COGS300
Emergence & Self-organisation

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I view the brain not as a box with compartments that contain sadness, joy, color, texture, and all the other "objects" and categories that one might think of. Instead, I envisage it as a constantly shifting dynamic system; more like the flow of a river in which patterns emerge and disappear, than a static landscape. "Meaningful patterns," as Sherrington said over fifty years ago, "but never abiding ones."[1] This is an entirely different image from the brain as a computer with stored contents or subroutines to be called up by a program. In nature's pattern-forming systems, contents aren't contained anywhere but are revealed only by the dynamics. Form and content are thus inextricably connected and can't ever be separated.

Self-organisation

The emergence of order through local interactions between parts of a system without control from an active agent.

Self-organisation

http://ianiselsewhere.com/Turing-Drawings/index.html

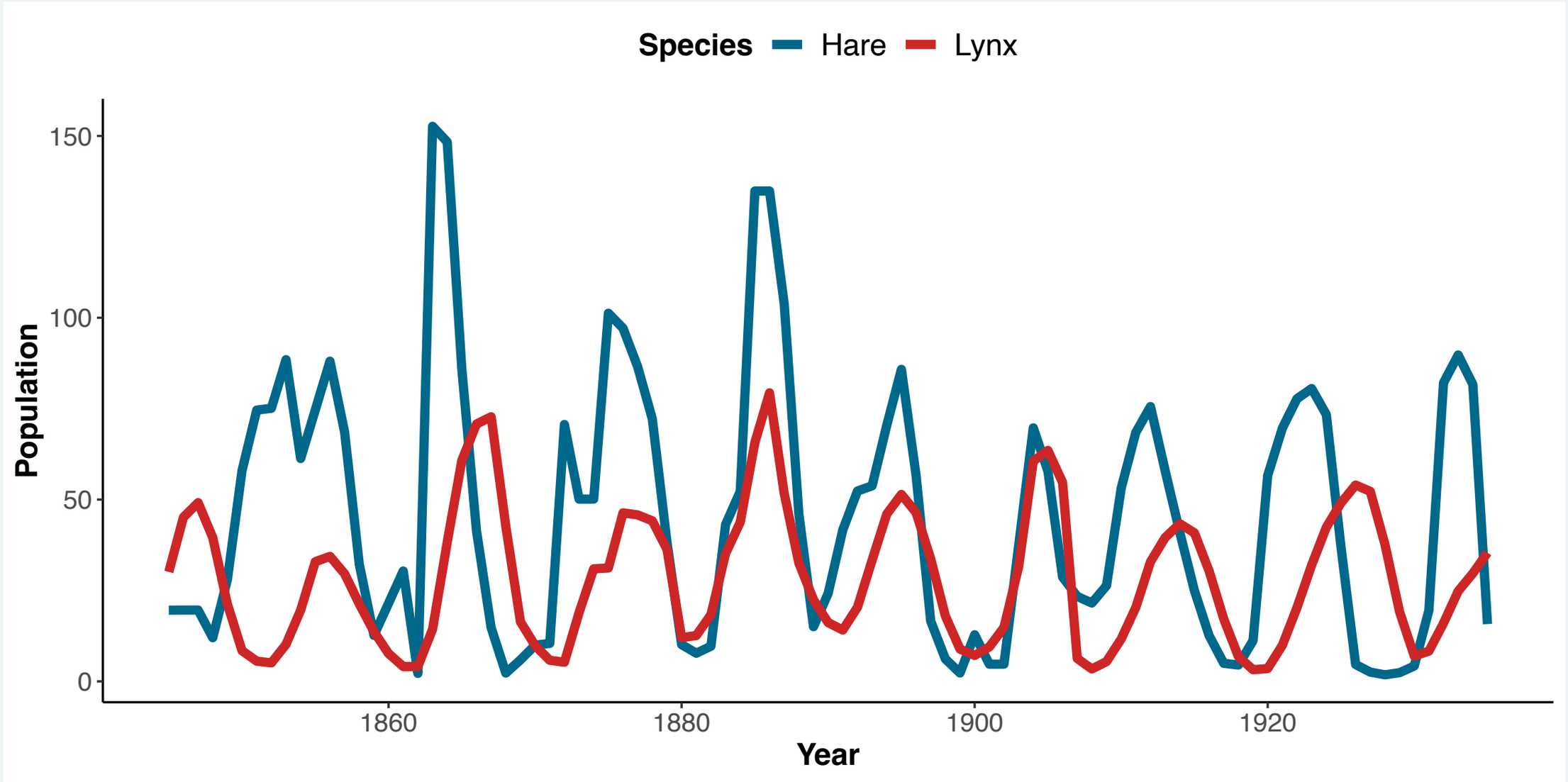
Positive feedback loops

A given event makes the recurrence of that event in the future more likely.

Negative feedback loops

A given event makes the recurrence of that event in the future less likely.

Positive + Negative feedback loops

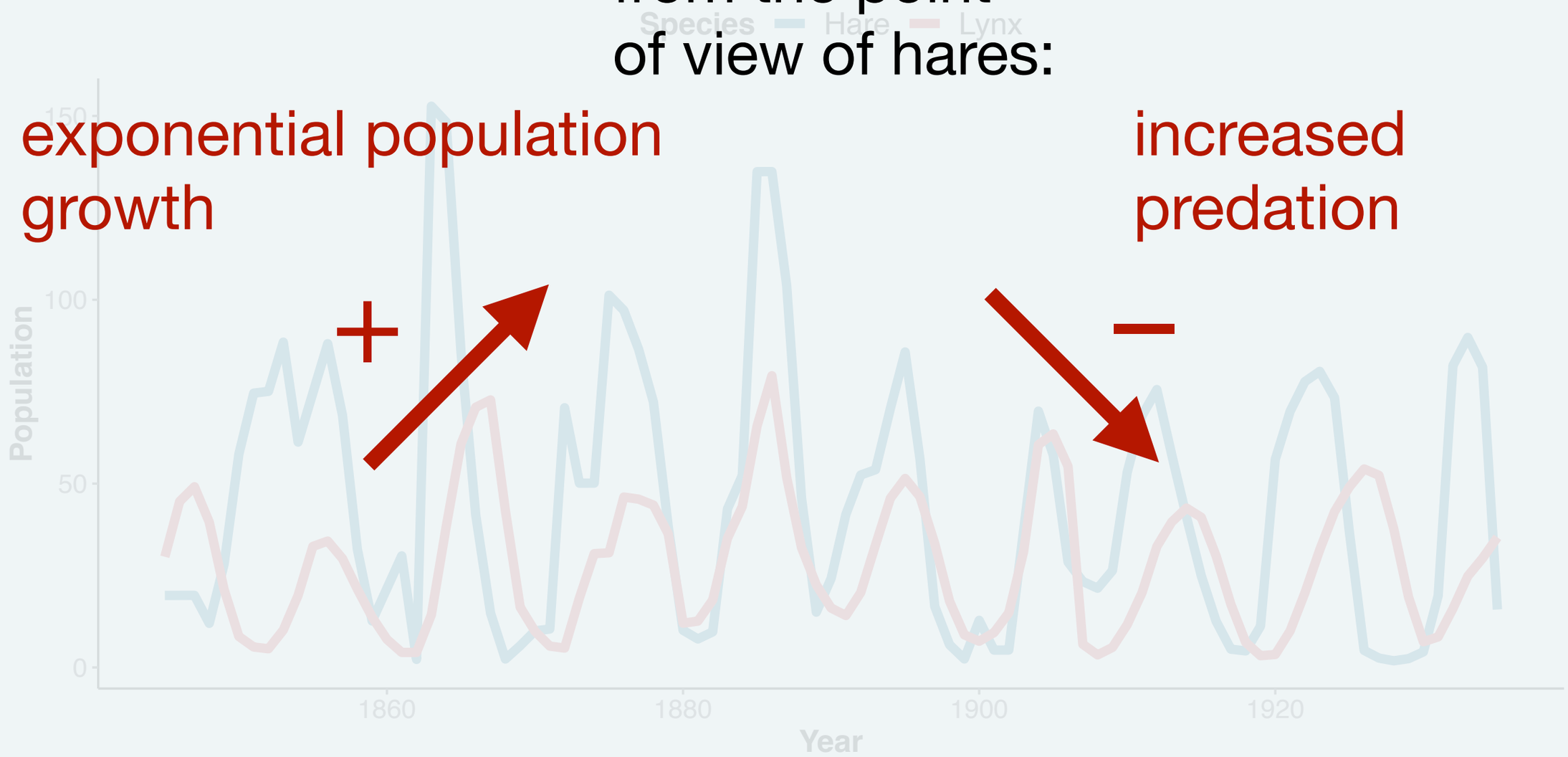


Positive + Negative feedback loops

from the point of view of hares:

exponential population growth

increased predation



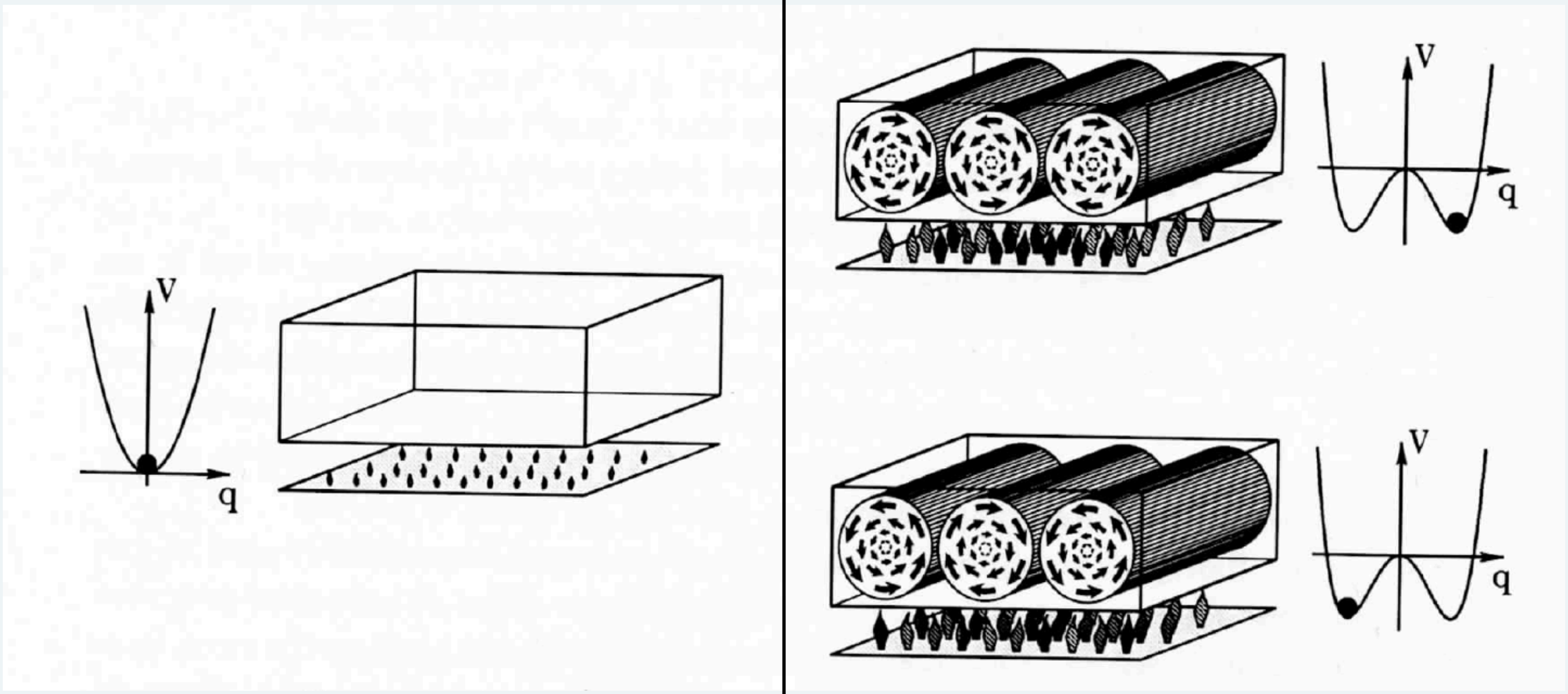
Self-organisation:
Control vs. order parameters

The terminology of dynamic analysis

- **open non-equilibrium systems**
  - open: exchanging energy / matter / information with environment
  - non-equilibrium: without external output, the system collapses
- **phase transitions**: transition from one “configuration” to another

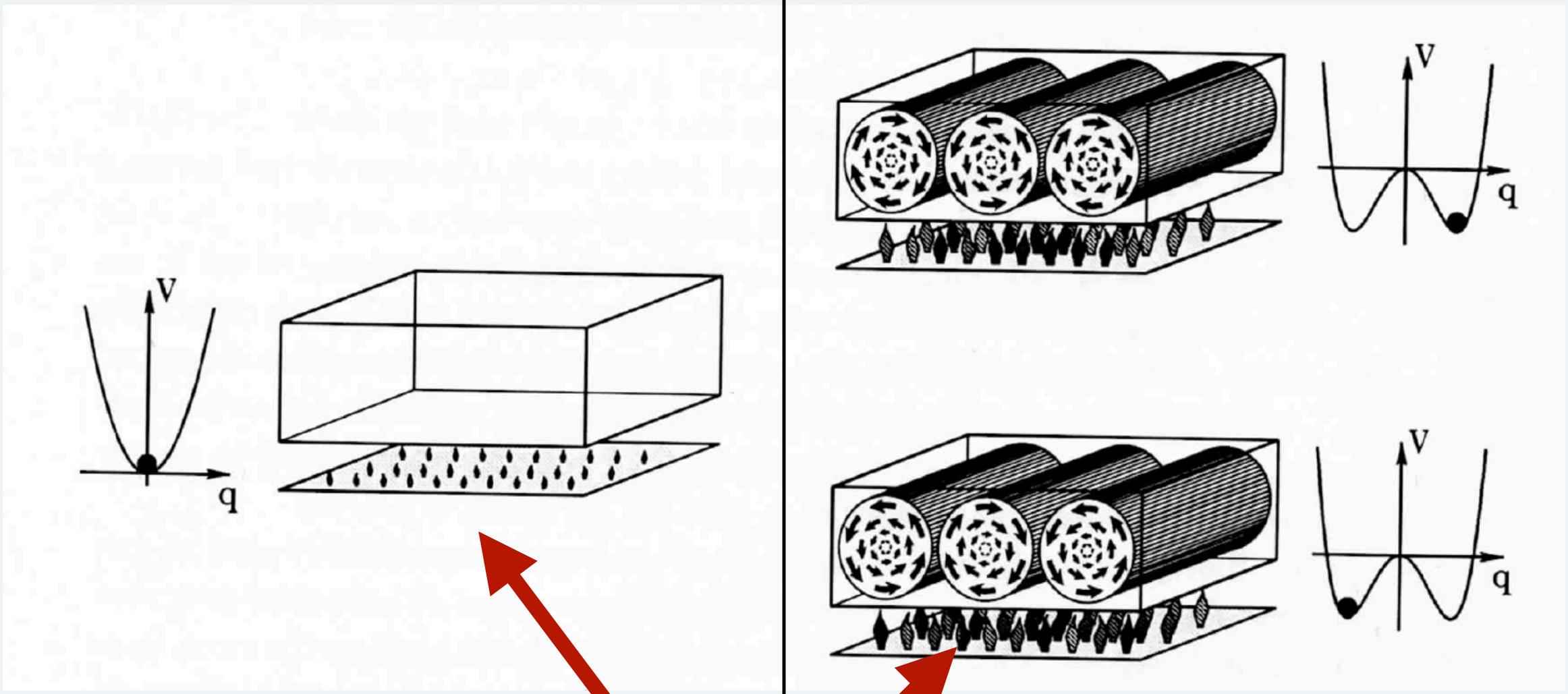
The terminology of dynamic analysis

- **the Rayleigh-Bénard instability**



The terminology of dynamic analysis

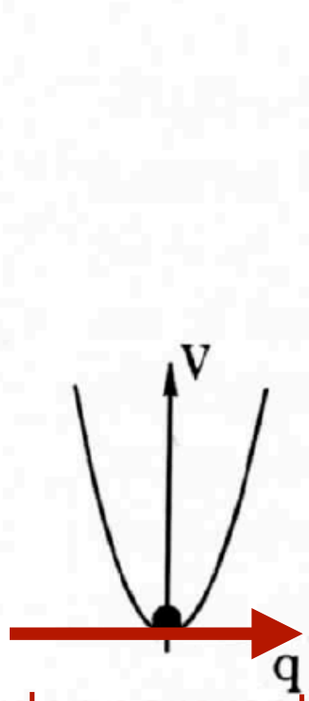
- **the Rayleigh-Bénard instability**

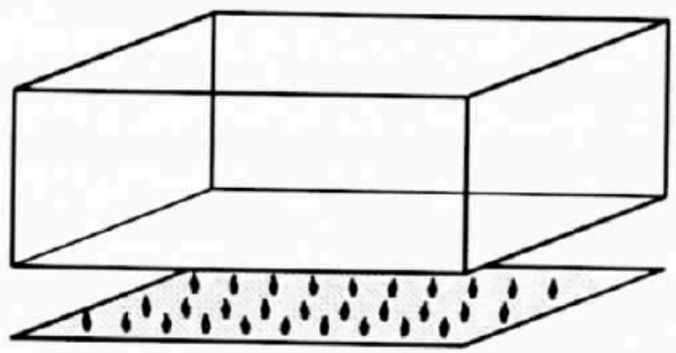


open system

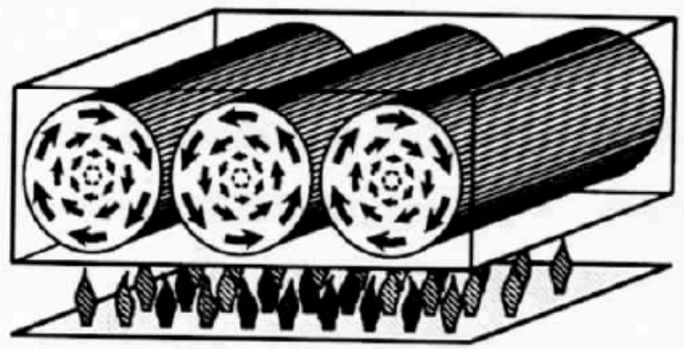
The terminology of dynamic analysis

- **the Rayleigh-Bénard instability**

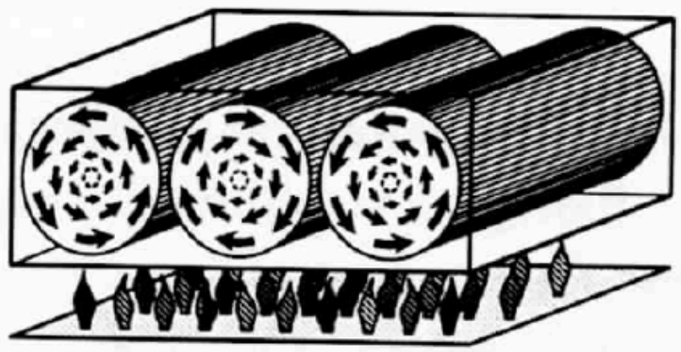


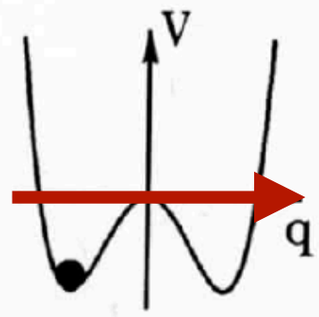


order parameter (direction & amplitude)



order parameter (direction & amplitude)





order parameter (direction & amplitude)

The terminology of dynamic analysis

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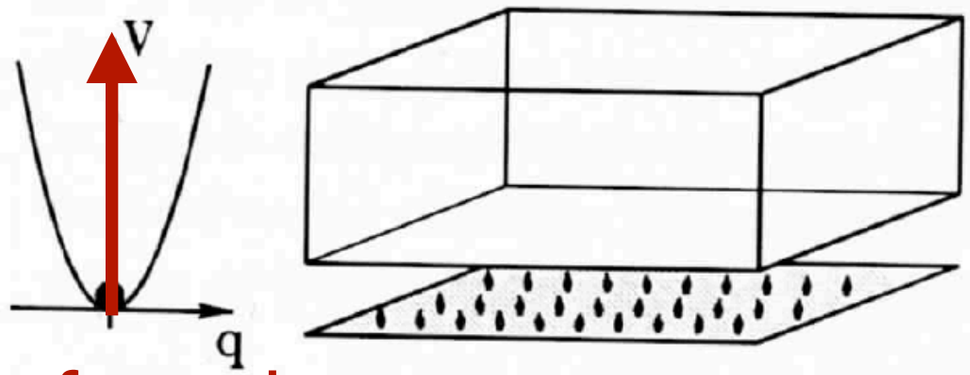
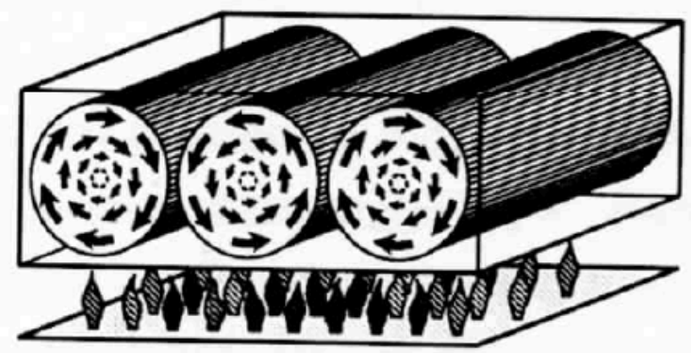
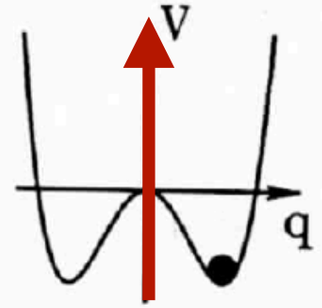
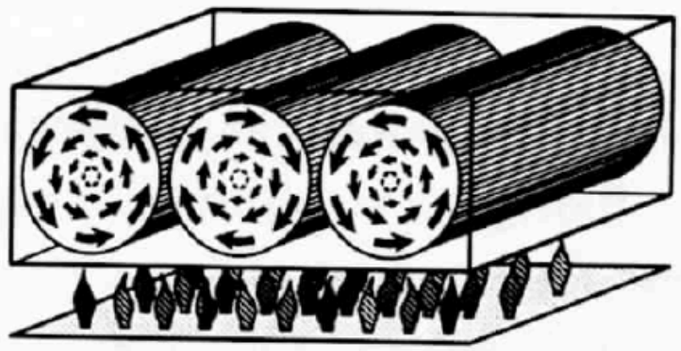


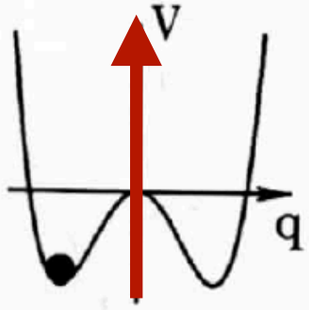
preferred states





preferred states



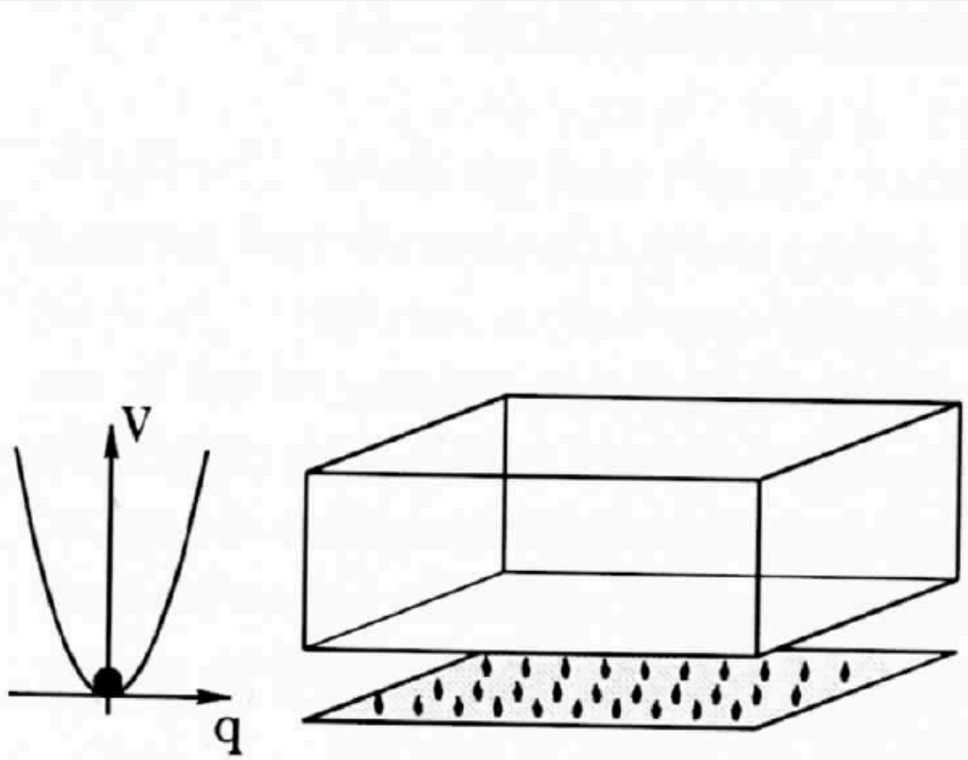


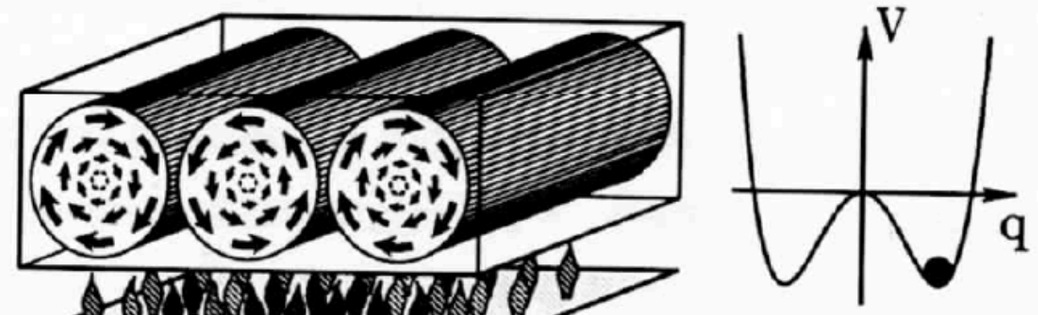
preferred states

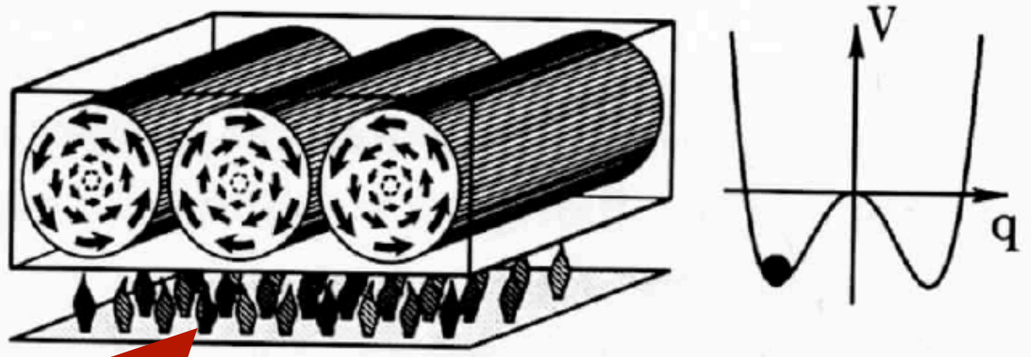
The terminology of dynamic analysis

weakly heated
-> no pattern

strong heat
-> instability



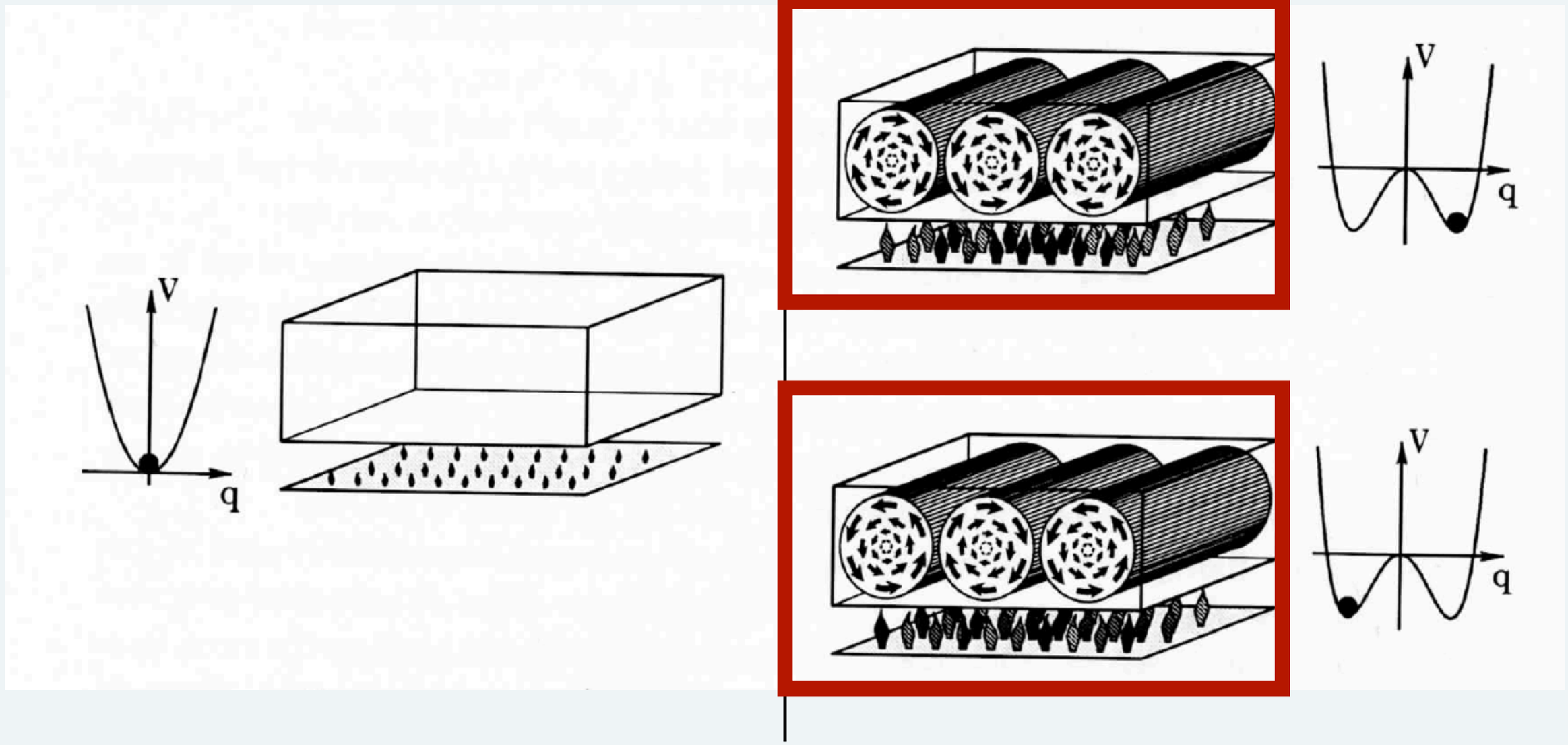




open system

The terminology of dynamic analysis

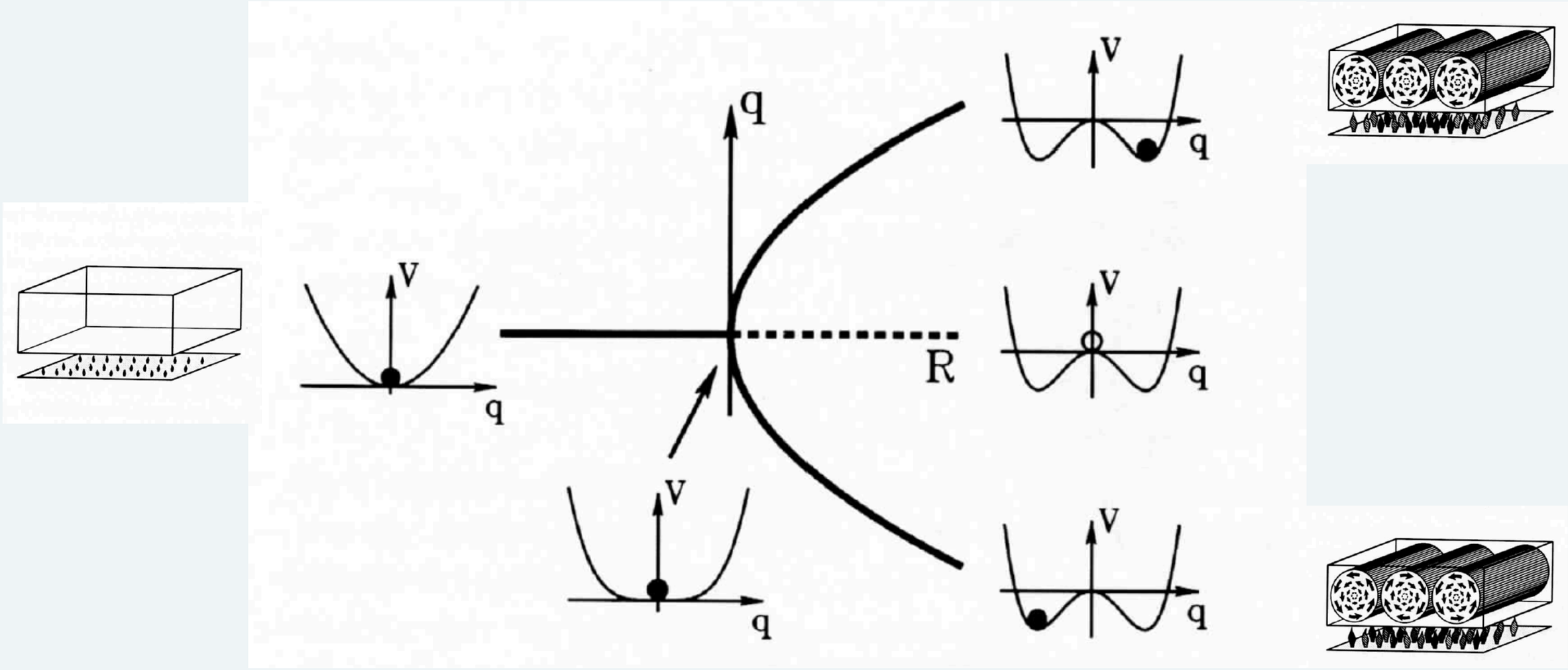
collective effect



The terminology of dynamic analysis

control parameter

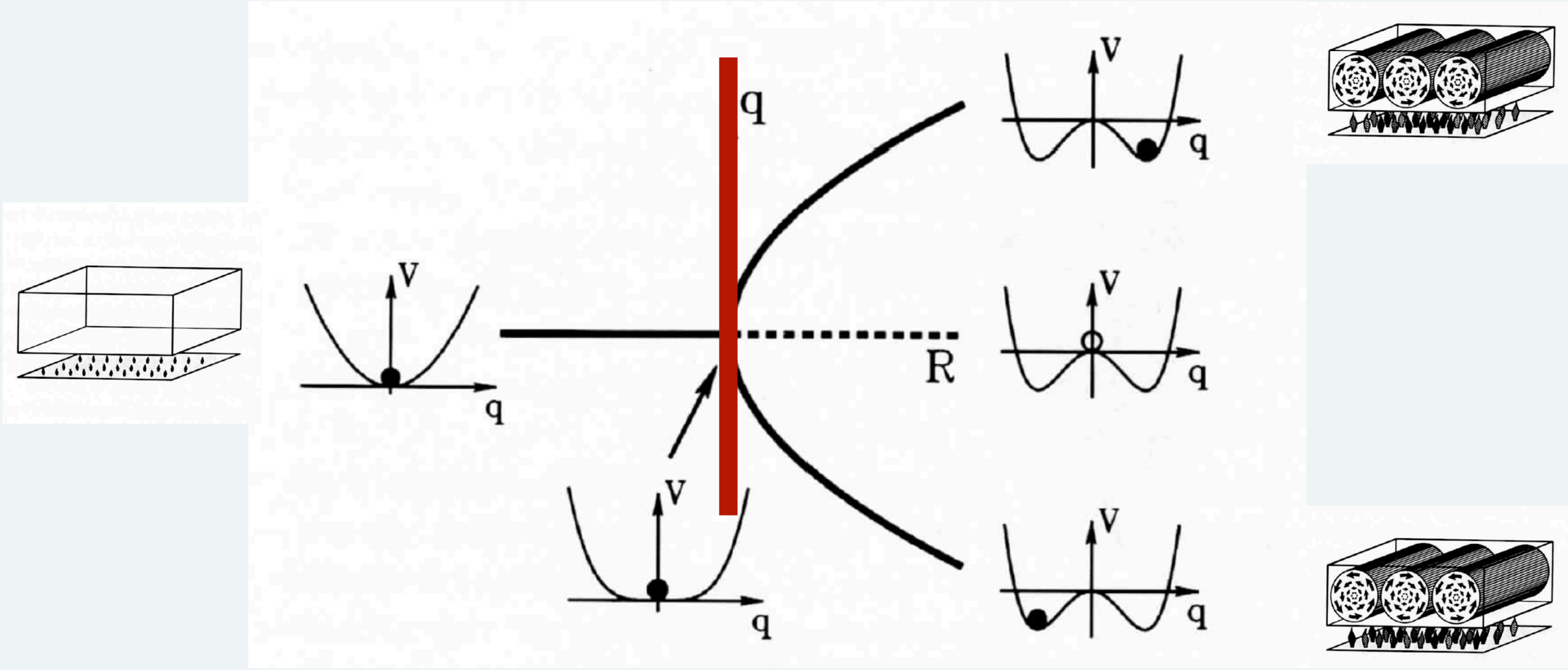
(temperature gradient)



The terminology of dynamic analysis

order parameter

(amplitude of convection rolls)



The terminology of dynamic analysis

(adaptive) landscapes