CAUSAL POWERS AND CATEGORICAL PROPERTIES

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The aim of this paper is to argue that there are categorical properties as well as causal powers, and that the world would not exist as we know it without them. For categorical properties are needed to define the powers—to locate them, and to specify their laws of action. These categorical properties, I shall argue, are not dispositional. For their identities do not depend on what they dispose their bearers to do. They are, as Alexander Bird would say, ’quiddities’. But there is nothing wrong with quiddities. And, in the second half of this paper, I shall defend the thesis that all categorical properties are quiddities.

Causal powers are properties that are displayed in causal processes. Of these, there are two principal kinds: powers to act, and powers to resist. The powers to act are the drivers of causal processes, e.g. the forces of nature, the potential differences, the temperature differences, the pressure gradients, and so on. The powers to resist are the properties that tend to reduce the influence of the powers, e.g. inertial mass, electrical resistance, elasticity and so on. Whatever one’s theory of causation, one must suppose that these causal powers are all dispositional, i.e. have identities that depend essentially on what they dispose their bearers to do. I do not think, as Shoemaker, Bird, and others do, that all properties are causal powers, or even that all dispositional properties are causal powers. There are propensities, such as decay probabilities, which are dispositional, but not causal, and categorical properties, which are neither dispositional nor causal.

I begin by developing the theory of physical causation on which I am relying. If you do not accept this, then you need not accept the theory of causal powers that I shall propose. Nor must you accept my conclusion that the categorical properties are all quiddities. So, a lot hinges on it.

1. Physical Causal Processes

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Causal processes necessarily involve causally related states of affairs. For a causal realist, the important metaphysical question is: What is the nature of this relationship? But the prior question is: Why should one be a causal realist? The short answer to the second question is that the only plausible alternative to causal realism is causal phenomenalism. But causal phenomenalism leaves this relationship unexplained, as the critics of Hume’s theory of causation have long been arguing. Hume’s regularity theory is more or less faithful to the phenomenology of causation. For, it is an account of causation that would enable us to distinguish, in many cases, between states of affairs that are merely successive, and ones that are related as causes to effects. But it does nothing to explain the phenomena. Nor does it explain why causal laws normally apply strictly only in idealised circumstances, or how there can be such a thing as singular causation, or why genuine causal laws have nomic necessity. What is needed, and what every causal realist would insist upon, is a theory of causation that would tell us what causal processes really are. For, if we had such a theory, we should not only be able to explain the phenomena upon which our common beliefs about causes and effects are based, but also the recognised status of causal laws, and their acknowledged applicability to single cases.

In paradigm cases, causation involves energy transference from one thing to another. In Hume’s billiard ball example some or all of the kinetic energy of the impacting ball is transferred to that of the ball impacted upon. In the act of warming oneself in front of the fire, the chemical energy stored in the wood is released as heat in the process of burning, and the heat energy is transferred radiantly to the person who is warmed. Such examples are obviously causal processes, and the mechanism of causation is no less obviously that of energy transfer. Therefore, it is initially plausible to suppose that this is the mechanism we are seeking. It is true that not all causal connections are quite like this. For in many cases, the causal process is two-way. Electrons, for example, repel each other, and gravitational masses attract each other. But in these cases there is, it is now believed, an exchange of virtual particles—photons in the first of these two cases, and gravitons in the second. So, these cases do not seriously undermine the initially plausible suggestion that causation is essentially an energy transfer process.

The most troublesome counterexamples to the energy transfer theory of causation derive from blockings, bluffings and diversions. I might, for example, make the room darker by pulling the curtains. Or, Shane Warne might cause the ball to miss the bat and go through to the stumps by not spinning it as much as usual. There are certainly energy transfer processes involved in producing the desired outcomes in these cases. But they are not produced directly. I made the room darker by preventing the light from outside from getting in, and Warne got his wicket by not doing what he was pretending to do. So the thesis that causation is essentially an energy transfer process linking cause to effect is not strongly supported by our linguistic practices. Nevertheless, there does seem to be a good case for distinguishing between the direct effects of the energy transfer processes that are initiated by us, and the outcomes that we intended to achieve. There is also a good case for distinguishing between the effects of natural physical energy transfer processes, and the outcomes that we find sufficiently interesting to note. We are, after all, interested here in what causation really is, not in the realisation of our wishes or intentions. Accordingly, I distinguish between physical causation, and causation more broadly construed. I define a physical causal process A ⇒ B as an energy transference from one physical system S1 in a state A to another physical system S2 to effect a physical change B in that system (relative to what the state of S2 would have been in the absence of this influence).

In the simplest kind of case, an energy transmission from one thing to another consists of a particle emission (e.g. a photon), its transmission as a Schrödinger wave, and its subsequent absorption (e.g. on a photographic plate, or any other particle-absorbing surface). I call all such processes ‘elementary causal’ ones, and postulate that all causal processes consist ultimately of such elementary ones. We know that these elementary causal processes are all temporally irreversible, because the process of particle-absorption is temporally irreversible. For, there is no such thing as the instantaneous, or near instantaneous, reflation of a Schrödinger wave. Therefore, it is reasonable to suppose that all physical causal processes are temporally irreversible, and that the temporal order is the physical causal order.

But this level of analysis, which we may call ‘the base level’, is not appropriate here. It establishes the temporal asymmetry and temporal direction of physical causation. But it is much too deep for the purposes of this paper. At this level, even the physical objects that are the bearers of causal powers do not exist. However, physical objects capable of having causal powers manifestly do exist at what I shall call ‘the object level’, i.e. at the level of ontological reduction at which we may speak freely of physical objects and their properties. The question of how things at this level may ultimately be constituted by elementary events and processes will be set to one side for the time being—although I shall have something to say about this question towards the end of the paper.

The causal processes that are the displays of causal powers are presumably ones that belong to natural kinds. For, if they were not of natural kinds, the causal powers would not be natural properties. But this is not much of a restriction. Clearly, there are a great many natural kinds of causal processes in nature. For example, all of the chemical reactions described in chemistry books are processes that belong to natural kinds; and the equations that describe these reactions are presumably descriptive of their essential natures. There are also a great many natural kinds of physical causal processes occurring in other areas of science. Think of those of meiosis, meitosis, refraction, reflection, diffraction, crystallisation, and so on.

2. Causal Powers

At the object level, there are apparently two very different kinds of properties, dispositional and categorical. The dispositional properties are those whose identities depend on what they dispose their bearers to do, and the categorical ones are those whose identities depend on what they are—but not, apparently, on what they do. The latter are the spatiotemporal and numerical relationships that are required to describe the structure of things. The causal powers, on the other hand, belong in the category of dispositional properties, along with propensities (See Section 5 below), which, I shall argue, are not causal powers. What these active properties all have in common is their dispositionality. The categorical properties, in contrast, are essentially passive; since there is nothing that their bearers are necessarily disposed to do just in virtue of their having these properties. Nevertheless, I will argue, the categorical properties do have some vital causal roles. For these properties determine where the active properties of things may exist, or be distributed, and, consequently, where the effects of these activities can be felt.

Given this preamble, we may define a causal power as any quantitative property P that disposes its bearer S in certain circumstances C0 to participate in a physical causal process ⇒, which has the effect E – E0 in circumstances C0, where E is the actual outcome and E0 is what the outcome would have been if P had not been operating. In general, the changes that P induces/prevents in the circumstances C0 will depend on the measure of P. Let P0 be the measure of P for S in the circumstances C0. Then, since P is a causal power, P must have a law of action A that describes what it does when it acts. If there were no such law of action, there would be nothing to connect different exercises of the same causal power. Since, by hypothesis, the value of the causal power involved in transforming E0 into E is P0, the law of action A (P, x) for P must be one that has the effect E – E0, where P = P0, and x = C0. That is,

E – E0 = A (P0, C0).

This effect, it will be noted, is a function of two variables, P0, which is the measure of the causal power in the circumstances, and C0, which is the set of values of the relevant parameters describing the circumstances in which P is operating. (NB. E0, which is the set of circumstances that would have obtained if P had not been operating, would often, but not always, be the same as C0. In prevention cases, however, E0 and C0 would normally be different.)

To illustrate: A weight above ground level has causal powers just in virtue of the potential energy it possesses, e.g. it has the power to compress things and the power to stretch them or pull them down. Ultimately, this power is, of course, that of gravity. How the causal power of the weight affects other things depends on where it is, and how it is fixed in its position, e.g. on whether it is resting on something, or hanging from it. Suppose the weight is of magnitude W, and that this weight is hanging at the end of a wire S made of some elastic material M. An elastic material is, by definition, one that is, within limits, intrinsically disposed to resist distortion, and, if distorted, to revert back to its original shape. If a piece of such material is stretched, for example, then it will be disposed to resist being stretched, and to regain its original shape, once the stretching force is removed. Let S be of length l0 before the weight is hung upon it. The action of hanging W from S then causes it to become extended, and (provided that the elastic limit is not exceeded) to acquire sufficient potential energy to return to its original length and cross-sectional area once the weight is removed. Let l be the extended length of S. Then the weight loses potential energy (l – l0) W, while the wire gains exactly this much elastic energy in the process. So, the process is a simple physical causal process, involving a direct energy transfer from the weight to the wire. And there are two causal powers involved in this process: the power to act (gravity) and the power to resist (elasticity).

The elasticity P0 of the material of S of the wire is defined by the law of action for W on S. The effect, (l – l0), of hanging W on S and is proportional to initial length l0, and inversely proportional to the cross-sectional area A of the wire. Thus,

(l – l0) = W l0/AP0

Like the laws of action of all causal powers, that for W on S is quantitative, depends on the magnitude and location of the power concerned, and involves one or more other categorical properties essentially. In this case, these other categorical properties are the original length l0 of S, the amount l – l0 by which S is extended, and the cross-sectional area A of S.

3. A Conjecture

There are two conditions that must be satisfied by all causal powers. Firstly, their instances must all have contingent locations. For the active powers must act from somewhere, and the resistive ones must be properties of the object or medium that is doing the resisting. But where the things are that are acting or being acted upon must always a contingent matter. For nothing has its location necessarily. Secondly, the causal powers must all have defining laws of action—i.e. laws that spell out in detail what each causal power would dispose its bearer to do, and the circumstances in which it would be so disposed. For this is what it is to be a dispositional property. And, the causal powers are essentially dispositional.

It follows from this analysis that location is not a causal power. Firstly, the instances of location do not have contingent locations. They are locations, and where it is located, it is located necessarily. Locations are not where they are contingently, because you cannot move a location to anywhere else. Secondly, location does not have a defining law of action, i.e. a law that spells out in detail what it would dispose its bearers to do. But if location is not a causal power, plausibly the same must be true of any properties, such as spatial relations, on which the locations of things depend. I therefore speculate that what holds for locations also holds generally for all categorical properties, including all of the purely structural properties of things.

4. The Case Against Quidditism

The fundamentally Lockean position outlined here has been attacked on two fronts. There are strong categoricalists, who deny that there are any genuine causal powers, and strong dispositionalists, who deny that there are any real categorical properties. I have discussed the principal arguments for and against strong categoricalism elsewhere, and I shall not repeat this discussion here. The main objection to my position now appears to be coming from strong dispositionalists, who argue that (a) if the categorical properties of things had no causal powers, then we should not know about them, and (b) if the causal powers of the different categorical properties were not distinctive of them, then we should have no way of distinguishing between them. Therefore, they say, the categorical properties must all have or be distinctive causal powers, i.e. powers that would distinguish them essentially from one another. Otherwise, it is said, they would all be mere quiddities. I call this ‘the argument from quidditism’.

The argument from quidditism is, at first sight, a very persuasive one. Nevertheless, it is unsound. For, as we shall see, the categorical properties of things can make a big difference, even though they neither are, nor have, any causal powers. For example, the locations of the causal powers can affect what actually occurs. One possibility, therefore, is that categorical properties are more like the locations of the instances of the causal powers than the causal powers themselves. This is the position I wish to defend.

Most of the properties we think of as categorical are ones that depend upon our being able to recognise common patterns of spatio-temporal relations. It is not my firm view that they are all dependent upon such patterns of relations. For I have no proof that this is so. But certainly a great many of them are: e.g. shape, size, orientation, speed, handedness, direction, angular separation, and so on. And, like the spatio-temporal relations upon which they depend, they are fairly clearly not causal powers. It could perhaps be argued that spatio-temporal relations are not causal powers because they are not properties. Hence, the fact that the dimension of spatio-temporality is not a causal dimension might easily be reconciled with a strong form of dispositionalism. All genuine properties, it might be said, are causal powers.

However, the properties I am calling ‘categorical’ are not out-of-the-way, recherché properties. Every law of action of every causal power refers to some of the categorical properties of the circumstances in which it may be effective, and the properties that I have listed above are among those that are most often required to describe these circumstances. So anyone who uses the ‘not really properties’ defence would owe us an account of what they really are. And, to their credit, I do not know of any strong dispositionalist who has ever used this argument. The argument on which they seem to rely most heavily is the one from quidditism.

In his defence of Sydney Shoemaker’s (1980) strong version of dispositional essentialism, Bird (2005) argued that what makes a property the property it is, i.e. what determines its identity, is its potential for contributing to the causal powers of the things that have it. Bird’s case for this strong version was that anything weaker would condemn us to quidditism. For if there were any property whose identity did not depend on what it disposed its bearer to do, but only on what it was (quidditism), then we should, necessarily, be ignorant of it. So, Bird is evidently committed to arguing either (a) that location is a causal power, or (b) that a location has at least some causal powers essentially.

It is clear from what has already been said that location is a not causal power. It is not a causal power, because there are no laws of action of location, and the instances of location do not have locations. Nor do the specific instances of location have any causal powers essentially. If you remove all of the causal powers from any given location (and this would always seem to be a possibility), the location remains, but the causal powers do not. Therefore, it cannot be said truly that the locations of things have any causal powers essentially. Therefore, locations are all quiddities.

But, if locations are all quiddities, then so are relative locations. For the actual locations of things depend essentially on their locations relative to things whose actual locations are taken as given. That is how they are defined. And, if these relative locations had causal powers, then we could reasonably argue that the actual locations of things must also have causal powers. But we have already excluded this possibility. Therefore, relative locations neither are nor have any causal powers. Therefore, the shapes of things, which depend essentially on the relative locations of their parts, must all be quiddities too. And, if this is so, then, plausibly, the same must be true of all of the categorical properties. They must all be quiddities.

5. Who’s Afraid of Quiddities?

It is said that nowadays no one is afraid of Virginia Woolf. This may well be so. But there are plenty of people who are afraid of quiddities. They think that if the world contained any quiddities, then they would be unknown to us, and unknowable, and hence that any claim to knowledge of such things would have to be false. But this is not what follows from categorical quidditism. It just means that that the shapes, sizes, orientations etc. of things cannot be known without the mediation of the causal powers that are located within them. But since everything that we can or do know about does have causal powers, the quidditism of the categorical properties does not matter. In fact, the categorical properties have long been recognised by empiricists as being among the most directly observable of properties.

But, how could anything that does not have any effects essentially be observable? My answer is straightforward. Easily. It could, like location, do so by determining where the causal powers act from, and so where their effects may be felt. The shape of an object has no effects essentially (since does not itself do anything), but it does partly determine the shape of the pattern of effects produced by the reflective powers of its surface material. For the shape of the object is one of the factors determining the spatial distribution of these powers. An unilluminated square has no visible effects. But an illuminated square does have such effects. It looks square. It is true that it does not have this effect essentially. For it is not essential to the squareness of an object that it should look square, or even that we should be capable of vision. The squareness of the object is not a source of the energy transfer processes that result in this perception. The lights that enable us to see, and the reflectivity of the various parts of the object’s surface, are the sources of these. The shape only determines where the reflected light may come from. But, like location, the object’s shape is inert. It is just a quiddity.

The causal powers of the lenses of our eyes produce images on our retinas of the shapes of things in our fields of vision, and the causal powers of the rod and cone cells in our retinas reproduce encoded versions of these retinal images in our occipital cortices, which, presumably, then ramify through the integrative circuits of our brains to produce conscious awareness of the shapes that we are observing. So, there is no great mystery about how we are able to know about the categorical properties of things in our environments. There would only be a mystery if there were no sources of power to illuminate the objects we see, or to reflect the light from their illumination, or if we ourselves lacked the visual or mental capacities to pass on or process the encoded information that we receive when we look at things.

There is no need, therefore, to be afraid of the categorical quiddities of nature. On the contrary, they are among the most direct objects of knowledge that we have of the world. They are not the only such objects. For the causal powers of things also give us direct knowledge of the world. They colour the world that we see, provide taste to the world that we savour, material presence to the world that we feel, and so on. But this direct knowledge is much more ambiguous. The colours are normally mixtures of many different kinds of light, and the tastes are usually our overall responses to many different kinds of substances. There is no good reason, therefore, to think that all properties are causal powers. Indeed, the best explanation that we have of the content of our sense experience derives from the view that there are two kinds of properties, categorical ones, as well as causal powers.

Those who wish to say that all of the most basic properties in nature are causal powers have another reason, besides fear of quidditism, for holding their position. This is the worry they have that if any of the basic properties in the world are categorical, then many of the fundamental laws of nature, viz. those involving these properties, must be contingent—contrary to the theory of scientific essentialism. For the argument for the metaphysical necessity of the basic laws of nature derives from the thesis that the most fundamental kinds of things in nature all have dispositional properties essentially. Thus, if x is a thing of kind K, and P is an essential and dispositional property of things of this kind, then all things of the kind K must have P, and so must be intrinsically disposed to behave in the manner prescribed for things with this property in the circumstances in which P would be activated. But this argument only works, if the essential properties of the most fundamental natural kinds are all dispositional.

I used to think something like this myself. But I now see that the fundamental properties of things cannot all be dispositional, if by ‘dispositional’ properties we intend to refer only to causal powers. For causal powers must have categorical locations, and could not exist otherwise. Therefore, no monistic theory of properties could possibly be founded on causal powers alone.

Nevertheless, the facts that:

(a) instances of causal powers must have locations, and so are dependent on categorical properties, and

(b) the laws of action of the causal powers all involve categorical properties essentially,

does not entail that the laws of action of the causal powers are contingent. For the laws do tell us how things having the various causal powers essentially must be disposed to act in circumstances of the kinds that would activate these powers. Hence, their obedience to these laws is not just a contingent matter of fact, but a metaphysical necessity.

6. Propensities and Monistic Dispositional Essentialism

Propensities are dispositional properties, i.e. properties whose identities depend on what they dispose their bearers to do. But, unlike the causal powers, they are unconditional, and the activities of their bearers do not depend on the circumstances of their existence. They are what might be called ‘absolute’ dispositional properties. Some examples are: half-lives, radioactive decay potentials, and excitation levels. These properties are certainly dispositional, but they are not causal powers, as causal powers are here defined. For the processes of radioactive decay and photo-emission are not causal processes. A substance that undergoes radioactive decay does so independently of the circumstances of its existence, and there is no describable energy transfer process that connects the radioactive particle to its decay products. At the moment of radioactive decay, an instantaneous change of state occurs, in which the decay products come immediately into being. But there are no temporally extended processes by which this change of state comes about. The gamma rays (if any) that are emitted, do not take time to get up to speed. Nor do the decay particles take time to form or be ejected once the process begins. The same is true of photo-emissions. The excited atom emits a photon and falls to a lower level of excitation. But there is no causal process by which this change of state comes about. It just happens.

Another process of this kind is that of Schrödinger wave absorption. There is a certain probability of an absorption event occurring—defined by the absolute value of the wave amplitude at the relevant point. But the change of state that occurs when a Schrödinger wave is absorbed is instantaneous, and the point of absorption is localised. But, as in the radio-active decay processes, there is no temporally extended process by which this change of state comes about. It just happens. According to quantum mechanical theory, the mechanism of energy transfer between systems, which is of the essence of causality, is the Schrödinger wave. Minimally, a causal process involves an emission event, an energy transference, and an absorption event. But the emission an absorption events are not themselves causal processes. They are the ingredients of such processes. Hence, the emission and absorption potentials of quantum mechanics are not causal powers, as causal powers are here understood, but something more primitive than causal powers.

In Section 4 above, it was argued that there cannot be a viable form of strong dispositionalism that is based on an ontology of primitive causal powers. For all instances of such powers must be located, and their laws of action must depend on the categorical properties of the circumstances in which they would be active. But propensities are more primitive than causal powers, and their laws of action are independent of circumstances. Therefore, if there is a viable form of strong dispositionalism it must be one that is based somehow on an ontology of propensities. I do not see how to construct such an ontology. For I do not see how to explain what the categorical properties might be, given such a basis. But, I cannot rule out the possibility of such a thesis one day being developed.

Meanwhile I think it is sensible to accept, at least provisionally, a less ambitious ontology that includes both causal powers and categorical properties. Strong categoricalists, such as Armstrong, imagine that they live in a world of quiddities. Their main problem is to explain what causal powers really are. For they certainly need them. Strong dispositionalists, such as Bird, imagine that they live in a world of causal powers. Their main problem is to explain how causal powers can be located. For they certainly need locations. Causal realists, like me, distinguish between categorical properties and causal powers, give a satisfactory account of both, and have the best of both worlds.

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