

EMERGENTISM

Examples of emergence

Heat

The molecules that make up any material are constantly moving, either vibrating in place (in a solid) or moving randomly around in so-called Brownian motion (in a liquid or gas). This activity, when aggregated and observed at a macroscopic level, is referred to as 'heat'. The aggregate is said to possess a numerical property called 'temperature', which is an index of the amount of heat. The individual molecules possess neither heat nor temperature. Only the aggregate has those properties. So, the property of heat is said to 'emerge' from the microphysical motion.

Liquidity

A substance such as water at room temperature has a combination of properties that characterise a liquid: it flows into spaces while maintaining its volume, solid objects can move through it, it is incompressible, and so on. Again, the concept of liquidity is meaningless at the level of individual molecules, but 'emerges' from the microphysical behaviour.

Traffic

Emergence occurs not just at the boundary from the microphysical-to-macrophysical. If you are watching a network of roads from a CCTV, you will see a flow of traffic and observe phenomena such as congestion and traffic jams. Yet the traffic consists of nothing but individual cars. If, on the other hand you observe an individual car in isolation, it cannot be said to be congested. Congestion is an emergent property that arises between different macroscopic levels.

Emergence and reduction

Operationalisation of emergent properties

In each of these cases of emergence, the emergent property is defined operationally in terms of known fundamental physical quantities. For example, temperature might be measured with a mercury thermometer: the length of the mercury thread is an index to the temperature. But length is just a basic quantity, not an emergent one. Heat is definable in terms of its conversion into simpler forms of energy such as the kinetic energy of moving a piston. Liquidity is definable in terms of the movement of the liquid through space, measurable with basic linear dimensions of space. Traffic flow is defined in terms of the linear movement of numbers of vehicles passing over various lengths of tarmac in a given number of seconds.

Although the emergent property cannot be applied to objects at the lower ontological level, its operational definition is wholly reducible to fundamental physical properties.

Reduction of emergent properties

We have seen that the operational definition of an emergent property *must* be constructed in terms of basic physical quantities. In addition, the emergent property is always modelled in terms of

smaller-grain physical processes. So, for example, heat was first measured and studied 'phenomenologically' as a macroscopic phenomenon that was defined operationally. Later, scientists formulated explanatory models that described the aggregated microphysical activity and showed that this model yielded a predicted phenomenological behaviour that matched well with the observed phenomenology.

'Weak', or reducible, emergence

Philosophers refer to this kind of emergence as 'weak'. We might call it reducible emergence, because it can be wholly reduced to underlying fine-grain processes. There is no residual mystery, and not much to get philosophers excited.

'Strong' emergence

Philosophers have proposed that there could be phenomena that cannot be modelled or explained by finer-grain processes. This is said to be 'strong emergence'. There is no consensus that any such strongly emergent properties have been discovered. But some candidates have been proposed. For example, the Oxford mathematician Roger Penrose has argued that some kinds of crystal formation are strongly emergent. Molecules add themselves to a crystal in such a way as form a particular crystal structure, but there is nothing driving them to move into those positions. It is as if the molecules are moving teleologically: they have a vision of the crystal they want to form, and join the forming crystal in such a manner as to achieve this. As if by magic! The observed phenomenon is defined operationally in basic physical quantities of size and shape. But there is no reductive model.

The highly contentious phenomenon of telekinesis is another example. The phenomenon is readily defined operationally: an object moves through linear space without an applied force. But the phenomenon cannot be explained in terms of finer-grain physical processes. Magic!

Because strongly emergent phenomena are defined in physical terms, there is a natural plausibility in the suggestion that they will one day have a physical explanation, perhaps in terms of some novel fundamental physical force. After all, we would be explaining one set of physical facts (the phenomenological observation) in terms of other physical facts.

'Very strong' emergence

Philosophers have also mooted a more radical emergence, which I shall call 'very strong' emergence. A 'very strongly' emergent phenomenon is one that cannot even be defined operationally in terms of basic physical quantities. As far as I know, the only phenomenon that this has been put forward for is consciousness. C.D Broad in 1925 argued that consciousness emerged from finer-grain brain processes. The huge obstacle here is that consciousness – i.e. private mental experiences – is not amenable to third-person observation and is therefore intrinsically incapable of operational definition in fundamental physical terms.

Since very strong emergent phenomena take us out of the discourse of physical science, there is a *prima facie* argument that they are not physical phenomena at all. But that hasn't stopped some people advocating strong emergence as a way of 'understanding' or even 'explaining' consciousness.

Supervenience

'Supervenience' is a philosophical concept that is used to pick out the notion of high level properties being completely determined by low-level properties. For example, the appearance of a person

supervenes on the collection of specific, measurable physical characteristics – the height, the distribution of body fat, colour of hair and skin, and so on. But the social status of a person does not supervene on the physical properties of the person's body: it also depends on the person's job, lifestyle, publications, relations to other people, and so on. The notion of supervenience is usually brought in when the relation between the higher and lower levels is too complex to be mapped out explicitly. In this example, we can recognise someone as 'lean and muscular' or 'portly' without being able to enumerate precise physical measurements that would serve as criteria. Or, tens of thousands of people agree that Renee Zellweger's appearance has suddenly changed but would be hard put to define the set of measurable physical characteristics that have changed.

Supervenience does not offer a substantive theory of consciousness. It is just a convenient label. So, advocates of emergentism may claim that consciousness is supervenient on the brain, without feeling the need to explain precisely how conscious experiences supervene on brain activity.

Cynics will say that supervenience is a piece of jargon that enables philosopher to sound technical while saying no more than 'the conscious mind is completely determined by the brain but we have no idea how'.

Brave, New Emergent World?

Emergent laws

One topic that gets emergentists really excited is the emergence of new laws of nature in high-level systems. For example, once we have the concepts of heat and temperature, we can discover the laws of thermodynamics (that heat is preserved, that objects tend toward thermal equilibrium, and so on). Those laws are inconceivable at the level of individual molecules. And so the idea has come into circulation that not only new concepts can emerge, but novel real-world behaviour. Of course, philosophers then want to apply this to the conscious mind, and say that the mind and its lawful operations emerge from the brain but act independently of low-level processes.

Top-down causation

If one accepts that emergent phenomenon can have their laws and force, then one opens the door to 'top-down' causation. The higher-level phenomena 'cause' things to happen at a lower level. So, for example, in the emergent phenomena of economics: growing unemployment will cause people to spend less money on luxuries. Economists will speak of this as if the high-level, emergent phenomenon has a real-world causal effect on movements of individual bank-notes. Some philosophers buy into this manner of speaking and propose that top-down causation is an ontologically real thing. Not so! Top-down causation is an artefact of our description. In this example, it is much more convenient to describe economic behaviour in high-level terms such as recession, growth, unemployment; and when doing so, it is a convenient shorthand to say that rising unemployment levels cause reduced spending on fast cars. But it is foolish for a philosopher to be taken in by this and to think that this is a genuine top-down causation.

Causal over-determinism

We can easily see why top-down causation is a bogus concept. In a causally closed system, the state of the system S at time t depends on the state of the system at the previous time $t-1$, together with

any inputs into the system, i . Symbolically we might write $S(t) = \text{func}(S(t-1), i)$. We do not need to be able work out the details of func : if it is a deterministic system then we know that such a function is at work.

Now if the high-level 'emergent' phenomena supervene on lower-level processes, then in principle there is some mapping M from the lower level state S to the higher-level state H . Symbolically, $H = M(S)$.

Therefore, successive high-level states $H(t-1)$, $H(t)$, $H(t+1)$ will be driven wholly by the low-level causation. $H(t) = M(S(t)) = M(\text{func}(S(t-1), i))$.

But that means that there is no scope for any independent causation at the higher level. For if there were a high-level causation operating from $H(t-1)$ to $H(t)$ that is different from that generated from the lower level state S , then we have a contradiction. But if on the other hand, the high-level causation always produces the same results as that driven by low-level causation, then we see that high-level causation is purely nominal. It is an artefact of the description.

Thus, despite the hopes of starry-eyed emergentists, top-down causation is necessarily a myth.

Emergentism and magic

The only escape route for a philosopher who wants to salvage something from the emergentist dream is to jettison supervenience. If we were to say that the mind is not supervenient on the brain, but actually has a life of its own, then we can consider independent laws of causation operating within the mental realm, and even top-down causation (but only on non-deterministic aspects of the low-level processes).

Such a scheme, however, abandons any attempt at explanation. The consciousness mind is inexplicably not reductive to the physical realm; and it obeys laws of causation that have no deeper causal explanation. In what sense is such a conscious mind really 'emergent' from the brain? How is this different from brazen dualism?

Emergentism considered insidious

This is why I say that emergentism is insidious. (At least, the non-supervenient kind of emergentism, which anyway is the only interesting kind.) It creates the illusion that it is offering a new way of understanding mind's place in the world of physical nature, while at the same time taking us stealthily back to old-fashioned Cartesian dualism.

Emergentism is a non-explanation. It tells us nothing about consciousness is, how it operates, and how it relates to the physical world.

Beyond emergentism?

If the mind does not 'emerge' then what does it do?

If the mind is not an emergent phenomenon of the brain, then what is the relationship between the mind and the brain? Clearly it is a close relationship, as various forms of brain damage have specific effects on the conscious mind.

The radical alternative to physicalism is mental monism or 'idealism'. According to this theory, there is no mind-independent physical reality. All that really exists is consciousness. So what is the brain for?

An analogy may be found in modern computer where 'virtual servers' provide information storage and information rendering services. In like manner, the background consciousness ('metamind', 'Brahman', 'God') acts as an intelligent infrastructure that offers a virtual brain as means of storing information and carrying out high-performance information processing and cognition.