

## Lecture 4 - Catastrophic Change, Power Laws, and Fractals

**What did you think of the reading?**

What does historical physics tell us about the future? Does this mean that predicting the future is impossible, because chaos always has the ability to turn the smallest decimal into the largest effect? What exactly do these laws of critical states say we can and cannot predict?

**Do the laws of historical physics apply to human systems?**

It's said that the laws of science can't apply to humans because, with our intellect and culture, we're too complicated. We remember the past, so, while we might still repeat ourselves, we do it differently. But memory and complexity are exactly the conditions of historical physics.

**What are the characteristics of Critical States?**

- They're ubiquitous: historical systems naturally organize themselves into critical states. That includes everything from societies to psychologies.
- They're fractal: Critical states are critical on all levels, and an arbitrary small change can result in an arbitrary large avalanche of changes, by virtue of snowballing.
- They follow power laws: Because of this "fractal size", the size of events follows a power law. If there are  $N$  events in a given time period of one size, there will be  $XN$  events half that size,  $X^2N$  events a quarter of that size, etc., and  $N/X$  events double that size,  $N/X^2$  quadruple that size, etc.

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