

An Explication of Emergence

Elanor Taylor

Section 1: Introduction

There is a general consensus in contemporary philosophy that debates about emergence are confused and messy. Kim, for example, says “*those discussing emergence, even face to face, more often than not talk past each other. Sometimes one gets the impression that the only thing that the participants share is the word ‘emergence’.*”¹ O’Connor refers to emergence as “*a notorious philosophical term of art*”², while Chalmers adds “*The term ‘emergence’ often causes confusion in science and philosophy.*”³ Dialogue becomes even more difficult when we turn to scientific uses of the concept of emergence, which are often taken to be radically discontinuous with philosophical approaches. Some claim that the idea of emergence prevalent in science is entirely different from the idea of emergence prevalent in philosophy.

In this paper I offer a unified explication of emergence, and show that this explication can help us to avoid much of this confusion. I argue that the best way to understand the concept of emergence is as the unavailability of a certain kind of scientific explanation for an observer or observers. After articulating a set of criteria for successful explication, I show that the explication I offer meets those criteria and fares better against them than alternative explanations. In addition to its unificatory appeal, this explication opens up new avenues for scientific and philosophical research and dialogue about the nature of emergence.

Section 2: The Idea of Emergence

The term “emergence” is used for a diverse range of phenomena – so diverse, in fact, that it is hard to grasp what such phenomena could have in common. For an illustration of this variety, consider the following list, every item on which has been described by a philosopher or a scientist as a case of emergence:

¹ Kim, J. (2006)

² O’Connor, T. (2006)

³ Chalmers, D. (2006)

1. The relationship between convection rolls in a body of heated fluid and the micro-physical states of that fluid⁴
2. The relationship between configurations in Artificial Life worlds and the cells that form them⁵
3. The relationship between phenomenal and neural properties⁶
4. The relationship between entangled states and the components of their constituent systems⁷
5. The relationship between the properties of a chemical compound and the properties of its constituent elements⁸

Despite the diverse range of different accounts and purported cases of emergence, there is a common, schematic conception of emergence: assuming a distinction between micro-level and macro-level properties, emergent properties are macro-level properties that are in some sense both dependent on and autonomous from their underlying micro-level properties.⁹ The combination of these two features – dependence and autonomy - makes emergence mysterious and also somewhat problematic. Dependence on and autonomy from the micro-level are not mutually exclusive features but, *prima facie*, they stand in tension with one another. Most accounts of emergence involve some attempt to reconcile these two features and dissolve the appearance of tension.

This schematic conception of emergence as a combination of dependence and autonomy presupposes a distinction between micro- and macro- levels. Typically “micro” means “more fundamental than macro”, but some have argued that cases of emergence obtain between equally fundamental levels.¹⁰ Accordingly, for the purposes of this discussion I will not attempt to offer an account of the micro- macro distinction, other than to understand anything emergent as “macro” and the base of an emergent as “micro”.

⁴ Kelso, J.A. Scott (1995)

⁵ Bedau, M. (2003) Dennett, D. (1991)

⁶ Chalmers, D. (1996)

⁷ Redhead, M. (1995), Teller, P. (1986)

⁸ Broad, C.D. (1925)

⁹ Bedau, M. (2003); Wilson, J. (forthcoming)

¹⁰ e.g. McLaughlin, B. (1992); Wilson, J. (2005); Chalmers, D. (2006); Barnes, E. (2013)

Section 3. Philosophical Approaches to Emergence

Given the idea of emergence as a combination of dependence and autonomy, one part of a typical philosophical account of emergence is an account of emergent autonomy. Often this will start either with the claim that emergent autonomy is metaphysical or the claim that emergent autonomy is epistemic. To say that emergent autonomy is metaphysical is to say that emergents are not metaphysically exhausted by their underlying micro-properties, which can be understood in a number of different ways including: a failure of the macro-level to reduce to the micro, the macro-level properties having causal powers that the micro-level properties do not have, or modal differences between the micro-level and macro-level properties. The proponent of an epistemic view, on the other hand, holds that emergent properties are only epistemically, rather than metaphysically, autonomous from the micro-level. To explain this distinction I will consider an example from each camp: Chalmers' metaphysical view and the epistemic view defended by Hempel and Oppenheim.

According to Chalmers almost all of the facts about the world are logically necessitated by the micro-level facts, which he takes to be the facts about fundamental physics, with one very important exception: the case of consciousness. The facts about consciousness are not logically necessitated by the micro-level facts, but only nomologically necessitated. That is to say, in worlds with laws like ours, the same micro-states will generate conscious experience but there are logically possible worlds in which the same micro-states do not generate conscious experience. This makes conscious experience, according to Chalmers, a case of strong emergence.¹¹

Epistemic approaches portray emergent autonomy as merely epistemic rather than metaphysical. For example, consider Hempel and Oppenheim. According to Hempel and Oppenheim:

“...emergence of a characteristic is not an ontological trait inherent in some phenomena; rather it is indicative of the scope of our knowledge at a given time; thus it has no absolute, but a relative character; and what is emergent with respect to the theories available today may lose its emergent status tomorrow.¹²”

They offer the following definition of emergence:

¹¹ Chalmers, D. (2006)

¹² Hempel & Oppenheim (1965) pg 64

“The occurrence of a characteristic W in an object w is emergent relative to a theory T , a part relation P_t and a class G of attributes if that occurrence cannot be deduced by means of T from a characterisation of the P_t -parts of w with respect to all the attributes in G .¹³”

Hempel and Oppenheim take emergence to be relative to a number of different factors. In Section 2 I mentioned that emergence is always relative to a micro-macro distinction, and this is characterised by Hempel and Oppenheim as a parthood relation. Emergence is also, on their account, relative to a theory, because theories introduce laws and principles that make some features deducible that would not be deducible from a body of knowledge not including the theory.¹⁴ Finally, Hempel and Oppenheim argue that emergence is relative to a class of attributes of the parts. For our purposes, Hempel and Oppenheim’s view provides a helpful example of an epistemic account of emergence because they locate emergent autonomy in the scope of human knowledge and the theories that a community has at hand.

There is a range of other kinds of philosophical accounts of emergence, including computational views that locate emergent autonomy in the computational irreducibility of the macro-level from the micro-level, but most philosophical accounts fall into the category of metaphysical or epistemic.¹⁵

Section 4: The Concept of Emergence in Scientific Practice

The concept of emergence is prevalent in scientific practice and appears in areas as diverse as quantum mechanics, developmental psychology and Artificial Life. Many authors have claimed that scientific and philosophical uses of the concept of emergence are discontinuous, some going so far as to claim that there are two separate concepts of emergence, one corresponding to the concept prevalent in science and one corresponding to the concept prevalent in philosophy.^{16,17} This brief survey of scientific uses of the concept of emergence will indicate that this is not in fact the case, and that scientific ideas about emergence are continuous with philosophical ideas about emergence.

¹³ Hempel & Oppenheim (1965) pg 64

¹⁴ For example, Hempel and Oppenheim discuss a case in which electric current flows through a wire connecting a piece of copper and a piece of zinc that are partly immersed in sulphuric acid. They argue that the facts about this flow may not be deducible from basic information about the attributes of copper, zinc and the acid, but may be deducible from a theory that includes these details, plus the principles and general laws of chemistry. Hempel & Oppenheim (1965) pg 63

¹⁵ For an anthology including some computational accounts, see Bedau, M. & Humphreys, P. ed (2008)

¹⁶ Chalmers, D. (2006) pg 1-2

¹⁷ Stephan, A. (2006) pg 485

Systems biology and systems chemistry are areas in which emergence is a common concept. For example, in a recent article on systems chemistry from the journal *Nature*, Nitschke describes systems chemistry as “*the study of complex systems, or networks, of molecules*” and directly addresses questions about the nature of emergence: “*Emergence occurs when a complex system exhibits properties that can’t be predicted by considering its subcomponents in isolation... Predictability is subjective, however... Perhaps a better definition of ‘emergent’ is ‘interesting and counter-intuitive’...*”¹⁸ For this practitioner, emergence is tied to unpredictability. In another recent piece on systems chemistry, Balazs and Epstein offer the following definition “*The term refers to phenomena in which the complexity of structures or behaviors in systems with many interacting components exceeds that predicted from the knowledge of the individual components and the forces between them.*”¹⁹ Again we can note the appeal to unpredictability, in this case the unpredictability of the complexity of certain systems.

Another area of scientific practice in which the concept of emergence is prevalent is Artificial Life. Assad and Packard attempt to offer an account of emergence in Artificial Life, and propose a graded scale of emergence from strong to weak, where each place on that scale represents a different form of failure of deducibility.²⁰ We can again note the appeal to unpredictability, and also to failure of deducibility. For an alternative view from Artificial Life, Bonabeau and Theraulaz describe emergence as involving “*entirely new behaviors*”²¹, offering a more metaphysical slant. Bedau offers an account of emergence as involving “*underderivability except by simulation*” in an Artificial Life world, a seemingly epistemic condition which he argues is in fact not merely epistemological.²²

Appeals to emergence in physics have received much philosophical attention, most of which treats such emergence as metaphysical. For example, Silberstein and McGeever argue that fundamental physics generates examples of metaphysical emergence, while Wilson offers an account of emergence as involving differences in degrees of freedom.²³ Morrison has recently proposed that superconductivity is a case of emergence, and argues for the importance of understanding emergence as ontological.²⁴ Because of the philosophical attention that physical concepts of emergence have received I will not focus on these in detail other than to note that in such cases emergence is typically thought to be metaphysical.

¹⁸ Nitschke, J. (2009) pg 737

¹⁹ Balazs, A. and Epstein, I. (2009) pg 1632

²⁰ Assad & Packard (1992)

²¹ In Langton, C. (1995)

²² See Bedau, M. (2003) and Bedau, M. (2008)

²³ Silberstein & McGeever (1999); Wilson, J. (2010)

²⁴ Morrison, M. (2012)

In this section I have very briefly examined some extracts from practitioners working in systems chemistry, Artificial Life and physics. The following common features were evident: emergence was understood in some cases as a metaphysical relation, and was also tied to unpredictability, failures of derivability, and resistance to certain kinds of explanation. As was true of philosophical treatments of emergence, in some cases epistemic and explanatory features were taken to be sufficient for emergence, while in others those epistemic and explanatory features were taken to be indicative of metaphysical emergence. As I mentioned at the start of this discussion, the position that there are at least two radically different concepts of emergence, one of which roughly corresponds to philosophical use and one to scientific use, is fairly popular. The extracts we have examined from scientific practitioners indicate, however, that this position is false.

Section 5: The Need For a New Approach

The philosophical literature on emergence is notoriously messy. Proponents of metaphysical and epistemic accounts of emergence will often take emergence to obviously be a metaphysical or an epistemic phenomenon, and the approach of *starting* with a particular idea of emergence as necessarily epistemic or necessarily metaphysical has led to a situation in which there is little common ground in philosophical and scientific debates about emergence.

The current situation is that philosophers with different views on emergence typically understand “emergence” as a term of art, different in the hands of each person who uses it. This makes philosophical dialogue about emergence troublesome and dialogue between philosophers and scientific practitioners even more so. If there really are numerous different concepts of emergence being applied to different kinds of phenomena, then this diversity is not a problem so long as we are explicit about the concept they are deploying and deploy it appropriately. In what follows, however, I will offer a rational reconstruction of the concept of emergence that can serve the majority of purposes to which the concept “emergence” is typically put. Furthermore I will argue that using this unified explication will open up interesting avenues for philosophical and scientific dialogue about and research into emergence.

The basic idea of a rational reconstruction is to take a vague but prevalent concept from a domain of discourse and to offer a precisification of that concept based on features of its use. Although

rational reconstruction aims at accuracy to original use, it is not determined by original use, and allows for revisions to the concept in question. The primary motivation for this explication is to attempt to unify discourse about emergence, to prevent equivocation and permit shared dialogue. However this requirement must be balanced against some other, important theoretical virtues, including simplicity, fruitfulness and accuracy to original use. According to these standards, an explication of emergence will be better insofar as it more fully satisfies the following desiderata:

1. Similarity. The explication must be similar to the concept being explicated such that in most cases where the latter is used, the former may be used, allowing for some differences.
2. Fruitfulness. The explication must be fruitful in so far as its use facilitates scientific and philosophical research on emergence.
3. Unification. The explication must permit unification of the concept of emergence as far as is permitted by meeting the other three criteria.
4. Simplicity. The explication should be as simple as success in the first three criteria permits.²⁵

The concept of emergence is a tough target for a rational reconstruction because it is used in philosophy as well as in scientific practice, and so the explicandum has already received some substantial philosophical attention. I will work around this by simply taking the explicandum to be the concept of emergence as it is used in scientific practice and in different areas of philosophy.

Section 6. An Explication of Emergence

In this section I will offer an explication of the concept of emergence, and expand on some of its central features. In Section 7 I will move on to argue that my explication meets the criteria for explication more successfully than its rivals.

I offer the following explication of the concept of emergence:

(EM) Given components A, B, C... n arranged in relation r into a whole, and an observer O, property x of the whole is emergent for O iff there is no scientific explanation available to O of the fact that the following regularity obtains of natural

²⁵ Note that criteria 1, 2 and 4 are among standards for explication developed in Carnap, R. (1950) pg 7.

necessity: *Whenever components A, B, C...n are combined in relation r, the resulting whole instantiates property x.*

In the rest of this section I will examine some central features of EM, before moving on to consider alternatives to EM in Section 7.

“Components” should be understood very loosely. I simply take the term “component” to be a placeholder for “bearer of the micro-level properties” and the term “whole” as a placeholder for “bearer of the macro-level properties”, where the distinction between micro and macro can differ from case to case. This element captures the idea that emergence is always relative to a distinction between micro- and macro-levels.

According to EM, a property is not emergent *per se* but only emergent relative to an observer. Although the conception of emergence given in EM refers to only one observer, EM allows for the possibility that a given property may be emergent for many observers, or even all, while another may be emergent for only one, or a few observers. This feature can be tweaked depending on the practitioner’s interests; for instance, some may wish to take emergence as relative to a scientific or epistemic community and EM can accommodate this by treating such communities as groups of observers. Such tweaks will, of course, affect which properties turn out to be emergent, in much the same way that a change of observer will affect which properties turn out to be emergent.

I take “explanation” to mean scientific explanation, but the particular kind of explanation in question can vary from case to case. For example, one property may be emergent relative to mechanistic explanation, but not to statistical explanation. This means that the absence of *any form* of scientific explanation (of this particular explanandum) is sufficient for emergence. Due to this broad standard for explanation, EM can encompass claims about emergence that were not originally explicitly stated in terms of explanation. For example, a failure of deducibility counts as a failure of deductive explanation and hence is sufficient for emergence. Alternatively, an account of emergence as a form of underivability within an Artificial Life world (central to accounts of “computational” emergence”) is a failure of a certain kind of explanation and also sufficient for emergence. The very basic idea that EM captures is that in cases of emergence, there is a failure of some general form of explanation of the macro-level emergent in terms of the micro-level base. In some cases this may obtain for metaphysical reasons, while in others for merely epistemic reasons. But all cases of emergence involve the failure of some form of explanation.

One might wonder, why put explanation at the heart of emergence when many accounts of emergence (including accounts I have considered in this paper) do not emphasize explanation? Three considerations are relevant here. First of all, there is a robust conceptual connection between explanation and emergence, which obtains even in accounts of emergence that were not explicitly formulated in terms of explanation.²⁶ Second, I take a very broad conception of explanation, according to which explanation comes in many different forms and is not monolithic. This permits EM to encompass a wide range of different features, including failures of deducibility and derivability, as explanatory failures. Finally, in Section 7 I will argue that EM more successfully meets a set of desiderata for explication than relevant alternatives, which in itself is an argument for embracing EM.²⁷

Note that the explanandum is a natural necessity rather than a simple generalisation, as this is intended to capture the common idea that emergence must involve a supervenience relation.²⁸ The relevant notion of “availability” will also vary from case to case. One standard is that an explanation is unavailable if a group of top scientists have worked on the question for a long time and have not succeeded in formulating such an explanation. We may also face cases of emergence relative to different standards, such as for example that that an explanation is unavailable only if it is impossible in principle to formulate one.

One striking feature of EM is that it portrays emergence as extremely prevalent. For instance, if the relevant observer has very limited scientific knowledge, then for that observer there may be very

²⁶ For example, consider the two philosophical accounts examined earlier. Neither Hempel & Oppenheim nor Chalmers explicitly formulated their account of emergence in terms of explanation, and yet the authors explicitly endorse the connection between emergence and explanation. Hempel and Oppenheim say “*If the assertion that life and mind have an emergent status is interpreted in this sense, then its import can be summarized approximately by the statement that no explanation, in terms of micro-structure theories, is available at present for large classes of phenomena studied in biology and psychology*”, Hempel, C. & Oppenheim, P. (1965) pg 65. Chalmers and Jackson explicitly tie emergence to failure of a priori reductive explanation in Jackson, F. and Chalmers, D. (2002). Furthermore, in most purported cases of emergence, an attempt at a scientific explanation of the relevant kind has failed. For example, consider the decline of British Emergentism. The British Emergentists thought that chemical properties emerged from physical properties but this was proved wrong by the new physical explanations of chemical bonding. See McLaughlin, B. (1992) pg 23.

²⁷ What about those purported cases of emergence in which the emergent appears to be completely explainable from the micro-level? For example, consider Wilson's conception of weak emergence in Wilson, J. (2010). According to Wilson an entity E is weakly emergent from component entities e_i when one of the degrees of freedom needed to describe a characteristic state of e_i is eliminated from the description of the same state of E, in virtue of some constraint being imposed on e_i . This is a non-explanatory conception of emergence, and yet this account does meet the conditions of EM. Even if it is deducible that there will be some constraint on e_i from the fact that the e_i components stand in a particular relation R, it is not deducible from this that the constraint will be associated with weak emergence, because the appearance of the weak emergence is partly determined by the laws of nature. This strategy generalizes to similar accounts, such that even non-explanatory conceptions of emergence can still meet the conditions of EM. Furthermore, even non-explanatory conceptions of emergence typically involve some explanatory difference between the micro and macro level, such as for example that the emergent can appear in explanations the micro-level components cannot.

²⁸ See e.g. Crane, T. (2001)

many more cases of emergence than for an observer with more extensive scientific knowledge. If we endorse EM, we endorse the idea that each of these cases is a genuine case of emergence, relative to the relevant observer. Some might take this to be an unfortunate feature of this explication, and the prevalence of emergence would be problematic if we had to treat all such cases as equal. EM provides resources, however, to address questions about why some cases of emergence are more interesting than others. For instance, we can focus on differences between the capacities, tools and knowledge of different observers and on differences between the different sets of micro-level properties. If some macro-level property is emergent simply because the observer has a misguided conception of scientific explanation, then this may be an uninteresting case of emergence. A more interesting case could involve the fact that an explanation of a certain kind is unavailable in this particular case, and that this is true for all observers in the contemporary scientific community. Given that EM does not require us to treat all cases of emergence as similarly important, the prevalence of emergence is not a problem for this reconstruction.

This last point is an immensely important element of EM. EM provides a conception of emergence as a prevalent and varied phenomenon. In endorsing EM, we accordingly endorse a shift in dialogue about emergence. We ask not just *whether* some property is emergent, but also *why* and *for whom* it is emergent. On this conception of emergence, there are many different cases of emergence that obtain for many different ranges of observers and for many different reasons.

A fan of metaphysical accounts of emergence might argue that EM is an inadequate explication of emergence because metaphysical accounts of emergence typically do not present emergence as relative to an observer. Instead metaphysical accounts of emergence typically present emergent macro-level properties as emergent *for everyone*, which makes relativisation to an observer redundant. In response we should note that EM portrays emergence as relative to an observer, but this does not mean that each case of emergence is emergent *for only one observer*. Some cases of emergence may be emergent relative to many observers, and others relative to only a few. Some cases may be emergent for all possible observers, and nothing in EM rules out such an eventuality. EM makes room for cases of emergence in which the emergence obtains for metaphysical reasons (in which case the relevant property would perhaps be emergent for all observers for all time) but also for cases in which emergence obtains merely for epistemic reasons. I will return to this point when assessing objections to EM in Section 8.

Section 7: Considering Alternatives

In this section I will take the criteria of similarity, fruitfulness, unification and simplicity in turn, and for each I will argue that EM meets that criterion successfully. I will also consider the extent to which alternative explications of emergence meet the same criterion.

The alternative explications I consider are a strong metaphysical explication according to which an emergent must be metaphysically autonomous from its micro-level base, and a weak epistemic explication according to which an emergent is merely epistemically autonomous from its micro-level base. These are fairly broad explications, and one might think that it would be more charitable to consider a wider range of more precise alternatives. However, the features that are salient to meeting these criteria for explication are shared by metaphysical accounts broadly, and epistemic accounts broadly. For example, given that all metaphysical accounts of emergence rule out merely epistemic cases, and all epistemic accounts of emergence rule out metaphysical cases, the details make little difference when it comes to the assessment of similarity. Furthermore, narrower explications will not prove to be as fruitful, not as unified, as they will focus discourse about emergence on a far smaller set of phenomena within a smaller disciplinary area. Rather than consider a wide range of precise and narrow alternatives, then, I will consider the broader metaphysical and epistemic alternatives.

7.1 Similarity

In asking whether or not EM is sufficiently similar to the explicandum, the important questions are whether or not in most cases where the concept of emergence is used, EM could be used, and whether or not in most cases where EM applies, the concept of emergence is used.

The answer to the first question is yes, with some unproblematic exceptions. The most serious exception is those metaphysical accounts of emergence that portray emergents as necessarily metaphysically autonomous from their micro-level bases. EM does not rule out a metaphysical interpretation of certain cases of emergence, however, but presents a conception of emergence according to which not *all* cases of emergence obtain for metaphysical reasons. According to EM, emergence itself is not a metaphysical concept, but some cases of emergence may obtain for metaphysical reasons. Another version of this objection is the claim that relativisation to an observer

rules out those treatments of emergence that portray emergence as obtaining for all observers (which includes metaphysical accounts of emergence). According to such treatments, if any property is emergent then it is emergent for all. In response I would point out that EM does permit cases in which emergence is relative to all observers, and so such cases are not a counterexample to EM.

Someone wedded to a metaphysical concept of emergence may, however, take further exception to EM along the following lines: the only cases of emergence worthy of the name are those in which the property is emergent for all observers, for metaphysical reasons. The proponent of this objection would argue that, given this feature of the concept of emergence, the problem with EM is that it permits weak cases of emergence that are not interesting or strong enough to deserve the name “emergence”. However, we should note that not all, and not even most, uses of the concept presuppose that the emergence in question must be strong. Most notions of emergence share some features – connection to explanation, connection to failure of deducibility or derivability – but not the idea that emergent autonomy should be understood entirely in metaphysical terms.

Furthermore, I have offered a reconstruction of the concept of emergence as relative to an observer, but this does not rule out the possibility that *some* cases may obtain for metaphysical reasons. I leave open the option of giving a metaphysical interpretation of certain cases, and my only restriction is to demand that we understand emergence as relative to a perspective. This rules out taking emergence *itself* as a perspective-dependent metaphysical relation, but it does not preclude developing a metaphysical interpretation of particularly intriguing, prevalent cases of emergence if there is good reason to do so.

Finally, let’s consider the two alternative explications of emergence against the similarity criterion. I have already argued that a metaphysical explication does not successfully meet the similarity criterion because it cannot be used in contexts where emergence is taken to be a contingent epistemic phenomenon, and given that such contexts include many scientific uses of the concept this makes the metaphysical explication particularly unscientific as well as insufficiently similar. Alternatively, a purely epistemic explication would also fail to meet the similarity criterion because it cannot be used in contexts where emergence is a permanent feature for all observers, or obtains for deep metaphysical reasons. EM avoids this problem because relativisation to an observer makes room for the convergence of many observers on many different cases of emergence. Accordingly, EM fares better than both of these alternative explications against the similarity criterion.

7.2 *Fruitfulness*

One could argue against EM along the following lines: this explication fails to make room for substantial philosophical debate about emergence. If we accept EM, then we are committed to the idea that all we need to do to find out if some macro-level property is emergent is to ask whether or not there is an explanation of a certain sort available to some observer. Further philosophical debate is halted in its tracks, and so this is not a fruitful explication of emergence.

In response, it is clearly an implication of EM that the question of whether some property is emergent or not for some observer is simple to answer. However, I see this as a positive feature. In making the question of whether or not some phenomenon is emergent so easy to answer, this explication rules out non-substantial debates about emergence in which people starting with different definitions of emergence talk past each other. Instead, EM encourages philosophers and scientific practitioners to focus on the important questions about emergence such as identifying *which* standards of explanation are appropriate, *which* micro-macro relations to focus on, and *which* observers are important. Emergence is cheap, according to EM, and once we have identified it we have further work to do in interpreting its significance. For example, we may ask which kinds of scientific explanation are significant, or appropriate to look for in particular cases. Much of the debate about the relationship between qualitative experience and the brain has been taken up by discussion of exactly which sort of explanation it is appropriate to seek in this case.²⁹ Such philosophical research is continuous with and complementary to empirical research into the reasons for different cases of emergence, which can be conducted by scientific practitioners.

To return to the alternatives, a purely epistemic conception of emergence is less fruitful than EM. On the epistemic conception of emergence, emergence is a contingent epistemic phenomenon, which may raise some scientific questions about why such cases occur, but not deep philosophical ones as emergence is a contingent feature that will pass when our knowledge improves. On the other hand, on a metaphysical conception of emergence, research into the possibility that emergence may simply be a contingent feature that we will eventually explain in new terms is closed down. EM is a more fruitful conception of emergence than these alternatives.

7.3 *Unification*

²⁹ See the Chalmers, D. (1996) and Block & Stalnaker (1999)

In asking whether or not an explication of emergence is *unified*, we are asking whether or not this explication permits practitioners working in different areas of philosophy and science to conduct dialogue about emergence without equivocation. EM permits this, in so far as EM offers a schema within which different notions of emergence can fit. For example, the metaphysician may be interested in cases of emergence that obtain for all observers for all forms of explanation, which the biologist is interested in cases that occur for the contemporary scientific community relative to mechanistic explanation. But both can recognise that they are interested in a schematically similar phenomenon, and can discuss the similarities, differences and so on between the cases, between their respective standards of explanation and so on.

A metaphysical conception of emergence cannot permit this level of unification because it rules out any non-metaphysical approach to emergence. Indeed, because so many scientific conceptions of emergence are epistemic, this makes the metaphysical conception of emergence particularly non-naturalistic. The purely epistemic conception of emergence does not permit cases of emergence that obtain for metaphysical reasons, and so faces a similar problem. EM, in permitting cases of emergence that obtain for merely epistemic reasons, as well as cases of emergence that obtain for metaphysical reasons, permits more unification than alternative conceptions.

7.4 Simplicity

The simplicity criterion states that the explicatum must be as simple as meeting the other three requirements will allow. Someone may argue that EM is not simple, perhaps pointing to the relativisation to an observer as a rather complicated aspect of EM, but given how central that aspect of the reconstruction is for enabling the explicatum to meet other criteria, fruitfulness and similarity in particular, this consideration doesn't hold much weight.

Overall, a survey of these criteria for explication indicates that EM meets these criteria, and does so more successfully than other mainstream explications of emergence.

Section 8: Objections

8.1 Not mysterious

Someone could argue against EM along the following lines: the philosophical community may not agree on much about emergence, but it agrees on the idea that emergence is mystical and surprising. EM portrays emergence as a prevalent, cheap phenomenon and so fails to do justice to mainstream conceptions of emergence. Samuel Alexander is famously quoted by Broad as describing emergence as a phenomenon that we must accept unexplained, “*with the philosophical jam which Professor Alexander calls ‘natural piety’*”³⁰, and yet my explication of emergence captures none of this mystery – it requires no piety.

In response, first of all note that the idea that emergence is inherently mysterious is not universally shared across either the philosophical or scientific literature on the subject. Epistemic and scientific conceptions of emergence, for example, typically do not involve this appeal to mystery, though they may portray emergence as often interesting and unpredictable. Even if this feature were a universal commitment, however, this consideration doesn’t make for an objection to EM as an explication of emergence because EM allows for a certain amount of mystery. Obviously not all cases of emergence, according to EM, are mysterious. But cases that obtain for many different observers and are also stable for those observers, and in which the reasons for the emergence are poorly understood, are intriguing and mysterious. Furthermore, in EM the sense of mystery associated with emergence is replaced with the idea that emergence involves the unavailability of a certain kind of explanation. A plausible way to think about this replacement is that when we originally thought emergence was mysterious what was actually involved was a failure of an attempt at an explanation.

8.2 Does not exclude the right cases

When introducing EM I discussed the following view: EM is inadequate because it not only permits cases of emergence that obtain for metaphysical reasons, but also permits cases that obtain for purely epistemic reasons. The proponent of an epistemic account of emergence may also argue that EM is inadequate because it permits cases of emergence that obtain for metaphysical reasons. The general form of these objections is this: given some belief about what emergence must be, EM is inadequate because it permits other cases.

I have already argued that EM does not require that we treat all cases of emergence as the same, or as equally interesting. Even if we must admit odd, seemingly unimportant cases of emergence, EM does not require that we regard them as philosophically significant. However, one might argue that

³⁰ Broad, C.D. (1925) pg 55.

this is problematic for two reasons: first, it does answer the original question because the problem cases are still cases of emergence, and second, it puts all of the serious philosophical work off onto building an account of the *important* cases of emergence. I will take these in turn.

In response to the first problem, note that unification and fruitfulness must be bought at *some* price. The price in this case is not having a neat, narrow conception of emergence that applies only to a small, restricted group of cases and is relevant only to one domain of discourse about emergence. Instead, I have offered a broad and schematic conception of emergence, but one that is naturalistic and permits high levels of unification and fruitfulness. Of course, some may not care at all about unification across different areas of discourse about emergence, and for those people EM will not be convincing. But given any interest at all in unifying discourse about emergence, EM is the best option.

Secondly, in response to the worry that in endorsing EM we shift a lot of the important work from the account of emergence over to an account of what is *interesting* about emergence, note that much of this work needs to be done anyway. EM is fruitful partly because it makes the need for such work so explicit. Someone might argue that this is work of interpreting cases must take place *within* an account of emergence, not beyond the remit of that account, as in EM. However, it is inappropriate to build more of this work into EM given the goal of providing a framework within which debates about emergence can take place without equivocation. If I decide that mechanistic explanation is the only important form of explanation, then I exclude philosophers and scientific practitioners who care about other kinds of explanation from discourse about emergence. Building such detail into EM would make EM less fruitful and less unified. Finally, this work of arguing for the significance of particular cases is often *not* successfully achieved within accounts of emergence. Consider for an example of this the debate over the relationship between qualitative experience and brain activity, “the explanatory gap”. Much of the literature on the explanatory gap focuses on the issue of which form of explanation, if any, is metaphysically significant.³¹ The claim that one particular form of explanation is significant did not fall out of the view that qualitative experience emerges from brain activity. Accordingly, it would be disingenuous to argue that EM fails because it does not answer these questions, as the questions are often not successfully answered by other accounts of emergence.

³¹ See Block & Stalnaker (1999); Chalmers, D. and Jackson, F. (2002)

8.3 Unified, but sparse and cheap

EM definitely unifies diverse conceptions of emergence, but perhaps at the cost of content; maybe the only way such impressive unification can be achieved is by making the explication almost content-free. EM is so sparse that it is hardly surprising that it can encompass almost every account of and purported case of emergence. This is a legitimate concern, and a concept of emergence that is so broad as to say almost nothing about the phenomenon is of little interest and little use.

EM does portray emergence as prevalent and often cheap, but also allows for differences between more and less interesting cases of emergence, depending on the nature of and number of observers in question, the kind of explanation they have in mind, and the relevant notion of availability.

Emergence may be prevalent, according to EM, but not all cases of emergence are equal. There are many different kinds of cases of emergence, and some of them are far more interesting than others. We can bring philosophical and scientific resources to bear on questions about why a given property is emergent for a given observer or observers, and all the while practitioners can avoid the problem of equivocation. Accordingly, EM provides resources to differentiate between cases, and for conducting dialogue and research into the nature of emergence.

Conclusion

Following a brief survey of philosophical and scientific approaches to emergence, I offered an explication of the concept of emergence as the unavailability of a certain scientific explanation for an observer or observers. I argued that this explication meets criteria for successful explication and is unified, encompassing a range of different philosophical ideas about emergence and allowing for continuity between philosophical and scientific research into emergence.

Endorsing this view requires a shift in the way we think about emergence. The interesting questions about emergence are not, on this view, questions about whether some property is emergent, but instead are about who the property is emergent for, what their conception of scientific explanation is, and why the emergence obtains. Instead of regarding emergence as a homogenous phenomenon, as it is typically understood, my explication of emergence portrays emergence as prevalent and very

diverse. This change may be radical, but in making it we replace a “notorious philosophical term of art”³² that “often causes confusion in science and philosophy”³³ with a precise, unified and naturalistic concept.³⁴

References

- Anderson, P.W. (1972) “More is Different.” *Science* vol 177, reprinted in Bedau & Humphreys ed (2008) *Emergence*. MIT Press.
- Assad, A. & Packard, N. (1992) “Emergence” in Bedau & Humphreys ed (2008) *Emergence*. MIT Press.
- Balazs, A. & Epstein, I. (2009) “Emergent or Just complex?” *Science* Vol. 325 no. 5948 pp. 1632-1634
- Barnes, E. (2012) “Emergence and Fundamentality.” *Mind*. Vol. 121, pg 873-901
- Bedau, M. (2003) “Downward Causation and Autonomy in Weak Emergence”. In Bedau & Humphreys ed (2008) *Emergence*. MIT Press.
- Bedau, M. (2008) “Is Weak Emergence Just in the Mind?” *Minds & Machines*. Vol. 18, pg 443-459
- Bedau, M. & Humphreys, P. ed (2008) *Emergence*. MIT Press.
- Block, N. & Stalnaker, R. (1999) “Conceptual Analysis, Dualism, and the Explanatory Gap.” *Philosophical Review*. Vol 108 (1), pg 1-46
- Broad, C.D. (1925) *The Mind and Its Place in Nature*. Routledge.
- Carnap, R. (1950) *Logical Foundations of Probability*. University of Chicago Press.
- Chalmers, D. (2006) “Strong and Weak Emergence” In Davies & Clayton (eds.) *The Re-Emergence of Emergence*. Oxford University Press.
- Chalmers, D. (1996) *The Conscious Mind*. Oxford University Press.
- Chalmers, D. and Jackson, F. (2002) “Conceptual Analysis and Reductive Explanation” *Philosophical Review*. Vol. 110, pg 315-61.

³² O’Connor, T. (2006)

³³ Chalmers. D. (2006)

³⁴ With thanks to Marc Lange, John Roberts, Karen Neander, Laurie Paul, William Lycan, Jessica Wilson, audiences at Illinois Wesleyan University and LMU Munich, and an anonymous referee.

- Crane, T. (2001). "The Significance of Emergence." In Gillett, C. & Loewer, B. (eds.), *Physicalism and its Discontents*. Cambridge University Press.
- Dennett, D. (1991) "Real Patterns." *Journal of Philosophy*. Vol. 88 (1), pg 27-51.
- Hanna, J.F. (1968) "An Explication of 'Explication'." *Philosophy of Science* Vol 35 (1), pg 28-44
- Hempel, C. & Oppenheim, P. (1965) "On the Idea of Emergence." In Bedau & Humphreys ed (2008) *Emergence*. MIT Press.
- Kelso, J.A. Scott (1995) *Dynamic Patterns*. MIT Press.
- Kim, J. (2006) "Emergence: Core Ideas and Issues." *Synthese*. Vol. 151(3), pg 547-559.
- Langton, C. (1995) *Artificial Life: An Overview*. MIT Press
- McLaughlin, B. (1992) "The Rise and Fall of British Emergentism", in Beckermann, Flohr & Kim (eds.), *Emergence or Reduction?: Prospects for Nonreductive Physicalism*. De Gruyter
- Morrison, M. (2012) "Emergent Physics and Micro-Ontology." *Philosophy of Science*. Vol 79 (1), pg141-166
- Nitschke, J. (2009) "Systems chemistry: Molecular networks come of age." *Nature*. Vol. 462, pg 736-738
- O'Connor, T. (2006) Article on *Emergent Properties* in Stanford Encyclopedia of Philosophy
- O'Connor, T. and Wong, H. (2005) "The Metaphysics of Emergence." *Noûs*. Vol. 39, pg 658-678.
- Quine, W.V.O. (1960) *Word and Object*. MIT Press.
- Redhead, M. (1995) *From Physics to Metaphysics*. Cambridge University Press.
- Silberstein, D. and McGeever, M. (1999). "The Search for Ontological Emergence." *Philosophical Quarterly*. Vol. 50 (195), pg 182-200.
- Stephan, A. (2006) "The dual role of emergence in philosophy of mind and cognitive science." *Synthese*. Vol.151 (3), pg 485-498
- Teller, A. (1986) "Relational Holism and Quantum Mechanics." *British Journal for the Philosophy of Science*. Vol. 37 (1), pg 71-81.
- Wilson, J. (2005) "Supervenience-Based Formulations of Physicalism." *Nous*. Vol. 29, pg 426-59.
- Wilson, J. (2010) "Non-reductive Physicalism and Degrees of Freedom." *British Journal for the Philosophy of Science*. Vol. 61, pg 279-311.

- Wilson, J. (forthcoming) “Metaphysical Emergence: Weak and Strong.” In Mumford & Tugby (eds.), *Metaphysics and Science*.