common nature dictates that one or both of them is going to have to give way. That common nature also excludes other possibilities, such as that the two balls will meld together, or that one or both of them will disappear, or that the ball at rest will explode or turn into a bird of paradise and fly away.

At the moment of contact, the ball already in motion exerts force on the ball at rest, resulting in a deformation of that elastic body and a consequent resistance on its part due to its capacity to resist deformation. In turn, this resistance results in a deformation of the billiard ball already in motion, and thus an elastic response on the part of that ball as well. Since the otherwise indistinguishable billiard balls are both deformed, and thus resist each other at the point of contact, their elasticity will express itself as an attempt to decompress in opposed directions. The result is that the two balls push against each other, each trying to expand into the space occupied by the other ball, with the result that, in most cases, they separate – a spatial gap is created between them.

While the foregoing models the initiation of motion, what accounts for continuous motion after the fact? Despite the universal acceptance of the principle of inertia as the first law of mechanics, it is simply not plausible that a phenomenon as common, persistent, and regular as continuous local motion should *literally* happen or occur for no cause or reason whatever. While there may no doubt be good reasons for not bothering about the causes of motion from the perspective of mechanics, it does not follow that no question can be raised about this by the philosopher of science committed to some form of scientific realism. One can perhaps sympathize with Galileo and Newton’s desire to break out of the limits of Aristotelian metaphysics, I think that by this point we can see that they went too far, throwing out the substantive baby with the metaphysical bathwater. Even if continuous motion does not require an external *per se* cause of the sort postulated by Aristotelians, this fact does not entail that it needs no cause at all. Nor does it exclude the possibility that continuous motion has an explanation in terms of a cause *internal* to the nature of body itself, which is universally expressed in those conditions. In that case, continuous motion would be possible without an external cause yet be more than a surd fact.

 Given this suggestion, we can now see a way around the stark choice between the *quod movetur* principle (as it is often interpreted) and the principle of inertia, which treats continuous motion as a surd fact.[[17]](#footnote-17) We have modeled the initiation of motion in the billiard ball case as an instance of *per se* causation. It remains, however, that the relation between the cause of the initiation of motion and its patient also involves *per accidens* causation, since the continuous motion of the patient once set in motion does not require the continuous application of force from its initiating cause, or indeed any external cause at all. To account for this we have to revise Aristotle’s teachings that the natural terminus of local motion is rest so that local motion in the horizontal plane is contrary to nature, hence “violent,” and thus that continuous motion needs an external *per se* cause in order to occur. Instead, we need to explore the idea that the capacity for local motion is part of the very nature of body *qua* body, just as that for falling or rising is according to the Aristotelian paradigm, so that local motion will thus turn out to be natural motion after all. In that case, a body neither moves itself (by some sort of exertion it applies to itself) nor is it moved by another (through the application of an external exertion to that thing) but instead simply moves in virtue of the fact that it is a body and possesses a potentiality for continuous movement by that very fact. When that potentiality, which is precisely the potentiality to move, is actualized in ideal conditions, i.e. in the absence of any obstructions, it continues to express itself because local motion in the horizontal plane is precisely what Galileo pretended not to understand about the Scholastic account of motion – the actualization of a potency insofar as it is in potency. In this case, unlike that of vertical motion, local motion in the horizontal plane is the realization of a potency that has no natural *terminus*, so that its *ergon* consists simply in the continuous actualization of its initial capacity to move. There is, then, no need to postulate the existence of inertia as an inexplicable, surd fact. For the same reason, there is no need for to endorse the *quod movetur* principle as traditionally understood. In that case, the principle governing change of place must be something like “All changes in the state of motion in a body requires an external cause to initiate it and persists until something external causes it to stop.” If we interpret the principle of inertia, not as a surd fact but as the realization of the potency for continuous motion inherent in bodies by nature, this is sufficient in these circumstances for the ball currently at rest to achieve continuous motion away from the point of contact even after separation has been effected.[[18]](#footnote-18) Even the case of a man pushing a table can be assimilated to the foregoing suggestion, with the stipulation that the circumstances do not permit the realization of the potency for continuous motion for that thing, so that, in these circumstances at least, it can move only through the continuous application of an external force. The interaction of two balls already in motion is along the same lines, though more complicated to state, and presumably thoroughly understood by modern physics.

 The same account, *mutatis mutandis*, applies to each successive level of physical analysis – atomic, sub-atomic, quantum, superstring, etc. – all the way down to the *mikra* if such there be, although terms like “body,” “contact,” and so on will become increasingly analogical in meaning and reach a point where the entities to which these terms are applied can no longer be literally imaged using contents derived from sense-experience. In each case, the cause that initiates motion does so through an act – imposition of force at the point of contact – which given the nature of the patient results in “pushback” and mutual repulsion of the two bodies, with the effect that the ball at rest begins to move and, given inertia, being moved in accordance with its nature continues to move “on its own” without being actively pushed by any external body. This is to describe the initiation of motion as the causal consequence of the interaction of two substances sharing commensurate natures beginning with contact and the imposition of force and ending with the production of the effect: the initiation of new motion or change of velocity or acceleration in a motion already occurring. This, again, is a single, temporally extended event or state-of-affairs, and thus an instance of *per se* causation. It therefore represents the application of a different paradigm for understanding motion than that assumed by Hume in his discussion, one that possesses intelligibility and initial plausibility as an account, given in terms of certain “occult” qualities, of the first billiard ball’s casual power to affect the second billiard ball and by so doing realize its potentiality for local motion. In this way, things, their natures, and the dispositional properties they possess in consequence remain the primary, i.e. ontological or metaphysical realities and principles of explanation for change, just as Aristotle teaches. Mechanical explanation, when applied at the level of sense-experience, proves inadequate and superficial, and only shows its true worth and employment at the theoretical level as a means to model material things insofar as they are material, hence transcend sense-experience. However, since material things are composites of form and matter, despite being our best clue as to what those things are like in their noumenal aspects, the scientific account is ultimately only a partial understanding of those things.

 Of course, I make no claim of scientific accuracy for the foregoing account; it is only an example of the sort of account needed here, one that focuses on the natures of bodies involved and their essential properties *qua* material things rather than on the imaginative visual representation of those things at the moment of contact or *mikra* in motion considered just as such. In the latter case, with our vision focused where Hume (led by Galileo) directs it, we will find ourselves staring vainly in the hope of discovering some *tertium quid*, a causal relation or necessary connection between two discrete, temporally successive events occurring in experience and forced to conclude that nothing of this sort can be perceived or, for that reason, even coherently conceived of. Although the account given here involves the appeal to occult qualities and merely posited mechanisms, there need not be anything suspect about this, so long as we recall that some instances of causation are straightforwardly visible, and that physical theories are intellectual constructs intended to analogically model the noumenal realities that lie behind observable phenomena rather than provide literal descriptions of them. Even in the cases I mentioned above, where (as Anscombe puts it) no one would deny that we see causes unless they were unwilling, in principle, to count *anything* as seeing a causal process, we can still seek a more fine-grained explanation in terms of things, their natures, essential properties, and *per se* causal interactions that produce the effects we observe. These, of course, will refer to entities and processes that are not observed, but posited by an explanatory inference. In the case of the initiation of motion, we simply skip this first step and begin with an act of positing motivated by an observed regularity. Since bodies in motion are visible but motion *as such* is not, we posit a hidden causal mechanism in order to account for the phenomenon we do observe, taking instances of the initiation of motion in experience as data to be accounted for by our hypothesis and against which it is to be tested. On analogy to causes that we do see, we are analogically justified in positing causes that cannot be seen and attempting to comprehend those causes through theoretical models. In turn, as science grows more sophisticated, all or nearly all the sensible content has been purged and the model becomes largely mathematical in character, focused on the application of predictive mathematical laws to specific situations.

 V

 With this in mind, we can see our way around Hume’s skeptical attack on causation. As I mentioned before, Hume believes that he can overthrow the entire notion of “cause” if he can undermine the only two kinds of causes recognized as such by the New Science: minds and causes of local motion. On a realist construal of their causal influence, each of these requires some *influxus physicus* in order to produce an effect through interaction with a patient. Hume takes it that if there was such an influx through the imposition or transfer of motive force, such an influx would be visible to us or in some other way directly detectible by the senses. Hume’s mistake (in this case, a forgivable one) is to make this supposition, which holds in many cases, in an instance in which it does not apply. Even if one supposes that this observable change is reducible to change of place among the *mikra,* it does not follow that change of place has to be an instance of observable change. Quite the contrary, it belongs to the level of physical explanation and is a theoretical posit from the very first.

In the same way, Hume’s claim that I cannot acquire the notion of cause from my own case through reflection on my acts of will is equally flawed.[[19]](#footnote-19) Hume maintains that my experience of willing my arm to move will not be different from the normal case even if, having just had a stroke, my arm is now paralyzed. However, nothing follows from this. Although I have elsewhere explained how the will can be a causal principle without entering the order of efficient causes, even if one supposes that the mind exercises its causality through physical influx, Hume’s argument still fails.[[20]](#footnote-20) The soul or mind (which Hume never denies is in fact a cause) causes the arm to rise simply as the remote and not the proximate cause of that observable behavior. The soul or mind is merely the initiating cause of an entire causal sequence involving nerve impulses, muscle contractions, and so on that only a kinesiologist can fully describe. One’s willing that one’s arm should rise simply causes the first step in this process which of course can be interrupted, and the effect thus prevented, through the failure of one or another of the various mechanisms that belongs to that causal process. Anatomy and physiology teach us all about these intermediate processes and mechanisms without excluding the possibility that the will is the remote, initiating cause of my arm’s rising in the sense that the observable action has my willing that it should rise as its first and original causal antecedent. The soul or mind, through the exercise of an act of will, is the cause of my arm’s rising in the same way that a dynamite plunger is the cause of an explosion, capable of exercising its particular causal power (by generating an electrical charge) even in cases in which no explosion is possible due to the fact that e.g., the wires have been cut, or the ground wire is loose, or the blasting cap does not contain nitroglycerin, or the dynamite to which the plunger is connected is fake. In the case under discussion, one experiences the will’s exertion (in the form of a physical “outflux” from the mind into the body) even in those cases in which that physical influx fails to enact my volition, just so long as this is a consequence of some further condition nor directly related to the exercise of that causal power.[[21]](#footnote-21) Hume’s argument on this score would be relevant only if there were cases in which my willing my arm should rise failed to give to that outcome even though all the other necessary conditions for that act obtained. Nor is this process too obscure or difficult for human beings to comprehend and was not so even in Hume’s own time.

 Hume’s arguments against causation, then, succeed against casual, and thus against scientific, realism as these notions are understood within the tradition arising from the New Science. However, as I have suggested here and elsewhere, the architects of the New Science overreacted against Aristotelianism to such an extent that they left their own paradigm metaphysically impoverished in such a way that it precluded the sort of scientific realism to which they uniformly ascribed. This, in turn, left the New Science vulnerable to the skeptical arguments that Malebranche, Berkeley, and Hume advanced against their causal and scientific realism, leaving only anti-realist interpretations of science in the field. Recovering scientific realism, I have suggested, requires that we cease to anathematize the notions of material things, natures, substantial forms, real qualities, and so on and find a way to reincorporate these ideas, not into science itself, but into our philosophy of science, i.e. our interpretation of the subject-matter, activity, and goal of natural science. Hume and Kant will not help us with this, but they can motivate us to see the need to supplement the New Science by searching for a metaphysic capable of underwriting scientific realism in the modern scientific context. Reinterpreting the notion of the causation in the way I have suggested here is one small, but important, step in that direction.

1. On this notion, see Eileen O’Neill, “Influxus Physicus,” in *Causation in Early Modern Philosophy*, University Park, PA, Penn State University Press, 27-55. [↑](#footnote-ref-1)
2. But see below, p. 24. [↑](#footnote-ref-2)
3. See Charles J. McCracken, *Malebranche and British Philosophy*, Oxford, Clarendon Press, 1983, 88-115, especially 96-98, and references. [↑](#footnote-ref-3)
4. Of course, in any particular case of such interaction between bodies, both may be cause in one respect and effect in another, where the interaction produces change in both bodies: the metal wastebasket I kick may be dented by my foot, and my foot broken in the act of denting it. [↑](#footnote-ref-4)
5. The term *mikra* was introduced by F. R. Tennant to refer to the smallest and most fundamental units of physical analysis, whatever these turn out to be. See his *Philosophical Theology*, London, Cambridge University Press, 1930, Vol. II, 43-50. [↑](#footnote-ref-5)
6. See McCracken, 96-7. As is well known, Berkeley and Hume repeat these arguments in their works as well; for documentation of this, see McCracken, 242-245 and 257-262. [↑](#footnote-ref-6)
7. See David Hume, *A Treatise of Human Nature*, L. A. Selby-Bigge, ed., Oxford, Clarendon Press, 1888/1973, 75-8. [↑](#footnote-ref-7)
8. Hume, *Treatise*, 155-172, especially 163-66. Malebranche offers a similar account of the origin of our belief in causal necessity, ironically based on seventeenth century neurophysiology. Despite its outmoded theory of “brain traces,” contemporary “cognitive scientists” may find this account inspiring or at least anticipatory of their own work. See McCracken, 98-99 and references to Malebranche’s discussion in the *Recherché*. [↑](#footnote-ref-8)
9. See Immanuel Kant, *The Critique of Pure Reason*, Norman Kemp Smith, trans., New York, MacMillan, 1929, 218-233. [↑](#footnote-ref-9)
10. G. E. M. Anscombe, “Causality and Determination,” in *Causation and Conditionals*, Ernest Sosa, ed., New York, Oxford University Press, 1975, 63-81. For an account of causation that articulates and defends the traditional view, see Donald Davidson, “Causal Relations,” in Sosa, op. cit., 82-94. [↑](#footnote-ref-10)
11. For a more recent defense of something like this metaphysical interpretation of causality, see Rom Harre and E. H. Madden, *Causal Powers*, Oxford, Basil Blackwell, 1975. [↑](#footnote-ref-11)
12. See *The Proof of the External World*, London, James Clarke, 2007, This is similar to Kant’s category of ground and consequent except that while Kant’s category is non-temporal prior to being schematized, the EOG relation is in time and even across time. [↑](#footnote-ref-12)
13. In her recent book *The Contents of Visual Experience* (New York, Oxford University Press, 2010) Susanna Siegel defends the visibility of causal relations; I only note here that all of her examples of perceptible causal relations involve what I am here calling *per se* causation, see 117-139, especially 117-120. [↑](#footnote-ref-13)
14. My discussion here owes a good deal to the work of Curt Ducasse; see, for example, his essay “On the Observability of the Causal Relation,” in Sosa, op. cit., 114-125. [↑](#footnote-ref-14)
15. Indeed, Hume must suppose this if his own account of causality is to be possible at all, since unless we can directly apprehend spatially contiguous and temporally successive sense-contents there will be no way for the causal habit to build itself up in the first place. [↑](#footnote-ref-15)
16. It is to be noted that Kant, in his theory of matter, to some degree anticipated this development. See his *Metaphysical Foundations of Natural Science*, Michael Friedman, trans. and ed., London, Cambridge University Press, 2004. For a brief description of Kant’s view, see Frederick Beiser, *German Idealism*, Cambridge, MA, Harvard University Press, 2002, 513. [↑](#footnote-ref-16)
17. On the historical accuracy of the traditional interpretation of this principle, see James Weisheipl, *Nature and Motion in the Middle Ages*, Washington, D.C. Catholic University of America Press, 1985, especially Chapters II and IV-VI. [↑](#footnote-ref-17)
18. Here we are formulating the principle of inertia in the manner suggested by Maritain: “All changes in the state of the motion of a body require an external cause and persists until some external cause it to cease.” See Jacques Maritain, *Approaches to God*, New York, MacMillan, 38-40. This is also sufficient to turn aside criticisms of the *Prima Via* of St. Thomas that appeal to the inertial motion as a counterexample to the *quod movetur* principle. [↑](#footnote-ref-18)
19. See David Hume, *An Enquiry Concerning the Human Understanding*, Buffalo, NY, Prometheus Books, 1988, 62-64. [↑](#footnote-ref-19)
20. See *How Free Will Works*, Eugene, OR, Wipf and Stock, 2011, 56-70. [↑](#footnote-ref-20)
21. Recall again the case of the man pushing the table, or, even better of a man trying to move a heavy safe that is beyond his power to set in motion. Here he experiences the “outflux” even though he is in direct contact with the object yet without being able to enact his volition in the least degree. In that case, we say he lacks the power to move the safe meaning only that he lacks *sufficient* power to do so, not that he can exert no force on it at all. [↑](#footnote-ref-21)