Brain Dynamics - a synergetic view

Hermann Haken (Stuttgart University)

synergetics: physics (lasers, fluids), biology (morphogenesis, evolution), ecology
spontaneous formation of patterns, structures, functions - general principles?

brain: 100 billion of neurons, highly complex, self-organization

dynamical system: high-dimensional state vector $\underset{\sim}{q}$, control parameters $\underset{\sim}{a}$

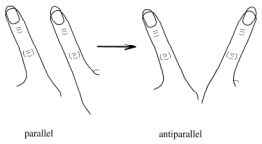
$$\frac{d\underset{\sim}{q}}{dt} = \underset{\sim}{N}(\underset{\sim}{q}, \underset{\sim}{\alpha}) + \underset{\sim}{F}, \quad \underset{\sim}{N}: \text{nonlinear}, \quad \underset{\sim}{F}: \text{stochastic (noise!)}$$

close to instabilities, bifurcations, non-equilibrium phase-transitions

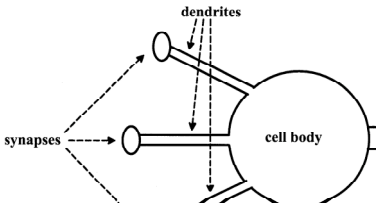
$\underset{\sim}{q} = \underset{\sim}{f}(\underset{\sim}{\xi}, t)$, $\underset{\sim}{\xi}$: order parameters, low dimensional dynamics

slaving principle new qualities

1) phenomenological: finger movement coordination



perception: vase - face  ambiguous figures, oscillation

2) microscopic 

neuron

pulse coupled neural network

pulse synchronization
binding problem ?

pattern recognition
(associative memory)

attractors (ANN)

saturation of attention
quasi-attractor