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Grounding and Emergence

Stephan Leuenberger

1 A tale of two literatures

Grounding and emergence are two “vertical” relations, linking different levels of reality. Their study belongs to what is sometimes called “inter-level metaphysics”. My brief is to critically survey how these relations have been compared, contrasted, and connected. There is little explicit discussion for me to report on, alas. In light of this, I shall do two things. First, I shall give an introduction to the literature on emergence, pitched at a reader who has some familiarity with work on grounding. (Grounding needs no introduction here, in light of its starring role in the other chapters of this volume.) Second, I shall highlight a few ways in which an appeal to grounding could illuminate the notion of emergence.

At the outset, I should note that the literature on emergence has rather different characteristics from the one on grounding. The latter – if I am allowed to paint with a broad brush – is relatively homogeneous, in the sense that a small number of seminal papers serve as a shared point of reference. (You know which ones I have in mind.) The working assumption is that different authors talk about one and the same relation when they use the term ‘grounding’. There is thus no urgent need to define the term, which is generally taken as primitive. Disagreements are treated as substantive rather than merely verbal. (However, see Kathrin Koslicki, “Skeptical doubts about ground,” this volume, for a different take on the working assumption.)

Grounding is taken to be topic-neutral, and contributors tend to be interested in general and non-contingent claims about it. Relatedly, the literature gives prominence to certain formal

questions - concerning the grammatical and logical form of grounding claims, and various structural properties of the grounding relation, or alternatively, of a corresponding operator. In so far as its examples are from outside the province of logic, it is largely indifferent to the question whether they are actual or merely possible. (See ch. 3 of this volume, "Logic and Structure.")

The literature on emergence is strikingly different on all those counts. It is dispersed over a number of sub-disciplines of philosophy, with different intellectual traditions, notably philosophy of mind, philosophy of science, and to a lesser extent metaphysics. Indeed, collections on emergence (e.g. Bedau and Humphreys (2008); Clayton and Davies (2006)) tend to cast the net even wider, and include contributions from various natural and social sciences, as well as speculative proposals from the margins of mainstream science.

Accordingly, the literature is highly heterogeneous. This means that whatever generalizations I am about to offer on the literature should be taken with a grain of salt.

It would be bold, if not fanciful, to claim that all contributors to the literature on emergence make claims about one relation, and substantively disagree about its features. By and large, authors are aware of this, and accordingly try to offer a definition of 'emergence'. (A sample will be given later in this chapter.) Primitivism about emergence is not a popular approach.¹

But a definition or analysis is not the be-all and end-all of the efforts of theorists of emergence. Typically, the holy grail is the solution of a recognised philosophical mystery, such as that of consciousness or of mental causation. That is, the main desideratum for a definition is that it makes "emergentism" about consciousness, or about the causal powers of the mind, a view that is not just plausible, but illuminating and perhaps even exciting. So an example of the application of the concept serves much more than a merely illustrative purpose, and it matters greatly whether the example is drawn from the actual world. In contrast, it is not a high priority to define a topic-neutral concept, or at least one which allows

for the formulation of interesting generalizations. Little attention is paid to the question whether emergence is a transitive relation, for example.

2 Emergence and levels of reality

As the remarks in the preceding section indicate, a short, precise, and generally acceptable characterization of emergence is not to be had. Accordingly, I shall approach the topic slowly and in a somewhat round-about way.

Emergence, I submit, involves novelty along some dimension. In ordinary discourse, we might talk about the emergence of a certain phenomenon at a certain point in time, or over a period of time – a monopoly in the market for text-processing software, say. The implication is that the phenomenon is novel in the sense that it was not present prior to that time, even though it may well continue to be present later. In general, the dimension along which there is emergence need not be temporal. To allow us to make sense of novelty, it does need to be directed, unlike spatial dimensions.

In the philosophical discussion of emergence, the relevant dimension is given by a stratification of reality into vertically arranged levels or layers. If a level is lower than another one, it counts as more fundamental. A phenomenon is novel at some level if it does not occur at any lower level, even though it may occur at a higher level. The characterization of emergence given in an influential article by David J. Chalmers appeals to such a background stratification into levels:

We can say that a high-level phenomenon is strongly emergent with respect to a low-level domain when the high-level phenomenon arises (in some sense) from the low-level domain, but truths concerning that phenomenon are not deducible even in principle from truths in the low-level domain. (Chalmers 2006: 244)

There is a great deal packed into this characterization, but for the moment I just wish to draw attention to the entailed difference in levels between what is emergent and that with respect to which it is emergent. Chalmers, like most other writers on emergence, does not say more about how levels are to be understood. That the world is layered is typically presupposed rather than asserted among theorists of emergence.

By default, the relation generating the levels can be understood to be parthood. Indeed, many authors explicitly define emergence to be a relation holding between properties of a whole and properties of its parts. The stratification of reality into mereological layers that is typically taken for granted in such discussions is nicely articulated in the classic Oppenheim and Putnam (1958).

However, parthood is just one relation that can generate a vertically oriented dimension. Another one, of course, is grounding. Indeed, it is often said that grounding allows us to make sense of the notion of relative fundamentality that is closely associated with the layered conception of the world.

The idiom of ‘grounding’ and cognate terms allows us to ask whether levels that are lower in the mereological ordering are also more fundamental. Popular views such as microphysicalism would appear to be committed to a positive answer. But priority monism, as advocated in Schaffer (2010), holds that the cosmos, the object which includes all others as parts, is the most fundamental, in the sense that all the others depend on it.

As I noted already, the term ‘emergence’ is used in more than one way. On one use, it is tied to a mereological layering of the world. In that sense, Schaffer's priority monism may be described as a view according to which the cosmos has emergent properties. (Though see section 4 for a qualification of that remark.) On another use, ‘emergence’ is tied to a layering generated by grounding or dependence. In that sense, ‘emergent’ cannot apply to Schaffer's

cosmos or its properties, since they are not higher-level phenomena. On the contrary, properties of parts might turn out to be emergent, in that sense, from properties of the whole – although that idea has not yet been explored, to the best of my knowledge.²

Grounding and its cognates may thus be of use in the articulation of a layered conception of the world that forms the background of debates about emergence. It must be acknowledged, however, that this is only a promissory note so far. There is no straightforward way to define relative fundamentality, or levels of reality, in terms of grounding, as the discussion in chapter 6 of Bennett (2017) shows. The simplest proposal for explicating that *f* is at a lower level than *g* is that *f* partially grounds *g*. But while this condition is presumably sufficient, it is not necessary: a fact about the quantum properties of a particular electron in Spain is arguably at a lower level than a fact about population density in Scotland, even though it does not ground it.

All may not be lost, though. Many emergence claims do not rely on levels being defined across disconnected chains, but only on comparisons of relative fundamentality within a given chain. A sufficient condition for relative fundamentality may be enough for that purpose.

3 Emergence claims and their logical forms

For now, I postpone the questions whether there can be an informative analysis of emergence, and how it might look. In this section, I do not discuss how emergence relates to grounding, but rather how methods familiar from the study of grounding might be of use in the study of emergence.

One of the contributions of the literature on grounding to philosophical progress has been the regimentation of discourse involving such terms as ‘grounds’ and ‘in virtue of’. Since a

Handbook chapter offers me as good a platform as any to recommend a regimentation of language of the emergence, I shall begin by asking what we should take as the canonical form of emergence claims. This question has already received a sophisticated answer by Hempel and Oppenheim (2008), and I shall present a modified version of their account. For simplicity, I shall assume that the background layering is mereological.

What is perhaps the most familiar use of any word in the family is the one-place predicate ‘is emergent’. This predicate is informally applied to entities of a variety of ontological categories. In the specialized literature on emergence, it is typically a predicate of properties. It seems to me, though, that something is emergent because it is emergent from something else, and that the locution ‘is emergent from’ makes for a better starting point for an analysis. (I choose the clunkier ‘is emergent from’ over ‘emerges from’ because of its connotations.)

While ‘is emergent from’ suggests a binary predicate, we actually need at least a ternary one, to allow that one and the same property is emergent in one thing but not in the other. My first stab at a canonical form is this:

F is emergent from A in x

Here, F is a property, A a class of properties and relations, and x a particular. If F emerges from A in x, then F can be called an “emergent property” of x; and A can be called the “emergence base” of F in x.

I shall shortly refine this formulation, and discuss in more detail under what conditions it is true. But the basic idea is clear, given our assumption that the background layering is mereological: if F emerges from A in x, then (i) x is a complex object which has F, (ii) the parts of x do not have F, but have some properties in A, and (iii) condition (i) and facts involving the parts of x and A stand in a suitable relationship, to be specified.

I called the above a “first stab.” The reason is that in general, a relativisation of the “is emergent from” relation to particulars does not seem enough. In my explanation above, I said the parts of A have some properties in A. But which parts? All of them? All of its proper parts? It seems that we need to have a specification of what parts count.

Consider the human brain as a candidate bearer of emergent properties such as consciousness, and let the putative emergence base A consist of all intrinsic properties of the relevant parts. The brain is made up of two hemispheres, which, we may suppose, are both intrinsically conscious. Then presumably, consciousness does not count as being emergent from the intrinsic properties of the brain relative to a decomposition into the two hemispheres: it is not a novel feature of the whole brain relative to that decomposition. But the brain has other decompositions: into cells (and inter-cellular material) into molecules, into atoms, into sub-atomic particles etc. Relative to some of them, consciousness may well be emergent.

Hempel and Oppenheim expressed this as a relativization to a parthood relation, or a meaning for the term ‘part of’:

The volume of a brick wall, for example, may be inferable by addition from the volumes of its parts if the latter are understood to be component bricks, but it is not so inferable from the volumes of the molecular components of the wall.

Before we can significantly ask whether a characteristic W of an object w is emergent, we shall therefore have to state the intended meaning of the term “part of”.

Rather than to a meaning of ‘part of’, I shall take the relation to be relativised to some parts that compose the bearer of the property. (For convenience, I shall say “a class of parts” rather than speaking plurally of “some parts”.) Accordingly, I propose that canonically, emergence claims have four argument places:³

F is emergent from A in x relative to Y

The idea is that among the members of the class Y, there are things that compose x, and which are potential bearers of properties in A.⁴

To summarize the necessary conditions for the truth of “F is emergent from A in x relative to Y” mentioned so far:

- x has F.
- No member of Y has F.
- Some members of Y compose x.

Notice that the first two conditions entails that x does not belong to Y – an emergent property of a thing is emergent from facts involving proper parts of that thing, not from facts involving that thing itself.⁵

A property’s being emergent is thus triply relative. We can de-relativise in the usual ways: by fixing the value of one of the variables, perhaps as a function of context, and by quantification. We may say that F is emergent from A relative to Y iff for all x that have F, F is emergent from A in x relative to Y. When it comes to the variable A, universal quantification will not do. We will want to exclude properties such as “being a part of something that is F”, which would in some sense trivialize the question what the relationship between the properties of the parts and the properties of the whole is. Once again, this was clearly recognized by Hempel and Oppenheim:

If a characteristic of a whole is counted as emergent simply if its occurrence cannot be inferred from a knowledge of all the properties of its parts, then, as Grelling has pointed out, no whole can have any emergent characteristic. Thus ... the properties of hydrogen include that of forming, if suitably combined with

oxygen, a compound which is liquid, transparent, etc. Hence the liquidity, transparenence, etc., of water can be inferred from certain properties of its specific constituents.

One salient choice for A is the class of intrinsic properties and relations. Assuming that everything is composed of mereological atoms – that there is no “gunk”, in other words – the class consisting of all of them is a nonarbitrary choice for our Y .

After a triple de-relativisation, we can define the monadic “is emergent” in terms of the quaternary predicate:

F is emergent =_{df} for all x, F is emergent from the intrinsic properties and relations relative to the mereological atoms.

In the absence of explicit relativizations, and given the assumption that there are mereological atoms, this often provides a sensible reading of emergence claims.

Grounding claims typically take facts as relata, and we might wonder whether emergence claims can also be cast in such form. Perhaps our form for emergence claims is general enough to yield emergence claims for a singular fact [Fa] as a special case:

[Fa] is emergent from A relative to Y if F is emergent from A in a relative to Y.

It is not clear whether this sufficient condition should also count as necessary: maybe [Fa] can count as emergent not because of any novelty in the constituent property F, but because the existence of the particular a is emergent.

If we disregard this worry, we can move the form of emergence claims even closer to that of grounding claims, by taking it to be a relation between one fact and a class (or plurality) of facts. Let $f(A, Y, x)$ consists of all and only facts of the form $[G(y_1, \dots, y_n)]$, for some G in A and y_i that belong to Y and are part of x. We can then define:

[Fa] is emergent from $f(A, Y, x) =_{df}$ [Fa] is emergent from A relative to Y .

I do not know whether this can be usefully extended to facts and classes of facts of different forms, e.g. facts involving relations, or quantified facts.

4 Janus-faced emergence

So far, I have dodged the most difficult question: what is the required relationship between x 's being F and the distribution of properties and relations from A among the parts of x that are in Y? I have already suggested that the former needs to be at a higher level than the latter, but that is clearly not a sufficient condition. The short answer to the question what sort of relationship is required beyond that seems to be: a relationship that is intimate, but not too intimate.

Emergent properties are Janus-faced. On one side, they contrast with “resultant” ones: paradigmatically, mass and charge properties of wholes, obtainable by summation from masses and charges of the parts. If the background layering is mereological, we may also call such properties “microreducible.”

On the other side – although this claim may be more controversial – they contrast with properties of wholes that do not depend in any way on properties of the lower level. Given a mereological background layering, we can call them “macrofundamental” properties. Clear examples of the latter are hard to come by. Perhaps they include so-called “distributional properties” as they are understood by philosophers such as Josh Parsons (2004) and Jonathan Schaffer (2010: 59). (Hence properties of Schaffer's cosmos may not count as emergent even if the layering is mereological, qualifying a remark I made in section 2.) On their view, a whole may have the property of being polka-dotted, where the instantiation of that property is not the result of it having homogeneous parts with different colours; rather, heterogeneity

among its parts is derivative from, or a result of, the whole having the distributional property.⁶

This Janus-faced nature of emergent properties is already evident in a classic discussion by C.D. Broad (1925). He contrasts the theory of emergence with two other accounts. On the one hand, he distinguishes it from what we might call “natural pietism”:

[According to this view, certain] characteristically different ways of behaving may be regarded as absolutely unanalysable facts which do not depend *in any way* on differences of structure or components. ... This ... consists in holding that there are certain differences which cannot be explained, even in part, but must simply be swallowed whole with that philosophic jam which Professor Alexander calls ‘natural piety’ (54-5).

On the other hand, he distinguishes the theory of emergence from “the ideal of pure mechanism,” exemplified by gravitating particles as conceived by classical mechanics.

A clear expression of such a double contrast is to be found in a more recent classic discussion, by James van Cleve (1990: 222-3):

Emergence contrasts with two alternatives, a looser alternative on the left and a tighter alternative on the right. On the left, we do not even have dependence or determination; on the right, we have full reducibility.

This suggests two necessary conditions for emergence: it entails the disjunction of dependence and determination, and it entails the lack of full reducibility. It is useful to express this schematically, with relations S and R, where R entails S: if emergence holds, then S holds but R does not.⁷ If this necessary condition is also held to be sufficient, I shall speak of an “S-without-R” or “S-but-not-R” account of emergence. Accounts of that type are legion in the literature. For example, emergent properties are said to be:

- Nomologically supervening but not metaphysically supervening (van Cleve 1990; Noordhof 2010)
- Metaphysically supervening but not functionally reducible (Kim 2006)
- Metaphysically supervening without there being an explanation for their supervenience (Vision 2011)
- Dependent but fundamental (Barnes 2012)
- Dependent but autonomous (Wilson 2015)

Needless to say, these slogan-characterisations do not capture the details of these respective proposals. But for reasons of space, they will have to do here.

5 Grounding in an S-but-not-R-account of emergence

In section 2, I introduced a quaternary emergence predicate. An “S-but-not-R” analysis of this predicate might take the following form:

F is emergent from A in x relative to Y =_{df}

- $l_S(F,x)$ stands in S to $r_S(A,x,Y)$, but
- $l_R(F,x)$ does not stand in R to $r_R(A,x,Y)$.

Here, l_S maps to F and x to an entity that is of the right category to fill the “left” argument place of S; and r_S maps A, x, and Y to an entity (or plurality of) that is of the right category to fill the “right” argument place of S; and likewise for l_R and r_R , mutatis mutandis. So $l_S(F,x)$ and $r_S(A,x,Y)$ might simply be F and A, if S is the relation of supervenience; or they might be $[Fx]$ and $f(x,A,Y)$, if S is the relation of nomic necessitation.

Remaining at the schematic level a bit longer, we now have three relations on the table:

- S, the broader relation, whose holding is a positive condition for emergence.
- R, the narrower relation, whose non-holding is a negative condition for emergence.
- S-without-R, or emergence.

Given the title of this chapter, it is appropriate to ask whether grounding might be one of these three relations.

Consider first the hypothesis that grounding is S-without-R, or emergence. For that to fly, we would need to be able to identify suitable relations S and R. Perhaps we might take the logically stronger relation R to be identity (or more precisely, class membership, or the “is one of” of plural logic).⁸ It is not clear whether we could capture S in any other way rather than disjunctively, as grounding-or-identity. But whether or not grounding can be fitted in such a scheme, the hypothesis must be rejected as implausible. Typically, emergence is taken to rule out not only identity, but also a kind of full reducibility that can hold between numerically distinct properties or facts – the kind of case where one thing is nothing over and above the other. If there are such cases, they will be cases of grounding (Rosen 2010: 122), but not of emergence.

A second hypothesis is that grounding is the positive emergence condition. Before evaluating this, I need to introduce a distinction that is now standardly made in the literature: that between weak and strong emergence. A stock example of weak emergence in the literature is provided by the Game of Life: simple low-level rules give rise patterns at the higher level, such as “gliders”, which we would not expect based on mere inspection of the rules, in the absence of simulation. More generally, if a phenomenon is weakly emergent, we do not typically gain understanding of it by looking at the properties of the parts of the system which exhibits the phenomenon. As this rough characterisation indicates, weak emergence is at bottom an epistemic matter.

Strong emergence, in contrast, would force us to expand our ontology. There are no uncontroversial examples, but there is a tradition that thinks that consciousness is strongly emergent from the microphysical properties of the brain.

With this distinction in hand, let us return to the second hypothesis: that grounding is the positive emergence condition. There is no obvious objection to this thought in the case of weak emergence. To a first approximation, weak emergence might be non-transparent grounding. The lack of transparency would need to be of a particular kind: it should not just be due to the complexity of the fact being grounded. Rather, the grounded fact needs to be simple, no longer containing the grounding facts as constituents. Thus we would have the following formula (if we wish to fit this into our formula, we can read “transparency” as “transparent grounding”):

weak emergence = grounding without transparency

Whether this characterization is better than alternative ones that have been offered of weak emergence is not a question I can take up here. For what is it worth, I think that with weak emergence, the main challenge is to pin down the negative condition (what I have called “transparency” here), not the positive condition.

However, grounding clearly fails to be the positive condition on strong emergence. It is not easy to argue against this by counterexample, that is by exhibiting a case of emergence that is not a case of grounding. The reason is that there are no uncontroversial cases of emergence. Indeed, many philosophers think that the notion is incoherent, and much of the literature is trying to address their worries. As the introduction to a recent collection puts it:

One critical focus [of debates about emergent properties] is on the very intelligibility of such ‘emergence’: critics of the notion are suspicious that emergent properties inhabit a kind of halfway house that is, by its nature,

unstable, given that such properties are characterized by two features that are in tension with one another. (Macdonald and Macdonald 2010: 1)

It is fair to say, though, that if there are instances of emergence, i.e. of S without R, they will not be instances of grounding.⁹ The relation S will then be distinct from grounding.

The third hypothesis to consider is that grounding is the negative emergence condition, i.e. the relation R. I take it that weak emergence is compatible with grounding. However, the proposal is quite plausible for strong emergence, on the face of it. It suggests the following equation, with S to be filled in:

strong emergence = S without grounding

This would be the most straightforward way of connecting grounding and emergence. Given the connections between grounding and metaphysical supervenience, functional reduction, and fundamentality, it seems to be in the same spirit as some of the other proposals listed above.

Indeed, using grounding rather than metaphysical supervenience in a definition of grounding might have an advantage that will be familiar to devotees of grounding. Jessica Wilson (2005: 438) pointed out that if natural laws are necessary, then “[e]mergent properties will ... supervene with metaphysical necessity on their physical base properties.” Depending on the kind of necessitarianism at issue, the putatively emergent property may not be grounded on the base property. If so, the grounding-theoretic formulation will not face the problem Wilson raises.

This last point generalizes. A number of authors have appealed to modal conditions when defining emergence (supervenience, necessitation, modal recombability, or the lack thereof). In some cases, these suffer from the sort of problems that have seen modal conditions replaced by ground-theoretic ones in other contexts. They may be hostage to

controversial views about what is possible, as the example of the last paragraph shows; or they may fail to be make distinctions that are fine-grained enough. Formulating these conditions in terms of grounding promises to solve these problems.

In the above schematic proposal, S has not been specified. But we might try to cash it out in ground-theoretic terms too, appealing to the distinction between partial and full grounding:¹⁰

strong emergence = partial grounding without full grounding

As it stands, this proposal is too simple. Extrinsic properties, like being less tall than the Eiffel Tower, should not count as strongly emergent simply because their instantiation is partially but not fully grounded by intrinsic properties of the proper parts of a thing.

Perhaps we could require that strongly emergent properties are such that their instantiation lack full grounds altogether, rather than simply lacking full grounds involving their proper parts. But on the orthodox account, some facts partially ground a fact just in case they are among facts that fully ground that fact. Partial grounds can always be supplemented to form a full ground. On that account, nothing could be strongly emergent according to the above formula.

In the literature on grounding, non-orthodox notions of partial ground have been identified. A promising candidate is Fine's strict partial ground, which can be contrasted with strict full ground to yield the following formula:

strong emergence = strict partial grounding without strict full grounding

A discussion of this notion of strict partial grounding, and its potential to help us understand emergence, is beyond the scope of this chapter.¹¹

6 Conclusion

While there is little explicit discussion of how grounding and emergence relate, I have identified a number of ways in which the literature on grounding can provide a resource for theorists of emergence.

Use grounding to define levels. The idea of emergence seems to presuppose a background picture of reality as divided into different levels. Standardly, such levels are understood in mereological terms: things at lower levels compose those at higher levels. The relation of grounding can be used to articulate a different segregation into levels, which need not coincide with the mereological one.

Regiment the idiom of emergence, grounding-style. The logical form of various emergence-claims, and the logical relations between them, are often less than fully transparent. The literature on grounding shows the usefulness of regimentation, and provides an exemplar of how to go about it.

Replace modal conditions by ground-theoretic ones. Emergence has often been defined partly in modal terms. Such definitions tend to be vulnerable to the same sort of objections that have plagued modal accounts of other “vertical” relations - objections that have motivated appeals to grounding in other contexts.

Grounding as a positive condition on weak emergence. Definitions of emergence are typically conjunctive, imposing a positive and a negative condition. What these conditions are will depend on whether the target notion is weak emergence or strong emergence. For weak emergence, grounding is a plausible positive condition, with the corresponding negative being epistemic in nature. (This point, as well as the next one, can be seen as illustrations of the foregoing point that modal conditions may be replaced by ground-theoretic ones.)

Grounding as a negative condition on strong emergence. Strong emergence – which is of greater metaphysical interest than weak emergence - is plausibly incompatible with grounding, and the absence of grounding may indeed be its characteristic negative condition.

Conversely, the literature on emergence also provides a great resource for theorists of grounding, especially those interested in adding variety and lifelikeness to their diet of examples.¹²

7 Further reading

Broad, C. (1925). *The Mind and Its Place in Nature*. Kegan Paul, Trench, Trubner & Co., Ltd, London. (Classic discussion of emergentism, contrasted with what Broad called “mechanism”.)

Humphreys, P. (2016). Emergence. In Humphreys, P., editor, *The Oxford Handbook of Philosophy of Science*, pages 759-778. Oxford University Press, Oxford. (A survey focussing on cases on weak emergence in the sciences.)

McLaughlin, B. P. (1992). The rise and fall of British Emergentism. In Ansgar Beckermann, Hans Flohr, J. K., editor, *Emergence or Reduction. Essays on the Prospects of Nonreductive Physicalism*, pages 49-93. Walter de Gruyter, Berlin. (A historically well-informed and philosophically sophisticated account of British Emergentism.)

van Cleve, J. (1990). Mind-dust or magic? Panpsychism versus emergence. *Philosophical Perspectives*, 4:215-226. (Classic statement of the contrast between the two views mentioned in its title.)

Related Topics

- Ground and Structure
- Fundamentality

Biographical Note

Stephan Leuenberger is a Senior Lecturer in Philosophy at the University of Glasgow. His publications on issues in interlevel metaphysics include “Grounding and Necessity” (*Inquiry*, 2014), “From Grounding to Supervenience?” (*Erkenntnis*, 2014), and “Global Supervenience without Reducibility” (*Journal of Philosophy*, 2018).

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¹ The multiplicity of uses of ‘emergence’ may still be harmful even once it is generally acknowledged. In a recent book-length study entitled *Emergence*, Paul Humphreys suggests that “in an intellectually ordered world, we would stop using the word ‘emergence’ and use more precisely defined terms Yet the word has irresistible attraction and I do not have the power to ban it. ... I shall retain the term as a convenience.” (Humphreys 2006: xviii)

² The interaction between the mereological layers and the dependence layers raises some tricky questions. See Steinberg (2015) for discussion.

³ I omit Hempel and Oppenheim’s fifth argument place, a scientific theory.

⁴ Why do I not require Y to be such that x is its fusion? Given the assumption that fusions are unique, the requirement would allow us to simplify our canonical formulation by dropping x, since it could be recovered from Y. The reason is that we need both argument places to be able to express claims such as “For all cells x, x is emergent from A in x relative to the class of molecules.”

⁵ As Michael Raven points out, the two conditions entail that the existence of x cannot be emergent from any properties relative to any decomposition, since whatever parts belong to a decomposition also have the property of existence. However, they do allow that certain essential properties of x are emergent – its kind membership, say, or its haecceity.

⁶ Sometimes, ‘emergent’ is arguably used in such a way to include macrofundamental properties, as when David Lewis acknowledges that “there might be emergent natural properties of more-than-point-sized things” (Lewis 1986: x).

⁷ Mnemonically, we can think of S as “supervenience” and R as reducibility, but some accounts of emergence use different relations.

⁸ The hypothesis that grounding is S-but-not-identity has the virtue of accounting for the widely assumed irreflexivity of grounding.

⁹ Compare Karen Bennett's argument that while grounding is a building relation in her sense, emergence is not because its instantiations fail to have implications about relative fundamentality (2017: 64). Obviously, instantiations of S will not have any implications that instantiations of S-without-R fails to have.

¹⁰ Wilson (2014: 544) claims that emergence “cannot be characterized by appeal to Grounding alone,” adding in a footnote that “at least two primitively related primitive relations”, which she calls “Partial Grounding” and “Complete Grounding”, would be required.

¹¹ In unpublished work, the author objected against defining emergence in terms of full grounding without orthodox partial grounding, and suggested the use of strict partial grounding; see Wilson 2018: 506-7; 2019. Related ideas are discussed in Leuenberger (forthcoming), but with a focus on fundamentality rather than emergence.

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