

It's Emergents All the Way Down

Preface:

The public conversation in the United States about the COVID-19 pandemic is viewing this pandemic too narrowly. To use an analogy, it is focusing on the bacteria at a spot in the Petri dish (local cases) and is ignoring the migration of the bacteria colony across the dish (national evolution of the pandemic over time).

The absence of this evolutionary perspective is blinding us to where the pandemic is taking the country. I have argued elsewhere that this blindness is leading us toward a political catastrophe that is of a different nature from the one that concerns us now: the conflict between public health and economic health.

(https://twitter.com/conways_law/status/1275452060251512845)

In this essay I present, through example, a visual framework that combines the local and evolutionary perspectives into one pattern that will help us see more clearly where the pandemic is taking us.

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- SCIENCE IS AN EMERGENCE PROCESS

Science advances one funeral at a time.

--Max Planck

This is no mere quip. It holds a big idea: scientific knowledge is a thing unto itself, but it lives in the minds of a lot of people. People have trouble changing their ideas, but when you change people the science can change.

Scientific knowledge is a distributed thing that lives in the minds of a lot of people, but it's not the people or their minds. What is it?

In this essay I'm going to:

1. answer this question about science specifically, then
2. show how the answer fits into a common two-level framework for describing all physical phenomena, and then
3. apply this framework to the COVID-19 pandemic.

The specific answer to the question about science: Scientific knowledge is an example of what's known as an emergent phenomenon arising from the activity of a bunch of people we call "scientists". Fig. 1 is a graphic model of this idea.

Science is the name we give to the whole two-level process.

Now, just because you can't touch it, scientific knowledge is no less of a "thing" than the people who create it. That's because something at the emergent level in one process is going to be an individual in another process.

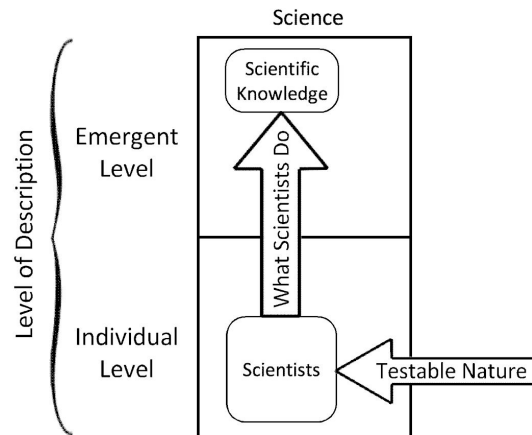


Fig. 1. Science Exists at Two Levels: Individual and Emergent

In fact, everything we think of as a "thing" is also an emergent somewhere else. Hence the title of this essay.

People who call themselves "systems thinkers" (I'm one of them) use the language of emergence a lot. I've queried many of them on Twitter for a definition. It seems to be one of those "I know it when I see it" things. I'm going to try to do something about that absence of specificity here.

- THINKING ABOUT EMERGENCE REQUIRES TWO LEVELS OF DESCRIPTION

First we're going to turn the model of Fig. 1 into a design pattern applicable to other domains of thought. In Fig. 2 you see the elements of the design pattern in black, with the replaceable domain-specific stuff in blue.

I assert that this applies to our experience at all levels of description; the job of science is to fill in the blue parts.

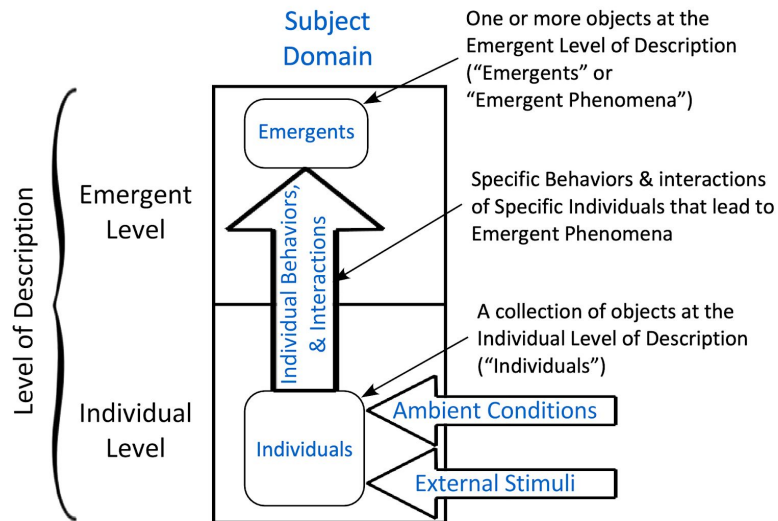


Fig. 2. The Emergence Process Design Pattern

- DEFINITION OF AN EMERGENT PHENOMENON

An emergent phenomenon is a phenomenon at the emergent level of description that arises from specific combinations of behaviors, interactions, and interventions at the individual level of description.

- COMMON EXAMPLES OF EMERGENCE

An earlier paper on this approach,

http://melconway.com/CBH/Missing_Quadrant.pdf

describes public health as an emergent phenomenon, using the two-level framework. Later the present paper will return to public health, specifically the current pandemic, in more detail. But first I'm going to elaborate on the definition of emergence using the common examples in the earlier paper.

A. Epidemic

In Fig. 3 an epidemic is an emergent phenomenon.

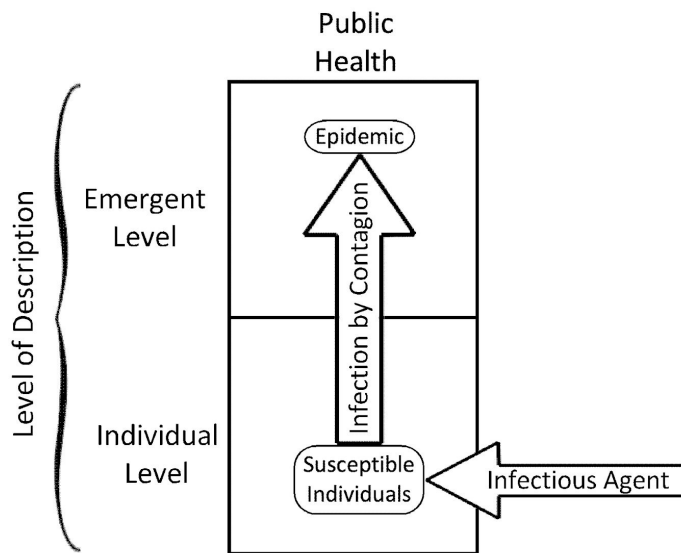


Fig. 3. An Epidemic is an Emergent Phenomenon

B. Phases of Water

Figs. 4 and 5 describe the ice and liquid phases of water as emergent phenomena, with the H₂O molecules as the individuals.



Fig. 4. Phase Transition at the Liquid-Solid Boundary

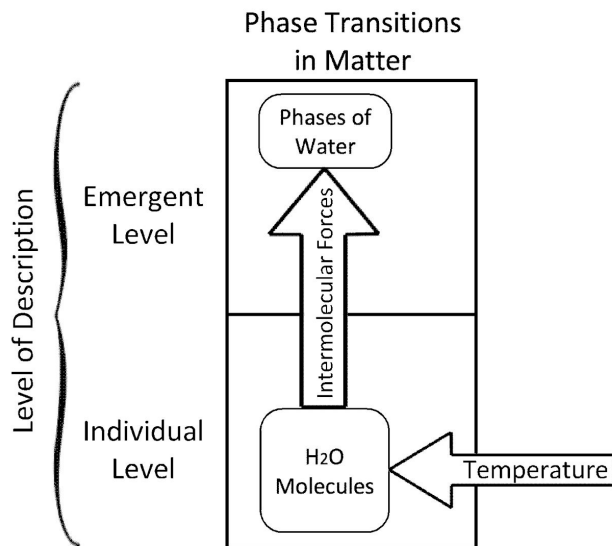


Fig. 5. Phases of Matter are Emergent Phenomena

Fig 6 is from the Wikipedia article on phase diagrams. From the Wikipedia description of the figure: “ The solid green line applies to most substances; the dotted green line gives the anomalous behavior of water. The green lines mark the freezing point and the blue line the boiling point, showing how they vary with pressure.”

https://en.wikipedia.org/wiki/Phase_diagram

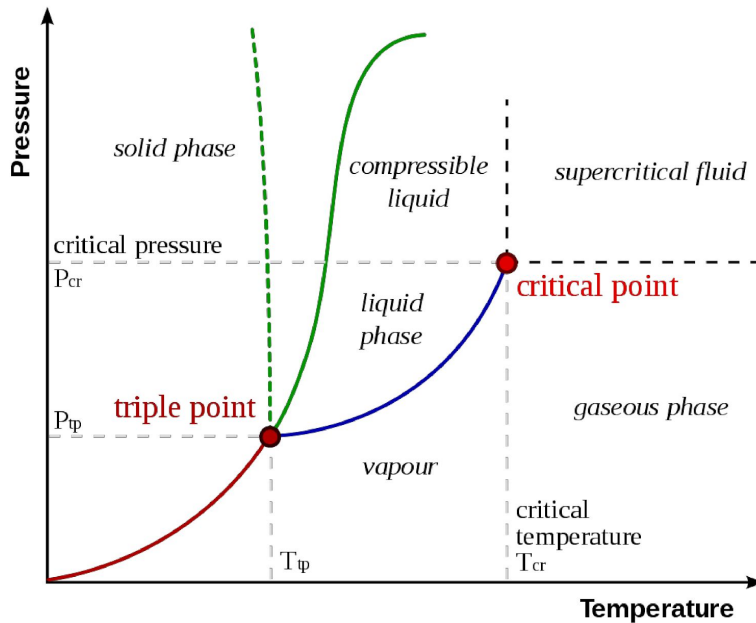


Fig. 6. Typical Phase Diagram (Wikipedia)

The message here is that what happens when you change the external conditions of water can be complicated and path-dependent. That’s a message I’m going to carry into the discussion of COVID-19.

C. Flocking of Birds

In Fig. 7 murmurations of starlings are emergent phenomena. See <https://www.npr.org/sections/13.7/2017/01/04/506400719/video-swooping-starlings-in-murmuration>

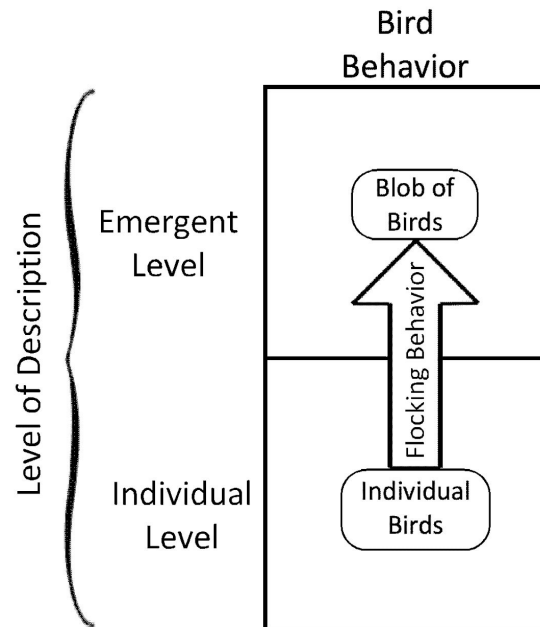


Fig. 7. Flocking is an Emergent Phenomenon

I have written that much human behavior described in multiple corners of social science can be, and should be, described and studied as uniform phenomena using this emergence pattern.

https://twitter.com/conways_law/status/1208468897176924163

- THE TWO-LEVEL PATTERN IS UNIVERSAL

I have also written my belief that everything in our world (with the possible exception of the fundamental particles of physics) is an emergent. I further believe that incorporation of this worldview into general education is a matter of great urgency.

https://twitter.com/conways_law/status/1197576009719177216

The unquestioning public acceptance of the US Government's response to the COVID-19 pandemic is all the example we need of the destructive effect of the absence of this thinking in general education.

- THE LARGE-SCALE DYNAMICS OF INFECTION

Fig. 8 is a map from the CDC website that shows the total cumulative cases of COVID-19 for each county in the continental US on June 23, 2020. At the beginning of the year there would have been no color in this map.

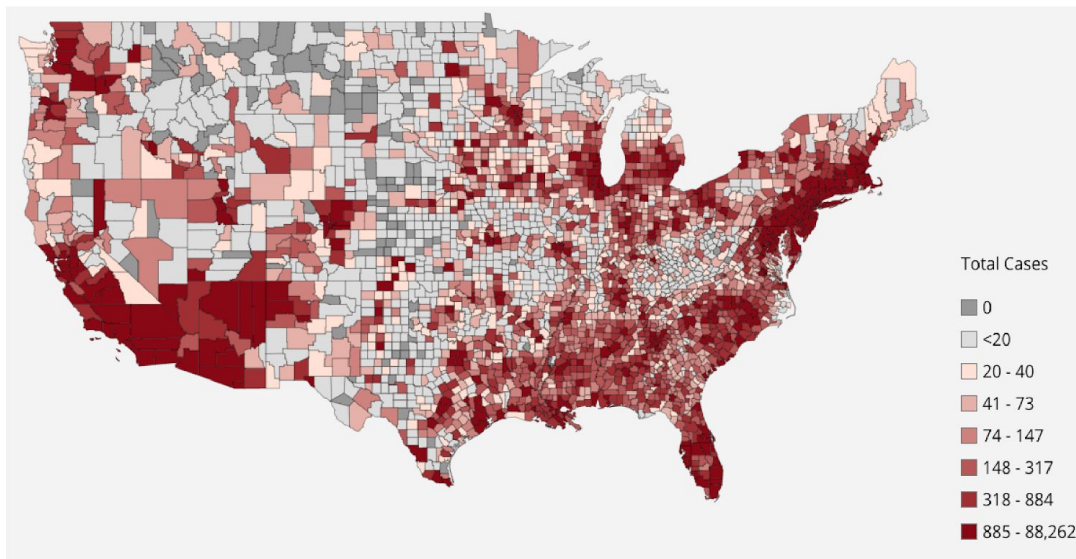


Fig. 8. Total COVID-19 Cases by County in the Continental US

Someone who follows the news can imagine an animation of the daily progress of this map beginning around March 1 that would show the dark areas spreading from the coasts toward the interior.

What is this thing we’re watching move across the country? If this were an America-shaped Petri dish we would say it’s a bacteria colony: a two-level emergence process with bacteria as the individuals and a bacteria colony as the emergent. So let’s call it a “COVID colony”. Fig. 9 shows it as part of an emergence process.

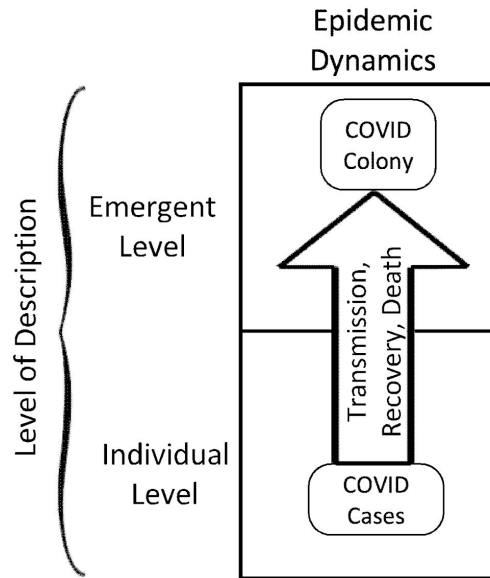


Fig. 9. A Colony Has a Life of its Own over Time

“EEK!” You say, “We’re not being inhabited by a colony.” Yes we are. This emergent is just as much of a “thing” as a COVID case, which, when you think about it, is a total abstraction dependent on an ICD-10 code. <https://www.who.int/classifications/icd/COVID-19-coding-icd10.pdf?ua=1>

What’s important, and what I’m totally missing in the public conversation, is that the *evolution of the colony* is what we need to understand in order to model the future of living with this virus. And my inability to find data in the CDC and WHO websites that allow me to understand the history of this evolution is alarming.