



REDUCTION AND EMERGENCE IN SCIENCE AND PHILOSOPHY

CARL GILLETT

Reviewed by Elanor Taylor

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Carl Gillett

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In *Reduction and Emergence in Science and Philosophy*, Carl Gillett offers a bold new framework for philosophical and scientific discourse about reduction and emergence. This book is essential reading for anyone interested in these topics, and also for anyone interested in the methodology of scientifically informed metaphysics.

Gillett argues that scientific discourse on emergence and reduction has come apart from the corresponding philosophical discourse. Philosophers are uninformed about scientific thinking in these areas, Gillett claims, and are clinging to problematic semantic, rather than ontological, models of reduction and emergence. The result of this is a philosophical consensus that reductionism is a dead position, and that emergentism is either vacuous in its weak versions or deeply odd in its strong versions. In contrast, Gillett argues, in scientific discourse both positions are 'live', though some philosophical work

divide between the literatures by developing a new, scientifically informed, and philosophically rigorous framework.

Gillett begins by developing an account of composition based on the use of compositional concepts in scientific practice. A key feature of Gillett's approach is that it permits compositional relations to obtain not just between entities and individuals, but also between powers, properties, individuals, and processes (see Section 2.2). There are a number of different such relations, which include the comprising of higher-level powers by lower-level powers, the realization of higher-level properties in lower-level properties, the implementation of higher-level processes in lower-level processes, as well as the constitution of higher-level individuals by lower-level individuals (p. 68). Gillett focuses particularly on the idea of a 'determinative entity', which is an entity that can make a difference to the powers of other entities. Causation is a form of determination, but there are also non-productive forms of determination, such as constraining what an individual can do and shaping the roles that an individual can play. Gillett uses the notion of determination to draw a distinction between a 'composed individual' and a 'collective'. A composed individual is determinative and so it can make a difference to the powers of other individuals, whereas a collective has no determinative powers of its own and is merely a collection of individuals that have determinative powers. This distinction between a composed individual and a collective plays a central role in Gillett's account of the further distinction between reductionism and emergentism.

Gillett's reductionist (hereafter the 'scientific reductionist') endorses the familiar slogan that 'wholes are nothing but their parts', and understands it as a purely ontological claim. According to the scientific reductionist, only the most fundamental components are determinative. Higher-level entities are not composed individuals, which would have determinative powers of their own. Instead, higher-level entities are collectives, rather than determinative individuals. Gillett illustrates this view and the motivation for it with the example of the hardness of a diamond. The scientific reductionist argues that we can explain the hardness of a diamond (and its associated powers, such as its capacity to scratch glass) in terms of the powers of and relations between the many carbon atoms that form the diamond (p. 106). Because we can explain everything that the diamond can achieve in terms of the carbon atoms, the scientific reductionist argues on grounds of parsimony that we have no need to posit a further determinative entity, the diamond. Thus the diamond is a non-determinative collective entity and only the lower-level entities that form the collective, the carbon atoms, are determinative. However, scientific reductionists have no expectation that this ontological fact should be reflected in a semantic reduction—such as a derivation of all truths about the diamond from all truths about the carbon atoms—and they are comfortable with the idea that there can be true theories and generalizations about the higher-level entities.

Furthermore, Gillett (Section 3.2) argues, the scientific reductionist is genuinely comfortable with the existence of a macro-world, and with higher-level scientific theories and explanations about that macro-world. This is possible for scientific reductionists because they hold that the macro-world is made up of collective, rather than composed, entities. Because collective entities are not determinative, permitting the existence of macro-level collective entities is perfectly consistent with the scientific reductionist's commitment to the idea that wholes are nothing beyond their parts. This is merely a sketch of Gillett's argument, and there is a great deal more detail in the book, including the articulation of two different live versions of reductionism based on alternative approaches to the nature of aggregation (see Chapter 8).

scientific emergentism.

Gillett's emergentist (hereafter the 'scientific emergentist') holds that there are composed, higher-level entities with determinative powers and that new, fundamental emergent laws apply to the components of certain macro-level individuals, which do not apply to those components when they are part of simpler collectives. Gillett gives an account of a form of determination called 'machresis', which he argues is a central aspect of emergence. The term 'machresis' is a portmanteau of the Greek roots 'macro' for 'large' and 'chresis' for 'use', and machresis is a form of non-productive determination in which composed entities determine some of the powers of their components. According to Gillett (p. 245), machresis occurs when the instantiation of an emergent property shapes the causal powers of the lower-level property instantiations that realize the emergent. Although machresis is not a form of causation, the idea that emergent wholes exert some kind of downward determinative influence on their components is similar to the concept of downward causation, a standard feature of more traditional accounts of strong emergence.

Overall, the scientific reductionist holds that the macro-world consists of non-determinative collectives and that the scientific laws reflect this, as the fundamental laws govern the behaviour of lower-level, rather than higher-level, entities. The scientific emergentist, on the other hand, holds that the macro-world contains at least some determinative composed individuals and that the scientific laws also reflect this, in that they include some fundamental emergent laws. This is an even briefer sketch, but the book contains a wealth of further detail that I encourage anyone interested in the topic to follow up.

Despite these strengths, I do have some concerns about Gillett's view. To what extent is the scientific reductionist really comfortable with the existence of the macro-level world, and with the autonomy and legitimacy of the higher-level sciences that study it? One supposed benefit of Gillett's new framework is that it portrays both the scientific reductionist and emergentist as holding fairly plausible positions, which are scientifically and philosophically live. Scientific reductionism is more plausible than other forms of reductionism, Gillett argues, partly because the scientific reductionist is happy with a certain level of ontological commitment to, and scientific theorizing about, macro-level entities, and so is protected from many standard objections to the more traditional accounts. However, the scientific reductionist appears to be comfortable with very little about the macro-level world.

According to the scientific reductionist, macro-level entities exist, but they are collectives rather than composed entities; as such, they are non-determinative. If macro-level entities do not have any causal powers or any other kind of determinative capacity, then it is hard to motivate ontological commitment to them. It is unparsimonious to commit to more entities than we have to, and there is little metaphysical motivation to recognize the existence of entities that are non-determinative and so do not do any work. Given the scientific reductionist's commitments, it would make more sense to hold that macro-level entities do not exist, but that sentences about macro-level entities may be true, and that they are made true by truths about micro-level determinative entities. However, in taking this position on the existence of macro-level entities, this would challenge the idea that the scientific reductionist is comfortable with the existence of macro-level entities and with scientific theorizing about such entities.

but are not determinative is unmotivated and unparsimonious given their prior commitments. Second, if scientific reductionists were to hold that macro-level entities are determinative, then they would have sufficient motivation for the position that macro-level entities exist, but would also have to abandon the central core of their reductionism. Third, if they deny that macro-level entities exist, then they are no longer comfortable with the existence of the macro-world and the autonomy and indispensability of the sciences that describe it; their position looks far more like the traditional, and less plausible, forms of reductionism that Gillett rejects. The claim, then, that the scientific reductionist has a different and more plausible attitude to macro-level entities than the traditional reductionist deserves further scrutiny.

I have a further concern about the nature and role of machresis in scientific emergentism. Gillett argues that machresis is a form of non-productive downward determination, whereby composed individuals have properties that can shape and constrain the roles played by their components, and in doing so, determine the powers of their components. Gillett notes that more traditional accounts of strong metaphysical emergence involve downward causation rather than machresis, and that downward causation has been the subject of a number of objections to emergentism. For example, Jaegwon Kim ([1999]) has argued that downward causation from wholes to parts would involve a problematic kind of self-causation. Gillett argues that scientific emergentism is not subject to such objections because of differences between machresis and downward causation, but I will argue that machresis is subject to a version of Kim's self-causation objection.

Consider two different ways in which the role played by, and hence the causal powers of, a property instantiated by a component entity (call this property instantiation X) can be shaped or constrained. In the first case, X has causal powers p, q, and r, but the role played by the component is constrained such that only q and r, but not p, can be exercised. Call this kind of case a 'constraint case'. In the second case, X has causal powers p, q, and r, but then when the component composes a certain higher-level entity, P gets a new role to play that involves the exercise of a new causal power, s. Call this kind of case a 'new power case'. A reasonable interpretation of the new power case is that the component entity has been endowed with, or given, an entirely new causal power. I present this case not to argue that it is a reasonable interpretation of a particular empirical case—Gillett himself articulates and defends the concept of machresis through an idealized thought experiment, rather than an empirical case study. Instead, I present this as a situation that appears to be possible given Gillett's definition of machresis, and yet also appears to leave scientific emergentism open to some of the objections that plague more traditional forms of strong emergentism.

Kim's ([1999], pp. 28–31) 'transitivity objection' to downward causation is that if a whole causally affects its parts, then it causally affects itself, which implies a problematic kind of self-causation.¹ In the new power case, a slightly different version of the same concern arises: the whole endows a part with a new causal power, and thereby appears to *endow itself* with a new causal power. Gillett's response to the transitivity objection focuses on the precise nature of the different forms of determination involved in machresis. He argues that in such cases, the downward determination from higher-level to lower-level is machretic, but the upward determination from lower-level to higher-level is compositional, and that there is no transitivity of determination if the chains of determination contain different forms of determination. However, the new power case involves the same kind of determination each way: the component is endowed with a causal power, and the whole is also endowed with a causal power. In giving itself this

Furthermore, even if the scientific emergentist continues to push the line that the kinds of determination differ in this case too, this does not answer the question of *why* this makes the self-endowment of causal powers metaphysically unproblematic. Cases like this indicate that we need to hear more about the metaphysical viability of machresis if scientific emergentism is to remain a genuinely live position.

Putting these concerns to one side, however, *Reduction and Emergence in Science and Philosophy* is a genuine must-read. I wholeheartedly recommend this book to anyone interested in these topics, and the practice of scientifically informed metaphysics more generally.

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References

Kim, J. [1999]: 'Making Sense of Emergence', *Philosophical Studies*, 95, pp. 3–44.

Notes

¹ See also (Gillett [2016], pp. 221–2).

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