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The question has been raised whether dispositions, such as solubility, brittleness and generosity, are reducible to categorical properties, such as molecular structure and brain codings. 'Reducible' means that the categorical properties, in suitable activating circumstances, should be sufficient to produce the result that is the manifestation of the disposition. For example, the molecular structure of a soluble salt should be sufficient to explain why it dissolves in water.

D. M. Armstrong ([2], pp. 13–14) notes three possibilities:

> *First*, we might come in the end to properties of the disposed thing which involve no element of dispositionality. They will be the ultimate properties on which truthful attributions of dispositions rest. *Second*, we might reach ultimate *potentialities* of the disposed thing, potentialities which do not depend upon non-dispositional properties. To adopt such a solution would involve accepting an ultimate ontological division among non-relational properties into potentialities and non-potentialities. *Finally*, there is the possibility that the process goes on to infinity, dispositions resting upon states which involve further dispositions which involve further states . . .

I will argue that the first of these is not in fact possible, that is, that dispositions are not reducible to categorical properties.

Similar arguments, though with weaker conclusions, have been advanced by R. Cummins ([3], p. 204) and J. W. Roxbee Cox [5]. An argument of Milton Fisk [4] is similar but has a different conclusion. The ultimate origins of all such arguments are, of course, Aristotelian [1].

Consider Democritus' attempt to reduce all the properties of things to the shapes and movements of atoms. He proposed to explain the hardness of solids, for example, by the fact that the atoms of solids were hooked and so stuck to one another. In order to make the solid hard, however, the atoms must not only be hooked, but must retain their hooked shape when they come into contact with other atoms. That is, the hardness of the solid depends not only on the shape of its atoms but also on their rigidity. But rigidity is a disposition, namely the disposition to preserve shape when acted on in certain ways.

This is a particular case of a problem which arises in general. A disposition is a disposition to behave in certain ways when certain causes act. If the categorical properties or structures of a thing are to produce this behaviour under these causes, the thing must retain the properties or structures despite the action of the cause, or

the properties or structures must react with the cause in some way. It must at least be the case that the properties or structures do not completely disappear, or reveal themselves as ghosts, as soon as the cause acts. The structure of a house of cards has no causal efficacy, because it collapses at a touch; the structure of a castle in the air has none either, because the hand passes through it unaffected, proving it a ghost.

But this rigidity of properties or structures, their tendency to be preserved, is dispositional. Hence dispositionality has not been eliminated.

This completes the argument that dispositions cannot be eliminated. But even if this result is admitted, one can still feel a certain dissatisfaction. Dispositions remain, but they are not quite the same kind of dispositions one first thought of. Rigidity is a disposition-not-to, rather than a disposition-to, like solubility or generosity: a rigid thing is disposed *not to* change when a force applies, but a soluble thing is disposed *to* change when put in water. There is indeed nothing ephemeral or second-order about dispositions not to change. On the contrary, the dispositions of buildings not to collapse despite their internal stresses, of boilers not to burst despite the pressure in them, of memories not to decay despite new input, and so on, are real and familiar enough features of the world. Friction (so much discussed in school science, so little afterwards) is the disposition of surfaces not to slide along each other; it is responsible for our ability to walk, or even to exist in any position other than the prone.

Nevertheless, dispositions not to change are not the same as dispositions to change. It is reasonable to ask, therefore, whether dispositions might be reducible to categorical properties plus dispositions-not-to. That is, can the positive dispositions at least be reduced?

Let us return to Democritus and the hooked atoms. Would the geometrical properties of the atoms (by hypothesis, their only categorical properties) and their rigidity, be sufficient to account for their behaviour? The answer is that it would be sufficient, if there were no behaviour, but otherwise it would not. If the atoms are hooked together in a rigid arrangement, so that, because of their rigidity, the atoms cannot move at all, then shape and rigidity will be enough to account for this. But if the atoms bump into one another, then the case is different. It is *possible* that no further change should occur after collision, but in our world, change usually breeds change. That there should be further motion, and if so, how fast it should be and in what direction, will need some disposition to determine it. When imagining hard atoms, one usually thinks of elasticity, the disposition to push off incident objects in a direction perpendicular to the surface of contact. If there is no elasticity, there is no motion after the collision; if there is elasticity, we have a positive disposition being actualised.

As with rigidity, this is an instance of what must happen in general. If a change is about to occur by a disposition being actuated, then this will happen by some cause acting on the properties of the disposed thing. If nothing happened after contact, nothing would have to be invoked except a disposition not to change despite action. Since, as we have assumed, some change does happen, things are otherwise. Purely categorical properties like shape, arrangement and symmetry, with their dispositions not to change, will not determine that something should happen next, rather than nothing. That something should happen next, and that the change should be the

determinate one it is, among the various logical possibilities, must be determined by some disposition to change. Therefore, dispositions-to are not eliminable.[1]

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[1] Aristotle, *Metophysics*, Θ 3.
[2] D. M. Armstrong, *Belief, Truth and Knowledge* (Cambridge, 1973).
[3] R. Cummins, "Dispositions, states and causes", *Analysis* 34 (1974) 194–204.
[4] M. Fisk, "Capacities and natures", in *Dispositions* edited by R. Tuomela (Dordrecht, 1978) pp. 189–210, sections 2 and 5.
[5] J. W. Roxbee Cox, "Mackie on dispositional properties", *British Journal for the Philosophy of Science* 26 (1975) 232–4.

[1] I am grateful to D. C. Stove for some helpful comments.