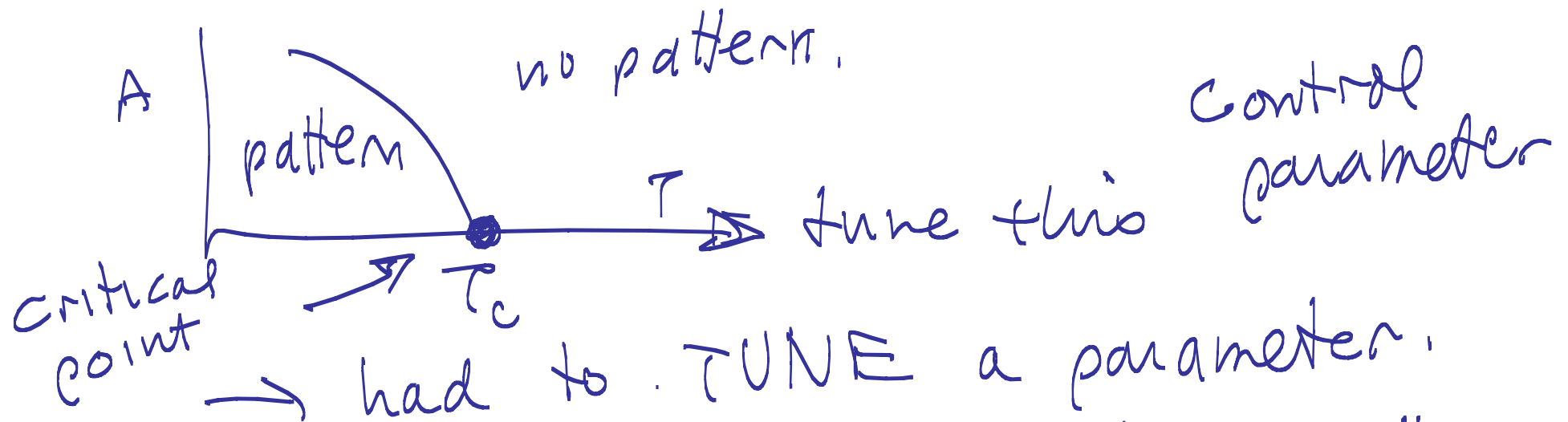


Emergence lec 22  
Self-organized criticality "SOC"

Life + War

phase transitions  $\rightarrow$  bifurcations, "tipping point"



$\rightarrow$  had to TUNE a parameter.  
There are systems that "self-tune"

critical states emerge internally

— from the natural evolution—

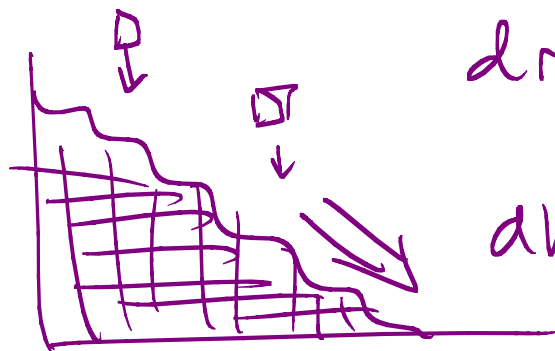
— large fluctuations, fractal nature.  
verge of symmetry breaking.

Per Bak, Tang, Wiesenfeld 1987.

"Self organized". BTW,

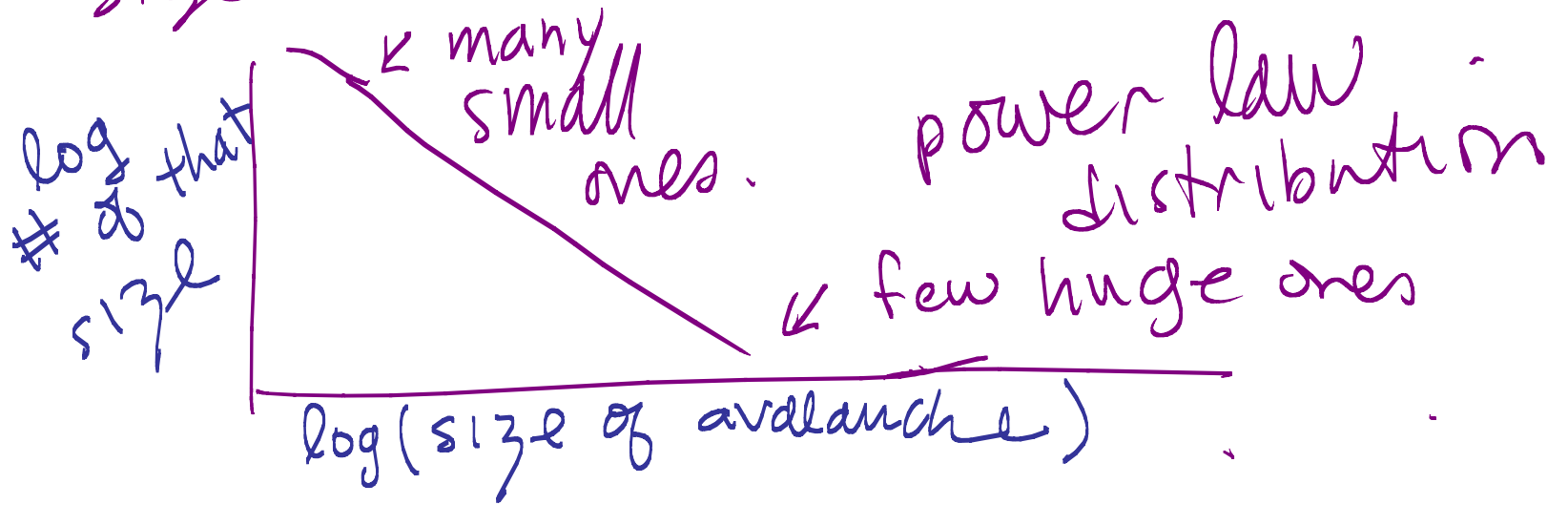
drop "sand" slowly.

Model  
sand  
pile



avalanches.

- can't predict size of avalanche
- size has NO SCALE



slow driving  $\rightarrow$  scale-free fractal distribution of "avalanches"

Gutenberg Richter Law

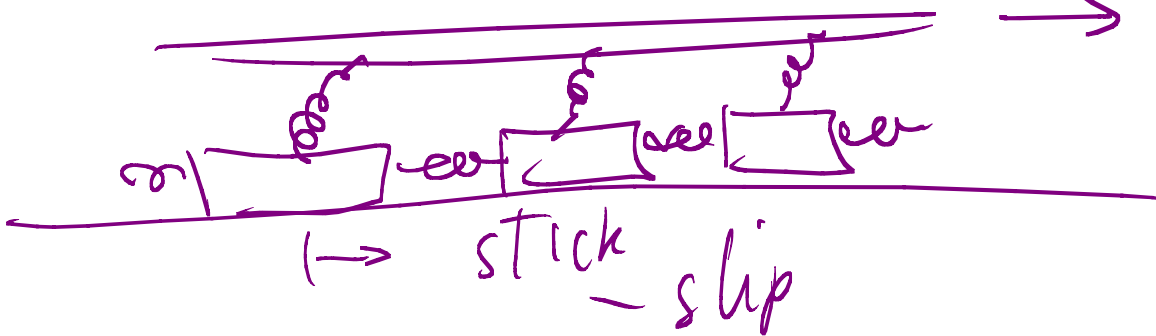
→ Earthquakes. (power law)

⇒⇒ slow driving forces



Burrige Knop off Models

→ Moves slowly



sticky rough friction

forest fire model.  
ISing model.

Claim: Nature under non-equilibrium  
driven conditions  
evolves to a SOC state  
"generically"

Per Bak: "How Nature Works",  
→ applied to war, terror, politics  
evolution 111111