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## CHAPTER 6

# Mutual Manifestation and Martin's Two Triangles

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# 1. Triggers and Partners

C. B. Martin has offered an alternative to the old stimulus-response model of how to trigger a power. He calls it mutual manifestation. Instead of powers being inert and standing in need of a stimulus in order to act, Martin's new model suggests that powers act when they are matched with their reciprocal disposition partners. We will stick with the terminology of mutual manifestation partnership as this, and how it works, will be the key idea explored in this chapter.

What is the difference between the stimulus-response and mutual manifestation models? The stimulus-response model suggests that powers do nothing without being appropriately pushed to do so. They remain latent, awaiting their stimulus, and unless received such powers will never be exercised. Examples of powers or dispositions and their stimuli are well known. Being dropped triggers the manifestation of fragility; being placed in liquid triggers the manifestation of solubility; and, as an example of a mental disposition, being asked 'Snakker du norsk?' triggers someone's disposition to speak Norwegian, if they have it. The stimulus-response model of how powers reveal themselves should be regarded as problematic by anyone who professes realism about dispositions, especially a pandispositionalist. Powers are rendered impotent by this account. They do not and cannot do anything alone. They are intrinsically powerless, which is of course a perverse outcome for a theory of powers. Instead, they must wait until they are appropriately triggered by the stimulus. Hence, it is the stimulus that appears active and the power itself passive. That will suit some accounts of dispositions, especially those that reduce them away in other terms, such as in the conditional analysis or the categoricalist metaphysic. But realists about dispositions will want their powers to be genuinely powerful rather than inert and active rather than passive. Instead of searching for things done unto them, powers should be what do the doing. Pandispositionalists will in addition object that the account bifurcates reality. All properties should be treated the same and we should not ascribe something to the stimuli—activity—that is not ascribed to the powers. Powers and their stimuli should not be regarded as two different types of entity or quality. It may be possible to resist such a conclusion. Perhaps the stimulus is not qualitatively different from a power. A stimulus might just be the action of a prior power. But then we still have to account for how that prior power came to be stimulated. If we rely on the same stimulus-manifestation model, then the same question arises for it in turn. This is not to say automatically that an infinite regress occurs, but some fancy footwork would be needed to sidestep the danger (see Holton 1999).

How does the mutual manifestation model avoid these problems? In Martin's metaphysics, there is no ontological division between powers and their stimuli. Rather, manifestation arises from equal partnerships. The sugar cube and the liquid are equal partners, for instance, in the production of dissolving. We do not say that one partner is the (passive) power and the other is the (active) stimulus. Each is as active as the other. They produce something together that they could not have produced alone. There is, thus, no qualitative bifurcation of reality. All powers are in the same boat and, for a pandispositionalist, so are all properties. This solves the problems we identified for the stimulus-manifestation model: powers are active and there is no regressive account of their activation. And there is an intuitive appeal in the idea that the partnership is equal too. If one considers ice in a drink, both the ice and the drink seem to be doing things. The drink melts the ice, but the ice cools the drink. Would there be solid grounds for classifying either as active and the other passive? Energy transference theorists of causation might think so, but that would be theory-driven rather than guided by our intuitions (see Fair 1979 and Kistler 2006). Such a debate could be had, but if we are just considering for the moment what we think makes philosophical sense, then the idea of joint and equal partnering of powers seems to have the advantage.

How many partners do we need? Any number will do. In the case of the striking of a match, there may be many that are needed to produce burning. Friction, flammable material, and oxygen all add their powers to produce flame. Why not ten powers or a hundred? Some complex causal processes may indeed involve a vast number. But must there be at least two powers together? Now that we have done away with the idea of powers being passive and standing in need of stimuli, there seems nothing wrong in principle with even a single power doing its work. Some believe that there are spontaneously manifesting powers, radioactive decay being the most obvious purely physical example. We are used to it in the case of persons too; for some of them we describe as spontaneous, meaning that they are liable to get up and do something new for no particular reason. This of course does not count as a partnership, for there are no partners: just single powers. But the metaphysical picture of the mutual manifestation model already allows that powers in groups can produce their effects without any other kind of trigger. Whether we are taking a grouping of powers as our unit, or the unit consists of a single power that really has no further subdivision into components, power(s) is enough to do the work. But is it really enough? Some chemical reactions need catalysts to get going, for instance. On the mutual manifestation view, the catalyst would just be a further power to be added. Until it arrives, we have an incomplete partnering of powers with

#### 2. TRIANGLES

respect to the particular manifestation that interests us. Once it's there, it's just a further mutual manifestation partner that completes the partnership.

We thus see that Martin's theory of mutual manifestation partners gives us a better model of powers than the stimulus-response model. All partners are equal and active. Rather than being in need of external stimulus to do its work, we should think of powers as being released or unleashed, such as when the water is released from the tap (Mumford and Anjum 2011, 37).

There is more work that could be done to justify Martin's model, but the aim here is not to produce a definitive argument for mutual manifestation as a theory of dispositions. Rather, it is to consider and amend the account of mutual manifestation and possibly of causation that would come from Martin's view.

## 2. Triangles

Many have thought of there being some connection between powers and causation. Powers are often thought to produce their manifestations. Indeed, this is the reason we think of it as perverse if the stimulus-repose model leaves our powers powerless. We will now set that problem aside and go with the idea that powers do indeed produce their manifestations. But how do they do so? And would this give us a theory of causation or of something else?

In his chapter on causation, Martin says the following:

You should not think of disposition partners jointly *caus-ing* the manifestation. Instead, the coming together of the disposition partners is the mutual manifestation: the partnering and the manifestation are identical. This partnering-manifestation identity is seen most clearly with cases such as the following. You have two triangle-shaped slips of paper that, when placed together appropriately, form a square. It is not that the partnering of the triangles *causes* 

## 2. TRIANGLES

the manifestation of the square, but rather that the partnering is the manifestation. (2008, 51)

Despite the title of the chapter from which this comes (*Causation*), it is very clear from the quotation that Martin does not see himself as offering a theory of causation in terms of powers. It is, rather, an alternative to causation. If the world is a world of powers, and we have the correct account of manifestation in terms of mutual partnerships, then it seems he is telling us that we would not need causation besides. This is effectively an eliminativism about causation. A world of powers, on the Martin account, is not a world of causation. But how could that be? Martin's suggestion is that the manifestation just is the partnered powers. When they come together, they don't do something to produce the manifestation, they just *are* the manifestation. As two triangles suitably arranged form a square (figure 1), so too the powers suitably arranged are the manifestation.





One of the reasons certain philosophers find an ontology of real powers attractive is the work powers can do in one's general metaphysics (Molnar 2003, 186), solving a host of thorny philosophical problems. Causation may be among them. It is without doubt one of the greatest philosophical problems of all. Martin's account of mutual manifestation seems to be offering a relatively simple solution to the problem. It suggests that one only needs powers, suitably arranged, hence manifesting, and one needs no further philosophical theory of causation. Gone would be one of the most difficult and discussed problems in the subject area. How realistic is Martin's ambition?

We will argue that Martin's own model of mutual manifestation is not adequate to account for causation in the eliminativist way that he suggests. But we do not wish to be misunderstood. The project of accounting for causes in terms of powers is one that we fully support (Mumford and Anjum 2011). To succeed, however, the theory requires the correct account of mutual manifestation. Martin's two triangles model suggests that there is no causation over and above the right mereological composition of the component parts or powers. If we look more closely at the composition of causes, however, we see that it is quite implausible to suggest that it would always consist in the mere addition of the component powers. There are more complex rules of composition that can involve interaction and alteration of those powers. Causation can thus involve the production of genuine novelty, which mereology alone does not deliver.

We cannot hope to eliminate the notion of cause from our philosophical lexicon, therefore. The notion that causation brings something to the world, over and above the mere coupling of disposition partners, for instance, remains sound. There are facts of causal production over and above the positioning of powers. This seemed to be a feature of the world that Martin was denying. Nor do we believe that causes are reducible to powers. The notion of a power is a notion of something that is productive: of its manifestations. But production is itself a causal notion (Mumford and Anjum 2011, 8). Our concepts of power and cause thus look too closely connected to allow the prospect of a reductive analysis. We still think that a dispositional theory of causation has much to recommend it. It tells us that dispositions tend towards their effects, for instance, but never necessitate them, even in the cases where they succeed in producing them. And we can take power to be a slightly broader concept than cause, which explains also properties, laws, and events. But this is still a theory; not an analysis.

## 3. TIME AND PROCESS

We will proceed to justify our claim, but there should be one caveat before we do so. It is not clear exactly what Martin intended the scope of his account to be. We offer an eliminativist interpretation of the passage quoted. He urged that in those cases we take it that the partnered powers just are the manifestation: they do not cause the manifestation. This is a theory, as he calls it, of 'partnering-manifestation identity.' One could hold that without being committed to the more ambitious thesis of dispositionpartnerings eliminating the concept of causation altogether. Martin could just have been saying that powers do not cause their manifestations: when suitably partnered, they instead are their manifestations. So causation is not found here, but it might be found elsewhere in the world and another account of something else entirely would have to provide it. This would be a far more modest claim on Martin's part. Unfortunately, Martin's account (2008, Ch. 5) is insufficiently detailed to allow a definitive interpretation. We cannot be sure that Martin was offering his claim as a bold eliminativist one or the more modest one we have outlined. We suspect the former though accept we may be mistaken. We will nevertheless proceed to consider the ambitious eliminativist thesis while conceding that it might not have been Martin's.

# 3. Time and Process

We will begin by pointing out two inadequacies of Martin's model for mutual manifestation. We accept that mutual manifestation itself is a better account of how powers come to exercise than is the stimulus-response model, but that should not lead us to think of it yet as perfectly adequate. We have elsewhere (Forthcoming) drawn attention to two ways in which the image of two triangles forming a square is an imperfect analogy. In the first place, when the two triangles are placed together in the right arrangement they form a square instantly. We know, however, that when mutual manifestation partners are brought together it takes time for them to produce their full manifestation. The analogy fails because it suggests that powers produce their manifestations instantaneously.

The relation between powers, causation and time is a troublesome and contested one. It has become rather orthodox to follow Hume (1978) on this issue and assume that causes are temporally prior to their effects. Martin's account seems an improvement on that, if our aim is to use it as a theory of causation. Partnered powers causally produce their effects and Martin's two triangles analogy suggests that they do so immediately. There is, thus, no temporal gap between the powers coming together—or being together and the manifestation occurring. The account suggests Hume is wrong, therefore, to commit to temporal priority for causes. We agree that Hume was wrong. We agree that there is no gap in time between powers being suitably partnered and them acting. But that does not tell the full story. Partnered powers may start to act instantly, with no temporal gap, but that does not mean that they have their full effect instantly, as Kant recognized (1921). It often does take time for powers to do their work, even if they start doing so immediately. Hence, the sugar may start to dissolve as soon as it is in contact with the water, but it still takes maybe a minute or so until it is all dissolved. The Earth may gravitationally attract a rock that has been rolled over a cliff edge, but it still takes some seconds for the ground and rock to collide. And you may speak Norwegian as soon as you are with fellow Norwegian speakers, but clearly doing so takes time. Indeed, speaking Norwegian is not something that could be done at an instant.

What is happening in such cases? Martin starts his chapter on causality by criticizing the two-event model of causation. He is right to do so. The account suggests that causation is a relation—one that Hume tells us is impossible to observe—between two events. In its place, we suggest we understand causation as involving continuous processes that are extended through time involving changes of properties. The sugar's dissolving in liquid is one such process. The process may have a beginning and an end, but it

#### 3. TIME AND PROCESS

is not as if we go straight from one to the other with nothing in between. Rather, the process goes through every intermediate stage between. The soluble and solvent powers, when partnered, issue in a natural process that can run its course, unless it is prevented or interfered with. Similarly, the rock that falls from the cliff, gravitationally attracted by the ground, goes through every space time point (continuum many if space time is dense) before it reaches the ground and rests. And speaking a language, like many other disposition manifestations, has to be process-like. It is necessarily extended through time, for one cannot have spoken a language at just one instant unless that were during such a process of speaking.

It seems that we have independent reasons for thinking that the manifestations of at least some powers are in processes, therefore, quite apart from anything we say about causation. But it can be noted that exactly the same can be said of causation and this gives encouragement to the project of grounding a theory of causation in the exercising of powers. Kant gives us an example. We ignite the stove so as to warm the room. The wood and the flame are brought together to cause heat. They do so immediately. Unlike Hume, Kant was quite ready to allow that causes were simultaneous with their effects: the ball causing a hollow in the cushion upon which it rests being his most famous example (1921, A203). In the stove example, however, Kant notes that it takes time for the stove to have its full effect. It is capable of heating the room to a temperature of 25°C, let us suppose. But it could take an hour for it to do so. Kant's claim of simultaneity of cause and effect is not threatened by this. Simultaneous does not entail instantaneous. The room is heated, and will be so while ever the powers of the flame are exercising, so we have simultaneity, but the whole thing is extended through time.

The analogy is inadequate, then. Martin's example, to accurately reflect the way mutual manifestation works, would have to suggest that the triangles, once together, took time to gradually become a square, through a

## 4. EMERGENCE

continuous process of change. Even cases of causation that look to be instant may be like this: it is just that the gradual change is a very quick one. When billiard balls collide, for example, and the cue ball causes the object ball to move, the causation seems to be going on exactly at the time they touch. This may look to be an instant matter, but physical theory tells us that the balls slightly squash into each other and then the object ball springs away. It is too fast for the unaided eye to detect, but it is process-like nevertheless.

## 4. Emergence

The second way in which Martin's analogy is inadequate is that it fails to allow for the production of genuinely novel phenomena. The status of emergentism is philosophically contentious, it need barely be said, but we do not need even strong emergence to show that there is something inadequate in Martin's model of composition. It seems very implausible to suggest that when we bring two or more powers together then what we are left with is merely a mereological sum of such powers. Instead, some kind of transformation looks to be incontestable.

To see this, one need only look at what happens when powers of things get combined in the sort of way Martin envisages. If we put together the powers of sodium, for instance, with the powers of chlorine, in the sort of way Martin puts together his two triangular cards, we do not get just their sum. It is hard to argue, then, that the partnered powers are identical with the manifestation. Sodium has a power to ignite spontaneously in water. Chlorine is poisonous. As Rothschild (2006, 153) points out, when we bring together these two substances with their various powers, we do not get something that is both poisonous and explosive. Instead, the two substances transform to become sodium chloride, that is, salt: something that has the powers of being soluble, tasty, and in the right quantities a contributor to human health. This is no simple mereological sum of the

## 4. EMERGENCE

powers of the parts. Some powers of the parts are no longer found in the whole and some powers of the whole are not found among the parts.

Shoemaker (1980) provides another example, which perhaps better illustrates how powers can be put together to form new ones. Hardness is a power to resist deformity and being knife-shaped involves various powers that we need not specify (but Shoemaker indeed thinks this property is a cluster of powers as he is arguing for pandispositionalism in this chapter). Only once we bring together these two distinct powers do we get something new: a power to cut, which each of the constituent powers did not alone have. This gives us a kind of power emergence only insofar as there is a power at the level of the whole that is not to be found in the constituent powers making up that whole.

These examples raise questions of interpretation. It might be alleged that we do not have genuine mutual manifestation in these cases. They really are about the addition or composing of powers and in that sense not really cases of causation. But that is exactly the point. They are not genuine cases of mutual manifestation either. It is not as if these powers are exercising together to produce a manifestation. And what this shows is that Martin's two triangles model of mutual manifestation is on the wrong track. It does not suffice to account for the transformative nature of causation, where partnered powers produce some process of change. When we strike a match, flame is ignited and this seems a genuine change to the extent that you cannot claim a flame is just a suitable arrangement of the powers of friction when the match is rubbed against the matchbox—and flammability of the match tip. And nor does Martin's model account for the emergent nature of powers through component powers, as in the cases of sodium chloride and the knife's power to cut.

Martin's model instead seems to be one of mereological summing together with some element of spatiotemporal arrangement. There are after all many arrangements in which the two triangles do not form a square. But

## 5. NONLINEARITY

where they are suitably arranged, there is still arguably no serious transformation occurring of the kind we think is to be found in the mutual manifestations of powers and in causation. The shape of the square is entirely explicable in terms of the shapes of the two parts. No novelty is produced. It is arguable, however, that in cases of causation we do have such novelty. It is as if, to adapt Martin's analogy, our two triangles could come together to form a circle rather than a square. How is that possible? Within the restrictions of Martin's model it is not. But Martin's model assumes that the partnered powers are left unchanged as a result of their partnership. The triangles remain triangles even while they are forming a square. It is only because they remain triangles that they are able to do this. If they turned into hexagons, for instance, they wouldn't be able to. We should focus in the remainder on how this transformation is possible and how it can sit with the theory of powers in general.

## 5. Nonlinearity

A linear system is one in which an output is proportional to its inputs. Martin's model for mutual manifestation, if the two triangles is a faithful analogy, is a linear system. The area of the square 'produced' is simply the addition of the areas of the two constituent triangles. Addition is a linear function. This would be fine if it were not the case that many causal interactions are nonlinear. The output is not simply the addition of inputs, but would have to be captured by a different and transformative function. If we plot on a graph the causal influence of sunshine on health, for example, we would find that it produced a curve rather than a straight line. Lack of sunshine is very unhealthy. A certain quantity is healthy because it delivers the essential vitamin D that, among other things, protects against cancer. But too much sunshine is again unhealthy because it dries the skin and contains ultraviolet radiation that is a carcinogen. Many causal systems are likely to be nonlinear. We will not speculate as to how many because

## 5. NONLINEARITY

counting in such cases may be meaningless. Perhaps it is sufficient to say that there are at least some, possibly many, nonlinear causal interactions and Martin's model of mutual-manifestation-as-identity cannot account for them. In other words, and keeping the issue of causation separate, there seem to be cases of mutual manifestation that cannot simply be identity because what is produced is a nonlinear function of the inputted powers.

How can we philosophically explain nonlinearity? We already have hints, but the answer we give will leave us with a problem in relation to our theory of powers, which we address in due course. The way we explain it is in terms of the powers interacting when they are partnered and undergoing a transformation, and it is for this reason that mutual manifestation involves a change that is more than just mereological summing.

Elsewhere, we provide an illustration of how this kind of interaction of powers could occur (Forthcoming). It concerns the volume produced during conversations. A typical conversation between two people would be conducted at around 60 decibels (dB). But we cannot assume that the volume of multiple conversations would simply be the addition of single conversations. If those conversations are held within a confined space, such as a drinks party within a room, then the conversations begin to affect each other. In order to be heard above all the other conversations, one conversing pair might raise their voices and talk at something like 63 to 70 dB, which they would not have done if they were in the room alone. (Note that the decibel scale is itself not additive but logarithmic: a conversation of 70 dB would be around twice as loud as one of 60 dB.) What the illustration shows, then, is that being within a mutual manifestation partnership actually changes the contribution made by one or more of the contributing elements. The noise produced by the whole drinks party is greater than the sum noises of each of the individual conversations had they been conducted in private: because they are brought together in such a way that they start to interact, affecting each other's contributions. Being together and working together affects the

## 5. NONLINEARITY

output of the parts. We thus have to consider nonlinear systems holistically for they really will produce more (or sometimes less) than the sum of their parts. Martin's two triangles model does not show this as a possibility.

Our example—drinks party conversations—of course involves human agency. The guests of the drinks party want to hear their partners speak and want to be heard by them so they intentionally raise their voices. Many nonlinear systems will not involve conscious agents, however, so will this illustration suffice for the non-mental realm? We claim that it does because even in non-conscious, non-mental systems, the same principle applies: namely that the individual components interact and affect each other's outputs. We give three simple examples, the first from biology and the other two from the non-biological world.

The biological case concerns the watering of plants in a limited space. At first, when we water the seeds, there may be a rapid growth of the plants in response to provision of water. But there comes a point where the plants start to crowd each other out. Their root systems grow and require more water but they are competing with the growing root systems of their neighbors. And the leafy foliage will have grown but will now be competing for light with the leaves of other plants, affecting the ability to photosynthesize. The rate of growth is negatively affected, therefore, such that the same degree of watering starts to produce a diminishing return in terms of growth rate. If we plot growth rate against watering, therefore, we get the curve that is indicative of a nonlinear interaction.

Now two non-biological examples, which concern familiar dispositional properties. The first is the common example of solubility and concerns rate of dissolving. When the sugar is first placed in the liquid, dissolving occurs quickly. But the more sugar goes into solution the more saturated the liquid becomes. The less solvent power the liquid has, therefore, and this slows the rate of dissolution of the remaining solid sugar. Here we have a clear interaction of the powers when they mutually manifest. The solvent changes the sugar by dissolving it—and using up its power of solubility while the sugar also can exhaust the solvent power of the liquid. Being involved in the mutual partnership thus affects the powers involved. They are not left unchanged as a result of their partnership, as Martin's model suggests. They are transformed. At the end of the process, both powers have spent themselves and we are left with a solute: a substance in solution. A second example concerns the burning of wood. At first, when ignited, the wood burns slowly as the fire takes hold. Then it grows and the subsequent flame and heat produced rise rapidly. But as it does so, it uses up the supply of flammable material that fuels it. The flames gradually die down and the temperature drops. If we plot the heat produced by the fire we get a curve, therefore, and this is precisely because the fire interacts with its fuel, reducing it over time and thus having less to burn. The two mutual manifestation partners—the powers of the fire and its fuel—change as a result of their partnership.

We have an explanation of the nonlinearity of mutual manifestation, therefore, which on our account is also an explanation of how causal systems can be nonlinear, and if correct this is enough to show us why Martin's account of mutual manifestation is inadequate. But there remains a problem. It could be argued that there is a price for this account because it appears to be inconsistent with a central tenet of disposition theory, namely that the identity of a power is determined by its manifestation. We will now proceed, therefore, to tackle this problem and we believe there is a solution.

## 6. Contribution and Identity

The identity of a power appears to be determined by its manifestation. Thus, it is that a power's manifestation is dissolving that makes the power solubility, it is that a power's manifestation is stretching that makes the power elasticity, and it is that a powers manifestation is jumping that makes it the power to jump. The latter example makes the point apparent. All powers are power to something. In well-known and commonplace examples we have a specific term for the power, such as fragility and solubility, where it is through knowing the concept that we understand what it is a power towards. But in other cases we don't have a specific term and then have to use the explicit dispositional vocabulary, calling it a disposition to x or a power to y, where the value of x and y determine the identity of the disposition. There are yet other cases where the manifestation type is even further hidden and would require some theoretical basis to understand, as in the cases of spin, charge, and mass. And there are cases such as being spherical that are according to the pandispositionalist powers, but where the manifestations towards which they dispose requires some work to find out, perhaps involving experimentation to discover.

The claim that the identity of a power is determined by its manifestation faces now two challenges, however. The first comes from the claim of polygeny: that effects are typically produced by many powers working together (Molnar 2003, 194). The second comes from nonlinearity, if the account we offered above is accurate, in which powers seem to change each others' manifestations. We will now explain how it is possible to retain the thesis that the identity of a power is fixed by its manifestation while accepting both polygeny and nonlinearity.

The problem created by polygeny is that most effects are typically produced by many different powers acting together, which is of course entirely consistent with a notion of mutual manifestation. Hence, the lighting of the match is caused by the flammable tip of the match, the fueling of the oxygen, the friction of the sandpaper, the dryness of the wood, and so on. But polygeny then threatens our claim that the manifestation determines the identity of the power because one of those powers—the friction of the sandpaper, for instance—could when combined with a different set of powers produce a different effect. The friction could wear down the rough surface of a piece of wood, for instance. It looks, therefore, as if the same power can produce different manifestations dependent upon the circumstances: which other powers it is partnered with.

Molnar, in seeing the pervasive nature of polygeny in causation, realized that this could pose a problem. It looks like the same power could produce lots of different effects depending on the situation within which it is placed. But Molnar also saw a way of avoiding this unpalatable conclusion. We should understand the manifestation of a particular power not to be the final effect that is produced for in the cases that cause us problems these are effects our original power can only produce with the cooperation of a number of other powers. Rather, the manifestation of the first power should be understood as a contribution towards the effect that the whole set of powers causes. And Molnar is then able to claim that the same power makes exactly the same contribution to any effect of which it is a part of the cause (2003, 194-196)<sup>1</sup> This solution has the disadvantage that it introduces a third element into the story: there will now be the power, its contribution/manifestation, and the final polygenic effect. But the third element seems inevitable once one accepts the polygeny of effects, as it seems one must, and equating the manifestation of a power with its contribution towards the effect has the distinct advantage that we can still allow the identity of a power to be fixed by its manifestation.

Our discussion and revisions of Martin's account of mutual manifestation has now raised a further problem, however, which comes from the acceptance of nonlinear interactions. We could say that powers make exactly the same contributions to effects no matter which other mutual manifestation partners they are with. But we argued above that causation can be nonlinear and then we explained nonlinearity in terms of the contributing powers affecting each other. This, when we filled out the account, involved the powers mutually affecting each others' contributions. The output of a power—its manifestation—was altered as a result of its partnership. So

<sup>&</sup>lt;sup>1</sup>For a more explicit discussion of the problem, see Mumford 2009a, 102–106.

where, then, does that leave the claim that a power's identity is fixed by its manifestation and its corollary that the same power will always make the same contribution to any causal situation of which it is a part?

Fortunately, it is possible to provide a solution that satisfies all our requirements. What we suggest, for meeting all our theoretical requirements while also being empirically plausible as an account of how powers compose, is that the identity of each power is given by its manifestation type. This will remain consistent for a power even if it is involved in a nonlinear causal interaction. What would alter in nonlinear cases of mutual manifestation would be the degree to which the power is manifested.

As a theoretical background to the making of this move, we should say that there is already a strong case for taking powers to be gradable (Manley and Wasserman 2007) and causation to be scalar (Moore 2003, 71). We take it that both powers and their effects can come in degrees. They have a magnitude: they are quantifiable. Hence, the power of elasticity is not merely elasticity *simpliciter* but, rather, anything that is elastic will have elasticity of some degree. Similarly for the manifestations of those powers. Elasticity can manifest itself in stretching, but the exact degree to which something stretches can vary according to the conditions and other mutual manifestation partners. The degree to which elasticity is manifested may thus vary, perhaps within a range that has an upper limit. Being heated will alter the degree to which something is elastic, for instance. Allowing such variation in magnitude clearly does not threaten the kind of identity condition that concerned us. We can still say that the manifestation-type fixes what the power is—whether it is fragility, attraction, spin, flammability, and so on and then allow that the degree of manifestation is dependent on the mutual manifestation partnership in which the power participates. And this will be designed to include those nonlinear cases where the degree of manifestation is determined through interaction with other mutual manifestation partners.

## 7. RECKONING

We contend, therefore, that the problems created by polygeny and nonlinearity can be answered without any damage to the theory of dispositions. Indeed, the powers ontology provides a rather attractive account of these issues.

## 7. Reckoning

We are now in a position to make a final reckoning and to summarize our findings. We argued that the notion of mutual manifestation—as an account of how powers come to be exercised—is a significant advance over the stimulus-response model. However, we need the correct account of mutual manifestation. Martin has given us the basic idea and he illustrated it with an analogy of two triangles forming a square. This, we said, was inadequate as it failed to accommodate some significant features of mutual manifestation. These features are also to be found in causation, which is significant for those of us who think that powers are a basis for causes. Partnered powers issue in processes that take time, we said, whereas Martin's illustration suggests that partnered partners are identical with their effects. We also said this was implausible for reasons we classified as emergentist. Resultant powers do not seem to be the mere mereological sum of their components. Third, we noted that mutual manifestation partnerships can result in nonlinear interactions and this suggests there is a genuine transformation in the production of a manifestation. We have just shown in the previous section that we can allow that interacting partnered powers can change the degree to which they manifest a power rather than change in their manifestation type.

If we are to sum up the problem with Martin's model of mutual manifestation we would say that it shows us something that is more like mereology than like causation. Martin urges that we do not think of partnered powers as causing their manifestation, but instead as being identical with their manifestation. Given what we have argued above, we think that this is precisely

# 7. RECKONING

the point on which Martin is wrong. We should indeed think of the mutual manifestation as being caused by the component powers working together. To do so is to allow that powers produce something, which may be novel and a transformation of its causes into something else. There is no reason to resist such an image of the world.