

**October
20 (mon) - 22 (wed)
2008**
**Co-op Inn Kyoto
Conference Hall**



Main Speakers

Harald Atmanspacher
(Institut für Grenzgebiete der Psychologie und
Psychohygiene e.V.)
Mark S. Blumberg
(University of Iowa)
Adrian David Cheok
(National University of Singapore)
Ludwik Leibler
(Centre National de Recherche Scientifique)
Shigeru Mlyagawa
(Massachusetts Institute of Technology)

Program Committee

Yoji Aizawa (Waseda Univ.)
Kuniyoshi Ebina (Kobe Univ.)
Yukio Gunji (Kobe Univ.)
Yoshihiro Miyake (Tokyo Ins. Tech)
Tadashi Nishihira (Kyoto Univ.)
Shunichi Noma (Kyoto Univ.)
Gentaro Taga (Univ. of Tokyo)

Organizing Committee

Masatoshi Murase
(Yukawa Inst. Theor. Phys, Kyoto Univ.)
Kazuo Nishimura
(Director of Inst. Economic Research, Kyoto Univ.)

International Workshop on

What is Creativity?

— Emergent Phenomena in Complex Adaptive Systems

Organized by

Institute of Economic Research, Kyoto University
Yukawa Institute for Theoretical Physics, Kyoto University

In cooperation with International Institute for Complex Adaptive Matter (I2CAM),
Asia Pacific Center for Theoretical Physics (APCTP), Kato-Kyoto GCDE,
Advanced Institute for Complex Systems, Waseda University,
Hayashibara Foundation, The Integrated Economic Research Foundation,
and Kyoto University Open Course Ware



http://www.yukawa.kyoto-u.ac.jp/eng/inst/conten/seminar/detail.php?SNUM=30003

**International & Interdisciplinary
Workshop on
What is Creativity?
Emergent Phenomena
in Complex Adaptive Systems**

**Co-Chair: Masatoshi Murase
Kazuo Nishimura
October 20 – 22
2008**

Proceedings

Ed. Masatoshi Murase

**“Emergent and Hidden Dynamics”
(Tentative Title)**

**John Wiley
(2010)**



Contents

- **Overview: Oppositions, conflicts and contradictions as driving forces of creativity**
- **Creativity as the emergence of order out of chaos**
- **Creativity as the rediscovery of old concepts in new contexts**
- **Creativity as the emergence of hidden dynamics with a double-edged sword**

Nishinomiya-Yukawa International & Interdisciplinary Symposium 2007

What is Life?

The Next 100 Years of Yukawa's Dream

October 15 (Wed) ~ 20 (Sat) 2007
CO-OP Inn Kyoto Conference Hall

Invited Speakers

Robert Arking (Wayne State Univ.)
Carl Becher (Kyoto Univ.)
David Deamer (SJC Santa Cruz)
John Evans (England)
Luisito Floridi (Gene, of Oxford)
Susumu Goto (Kyoto Univ.)
Nicholas Humphrey (London Univ.)
Masami Ishida (Nat. Inst. Env.)
Akeo Kamei (Kobe Univ.)
Jeonghwan Kim (APCTP)
Hajime Kusata (Miyagi-Senri Hospital)
Saburo Matsui (Kyoto Univ.)
Tetsuro Matsuzawa (Kyoto Univ.)
Nobuhiko Mizuka (NIRS)
Hiyoshi Miyagawa (Univ. of Tokyo)
Yoshihiro Miyake (Tokyo Inst. Tech.)
Alex Mugger (U.C. Davis)
Aage H. Müller (Univ. of Texas, Dallas)
Vijayaram Narendranath (IISc, Bangalore)
Yoshiaki Otsuka (New York Medical College)
Kazuhiko Otsuka (Tokyo Women's College)
Donald W. Pfaff (Rockefeller Univ.)
Raymond Primack (Univ. of Rochester)
Ralf Rindler (UK)

Leif G. Svalund (Lund Univ.)
Hiroyuki Tanaka (Kyoto Univ. of Art and Design)
Masahiko Shimizu (Univ. of Tokyo)
Santaro Tago (Univ. of Tokyo)
Junji Takahayashi (Kyoto Univ.)
Hiroyuki Takemoto (Univ. of Tokyo)
Mark van Alfen (CNRS, Paris)
Toshio Taniguchi (Osaka Univ.)
Mutsaers VanZand (Shizuoka Univ.)

Organizing Committee

Chairman: Masatoshi Murase (Kyoto Univ.)
Co-Chair: Yukawa Institute for Theoretical Physics, Kyoto University

Yukawa Institute for Theoretical Physics, Kyoto University
http://www.yukawa.kyoto-u.ac.jp/ ~~~~~ TEL: 075-753-2000

**Nishinomiya-Yukawa
International & Interdisciplinary
Symposium on
“What is Life?”
Chair: Masatoshi Murase
October 15 – 20
2007**

**Proceedings:
Progress of Theoretical Physics
Supplement No.173, 1–370 (2008)**





**2008, October 8
At Yukawa Hall**

**Professor Toshihide Masukawa
2008 Nobel Prize Winner**

**Former Director
Yukawa Institute for Theoretical Physics
Kyoto University**



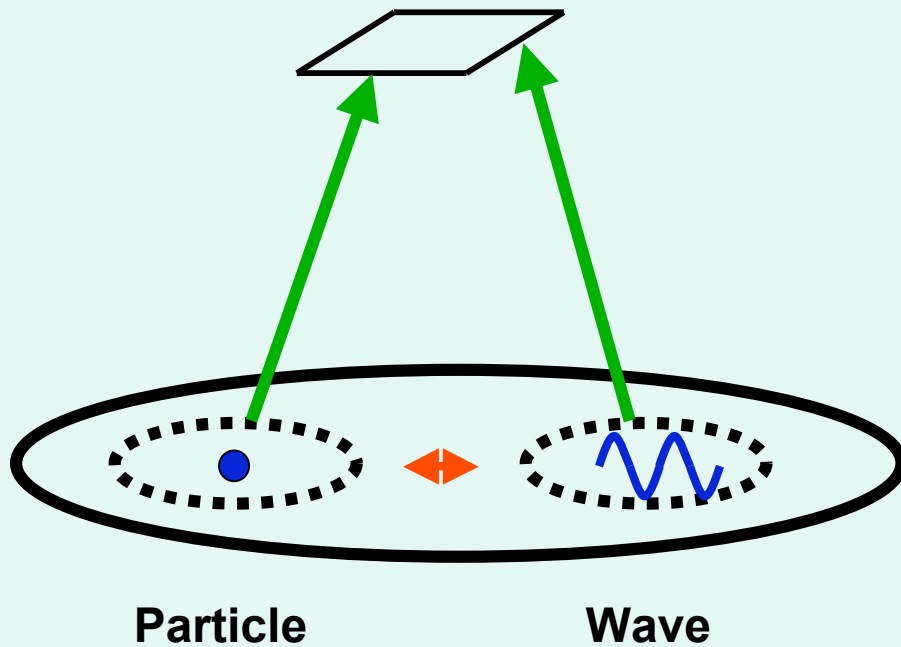
Photo: by Ms. Nosaka

Conflicts are driving forces of Scientific evolution



Niels Bohr
1885 ~1962

Quantum Theory

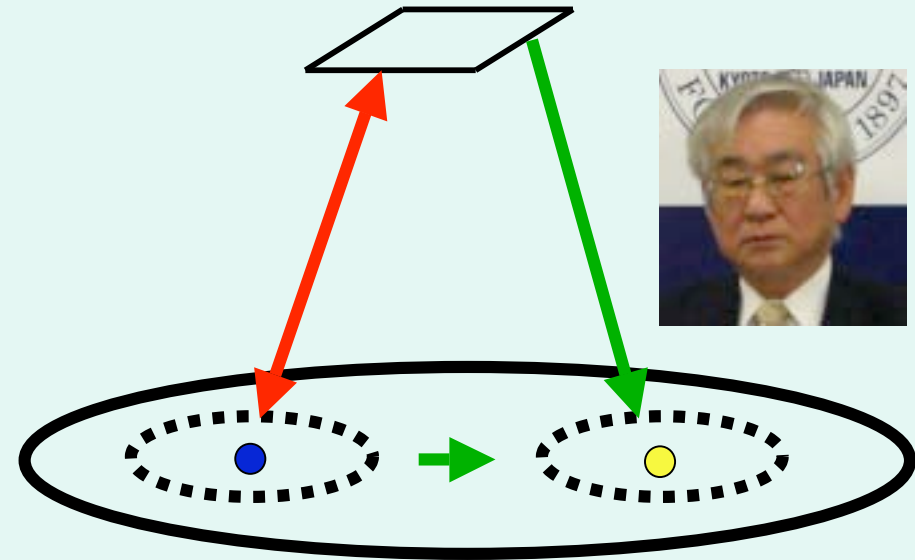


Particle

Wave

Opposites are complementary

A Unified Theory



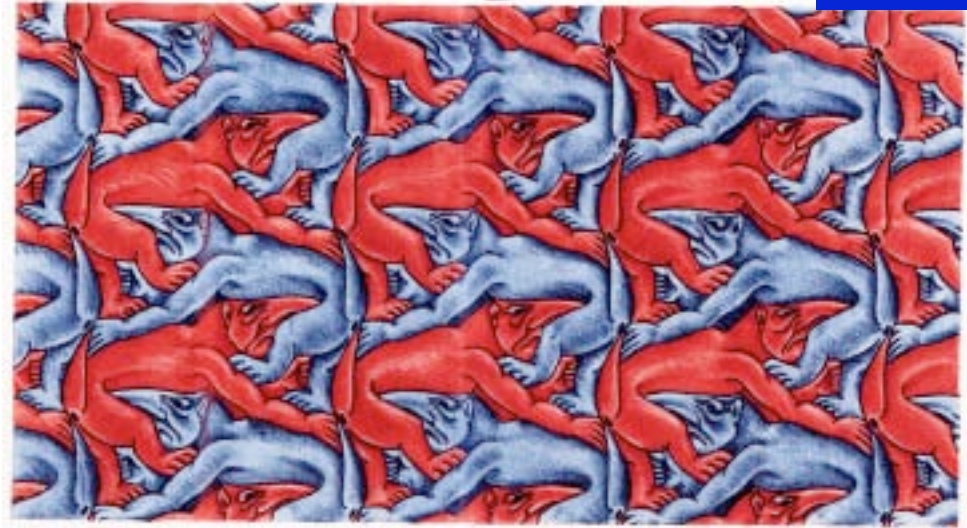
Known Particle

Unknown Particle



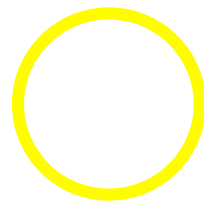
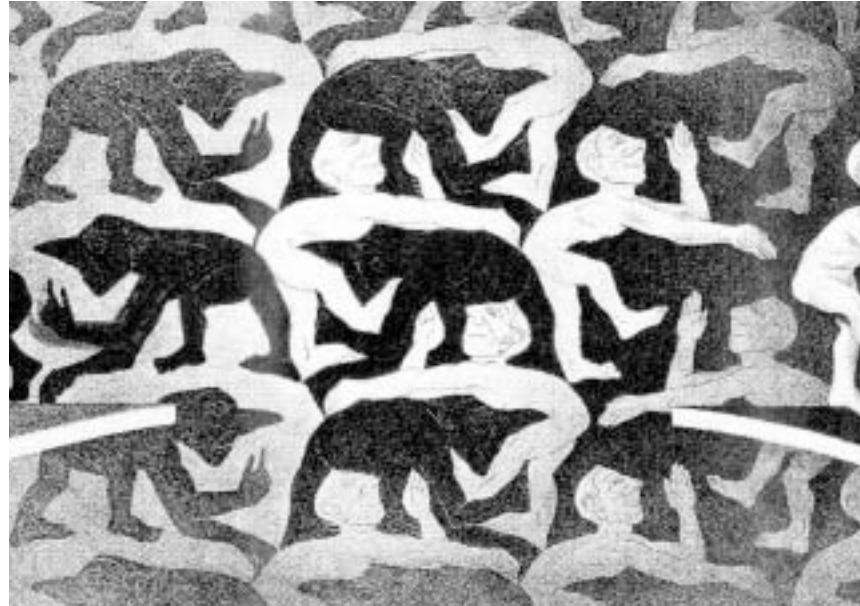


Dutch Artist M.C. Escher
1898.6.17. ~ 1972.3.27
From “*Visions of Symmetry*”
by Deris Schattshneider (1990) .



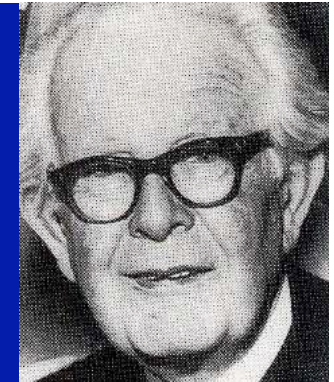
Opposites are complementary

Escher No. 62, 1944



Escher No. 63, 1944

Developmental Psychology



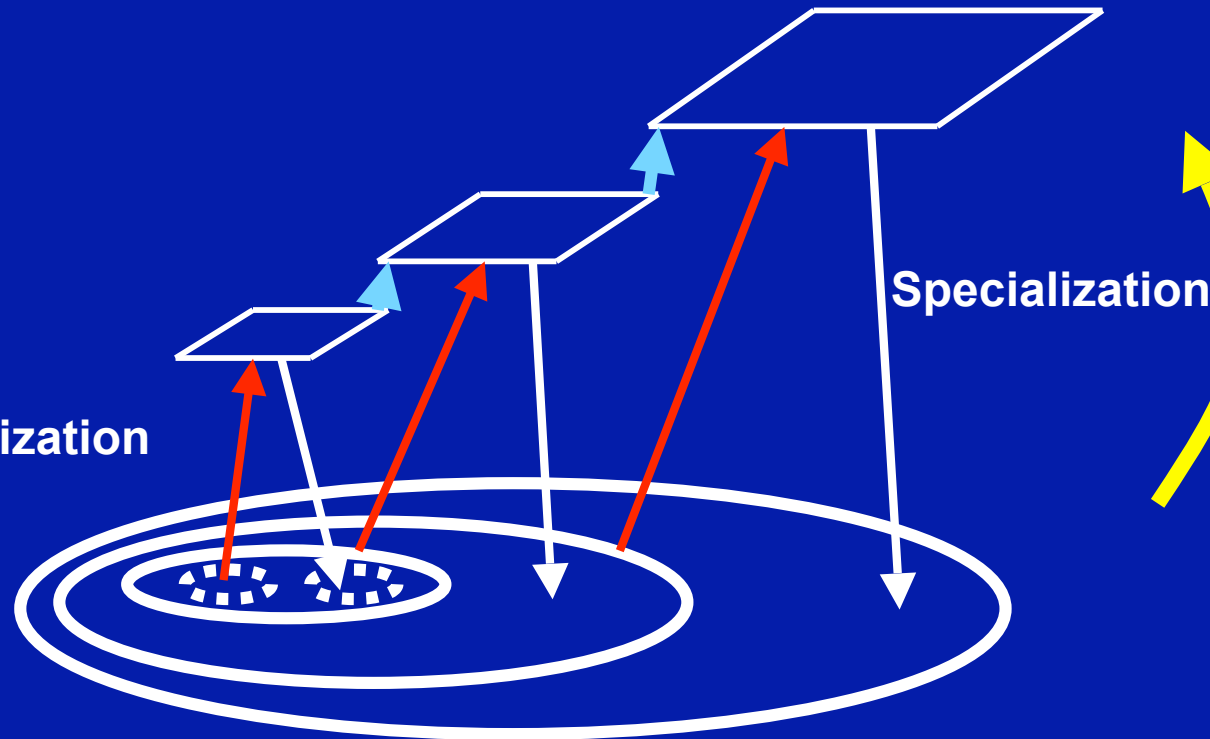
Jean Piaget
1806-1980



Mark S. Blumberg

Theoretical domain

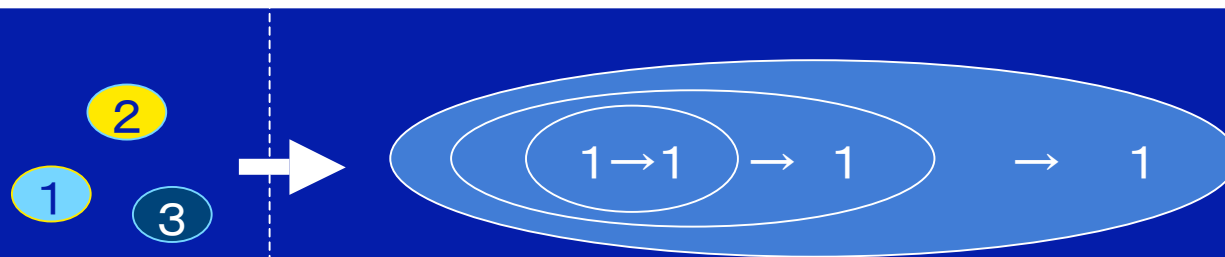
Empirical space



generalization

Specialization

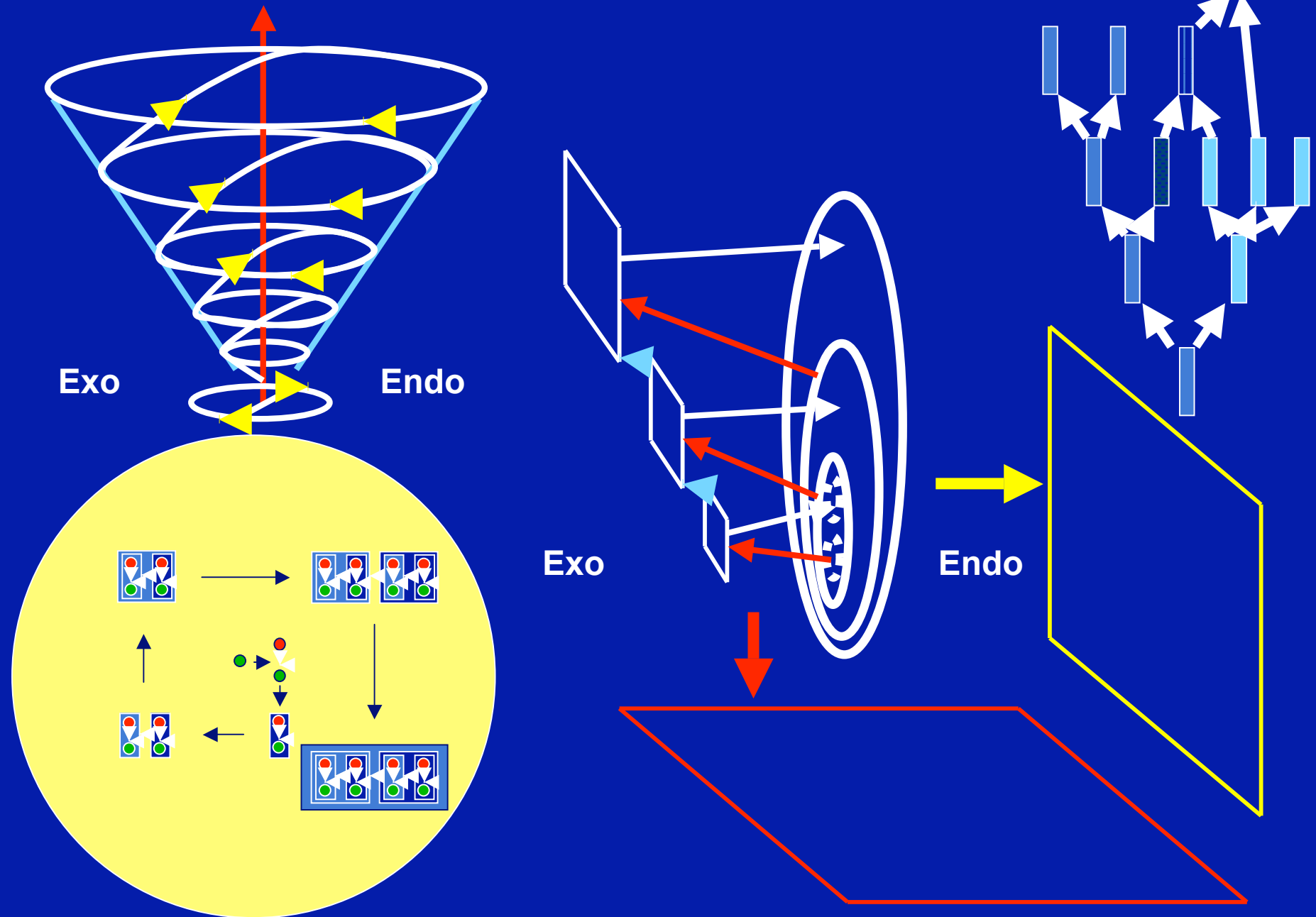
Time



Critical Period

Concept of
Number

Life as a process of endo-exo circulation





C. G. Jung
1875-1961

Religion

Connection of oppositions

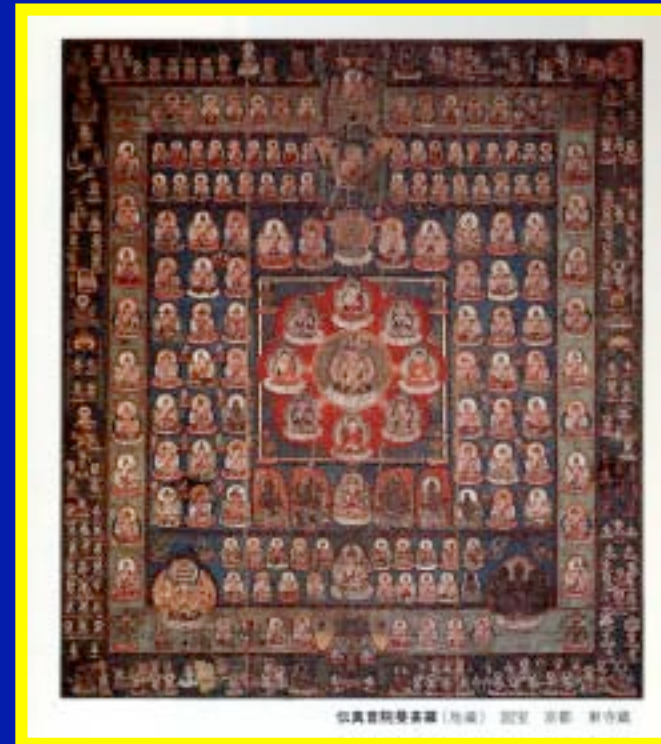
**Mandala as a symbol of
“Opposites are Complementary”**



**Harald
Atmanspacher**



Consciousness process

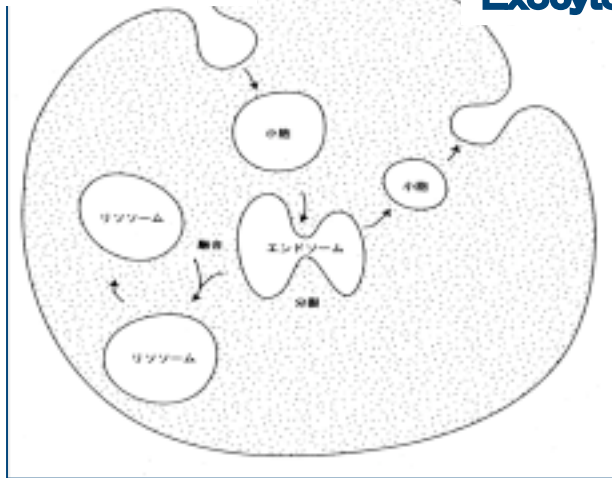


Unconsciousness structure

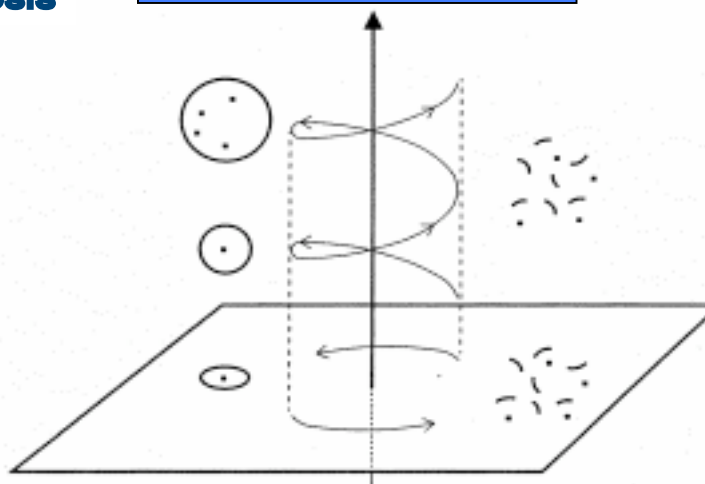
Murase (2001)

Endocytosis

Exocytosis

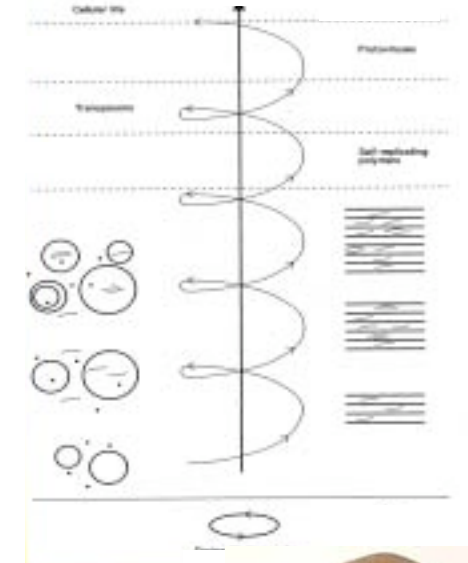


Evolution



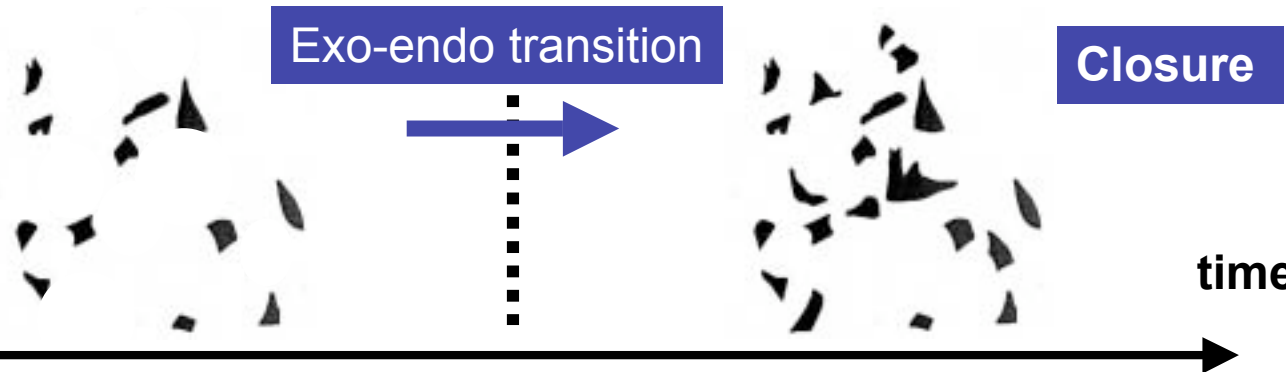
End-exo circulation

Murase (2000)



Ludwik Leibler

Emergence of order is associated with an exo-endo transition



Closure

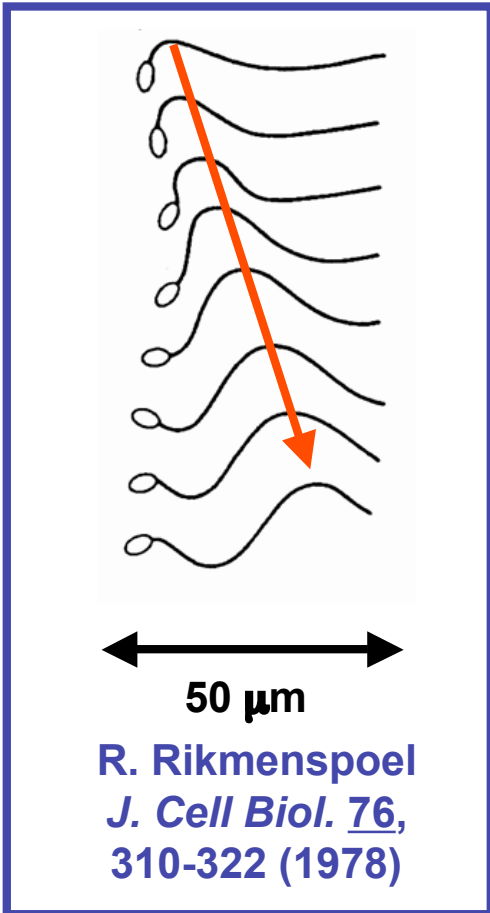
R. L. Solso 'Cognition and the visual arts' MIT 1994

Contents

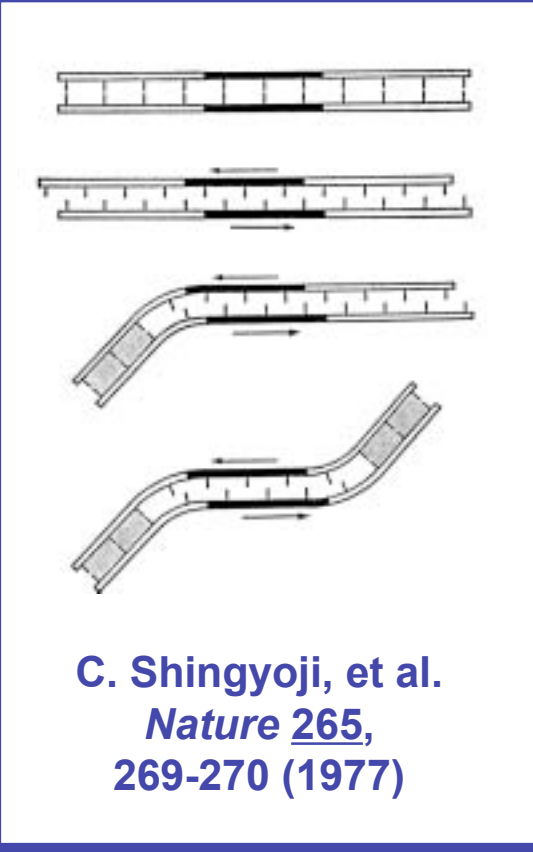
- **Overview: Oppositions, conflicts and contradictions as driving forces of creativity**
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- **Creativity as the emergence of hidden dynamics with a double-edged sword**



C. J. Brokaw
J. Cell Biol. 114, 6 (1991)

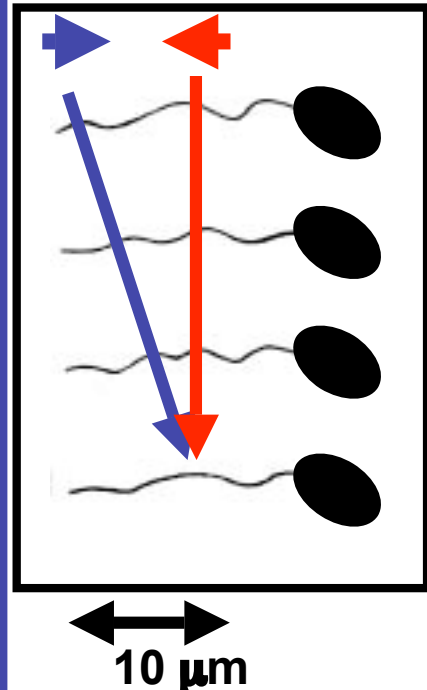


Sliding filament model

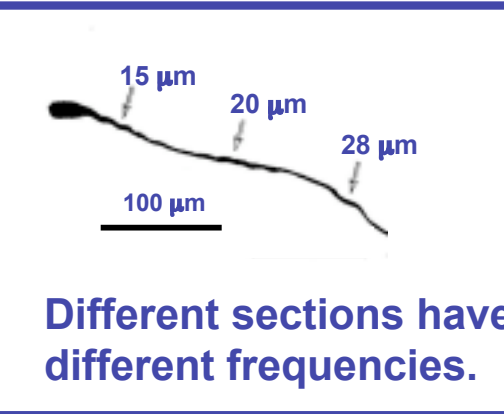


The motion of *Strigomonas Oncopelti*

From M. E. J. Holwill
J. Exp. Biol. 42, 125-137 (1965)



Soliton-like behavior



The motion of a 800 μm-long cricket sperm flagellum
From R. Rikmenspoel
Biophys. J. 23, 177-206 (1978)

Moment-balance equation

$$M_S + M_E + M_V = 0$$

Flagellar equation

$$\frac{\partial^2 S}{\partial s^2} + E_B \frac{\partial^4 \sigma}{\partial s^4} + C_N \frac{\partial \sigma}{\partial t} = 0$$

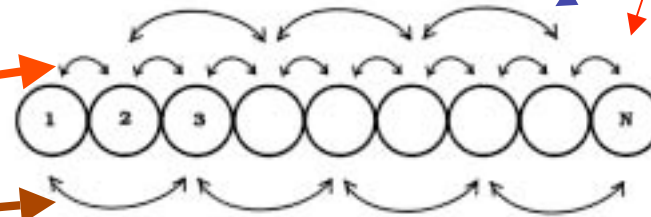
$S = S(n, \sigma)$
shear force

n : fraction of active molecule

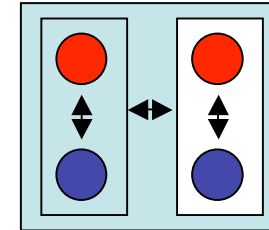
σ : shear displacement

E_B : bending resistance

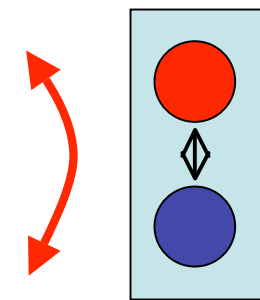
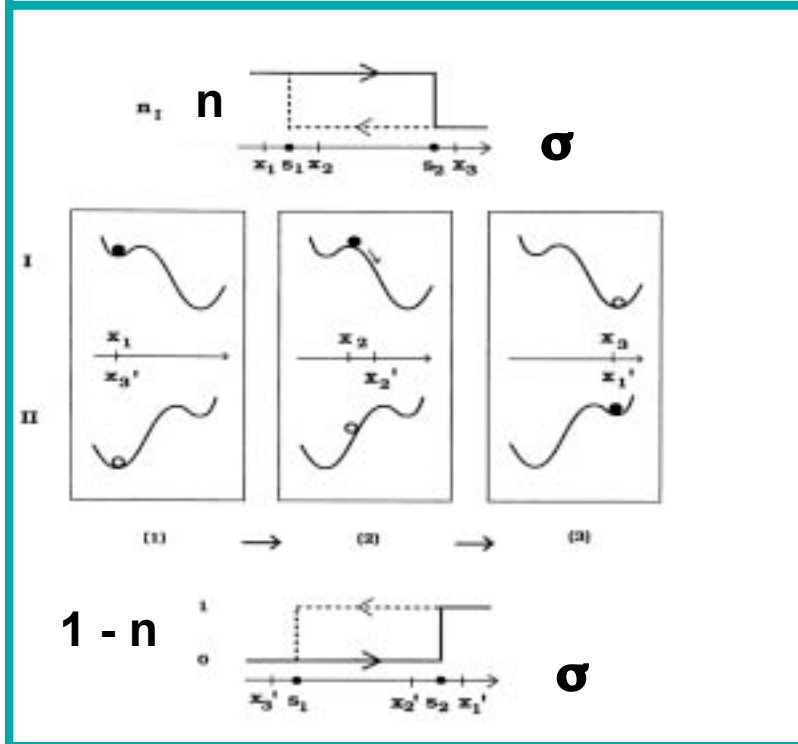
C_N : viscous resistance



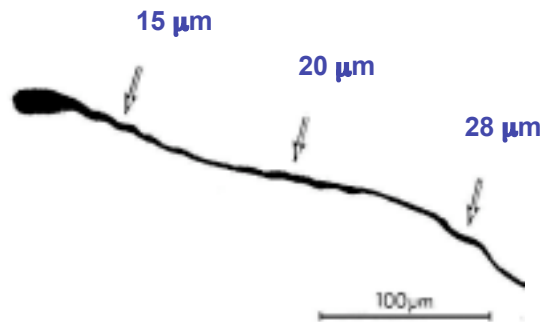
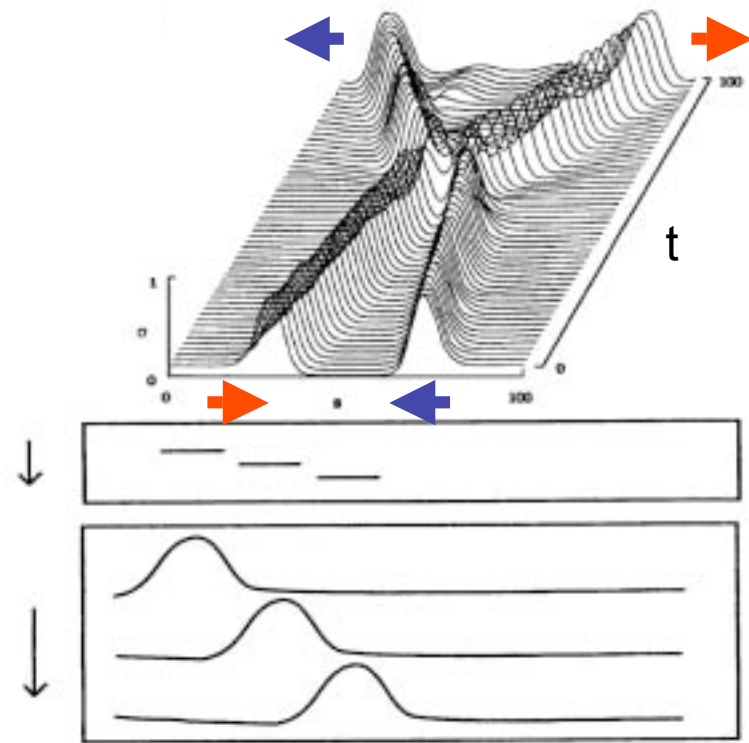
Inter-subsystem conflicts



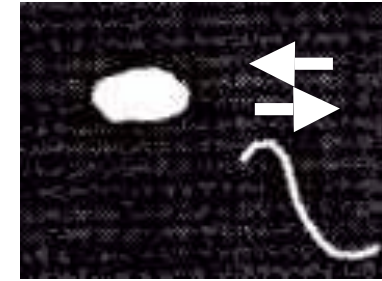
Bi-stability and hysteresis switch



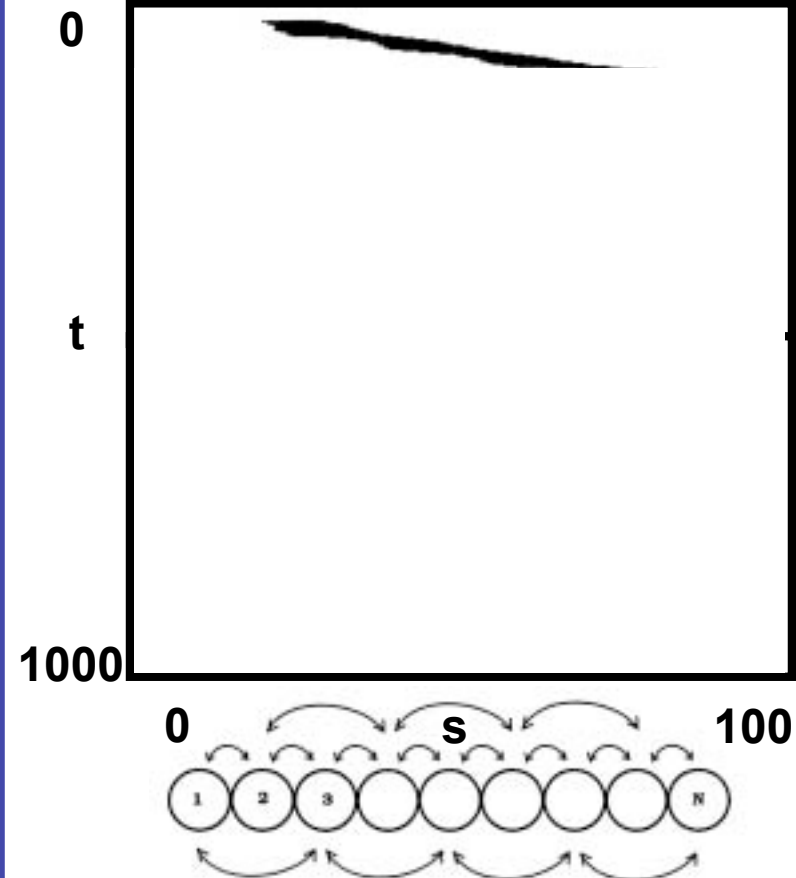
Intra-subsystem conflicts



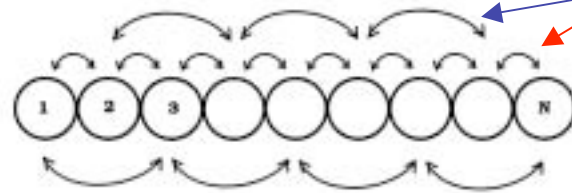
S. F. Goldstein
et al. *J. Exp. Biol.*
53, 401 – 409 (1970)



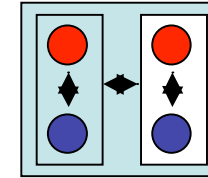
$$S(\sigma)_{ss} + E_B \sigma_{ssss} + C_N \sigma_t = 0$$



Hybrid dynamical systems with $S=0$ and $S=0$ (on) (off)



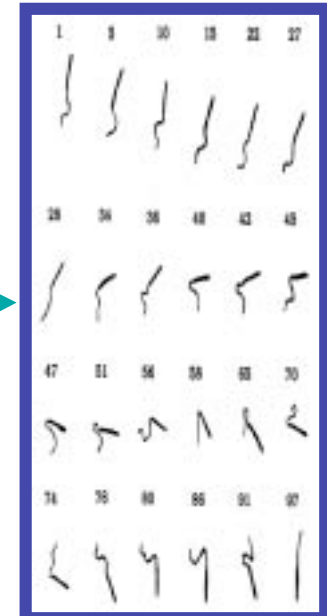
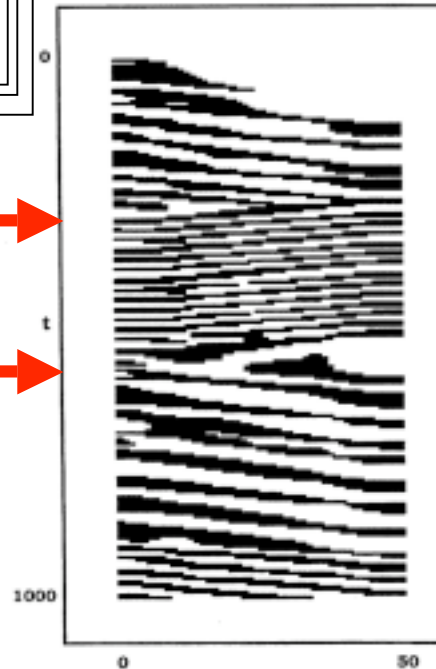
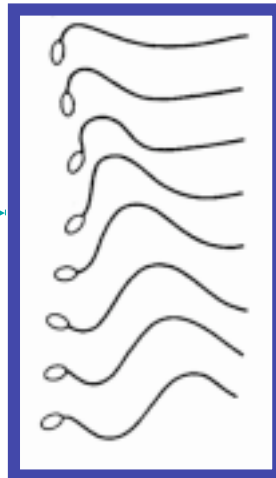
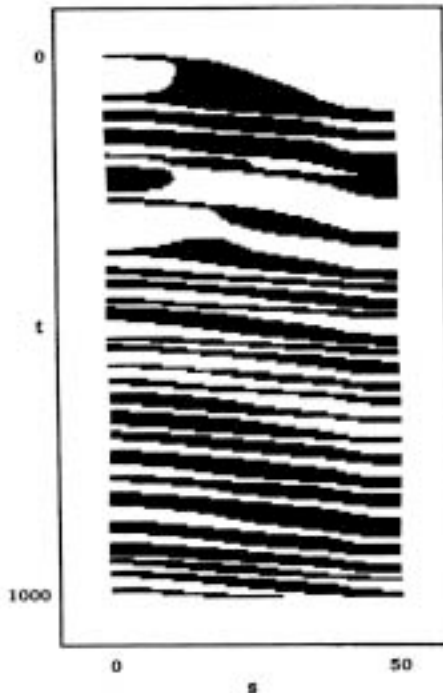
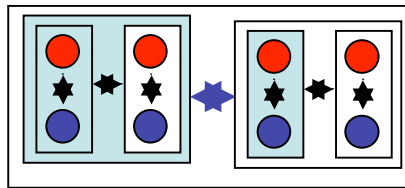
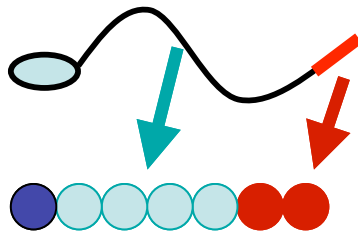
Inter-subsystem conflicts



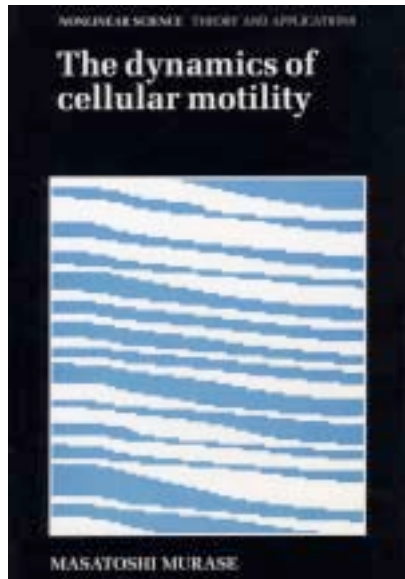
Further conflicts regulate intrinsic instability.

Trans-subsystem conflicts

$$S(\sigma)_{ss} + E_B \sigma_{ssss} + C_N \sigma_t = 0$$

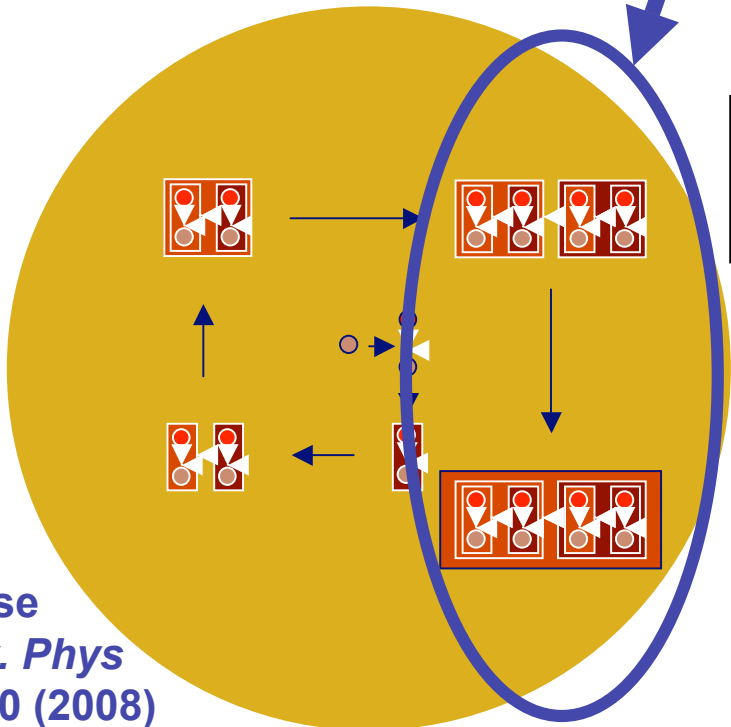
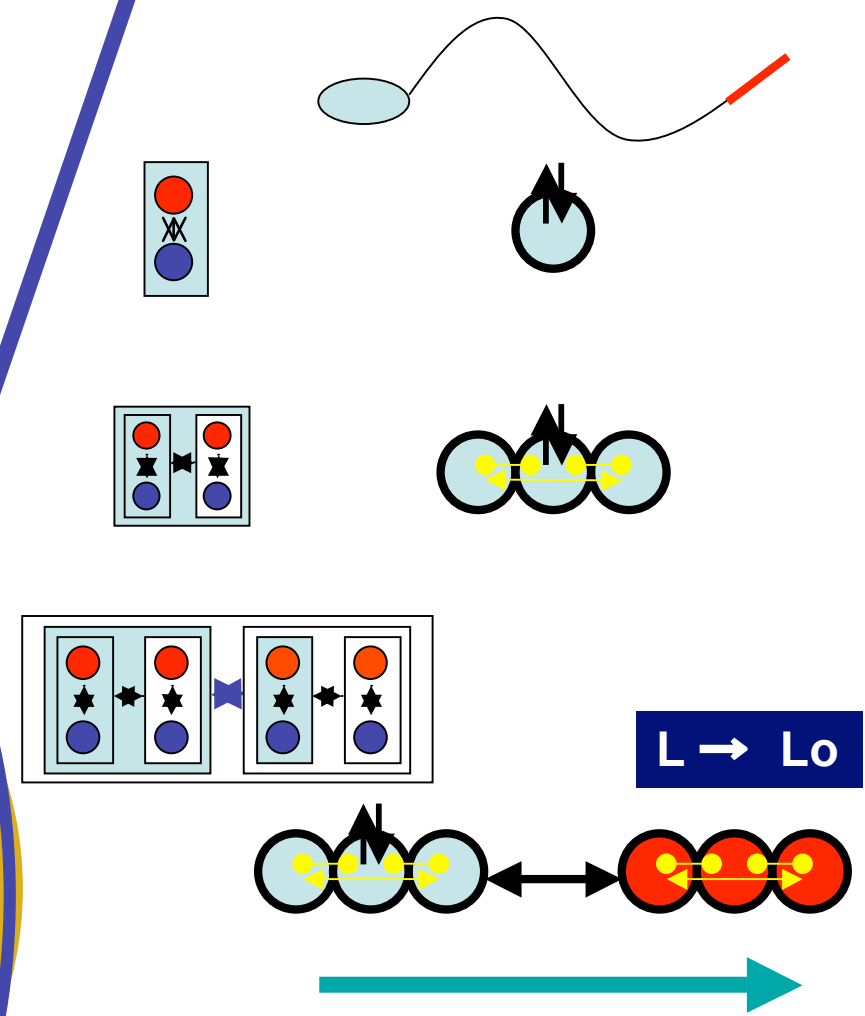
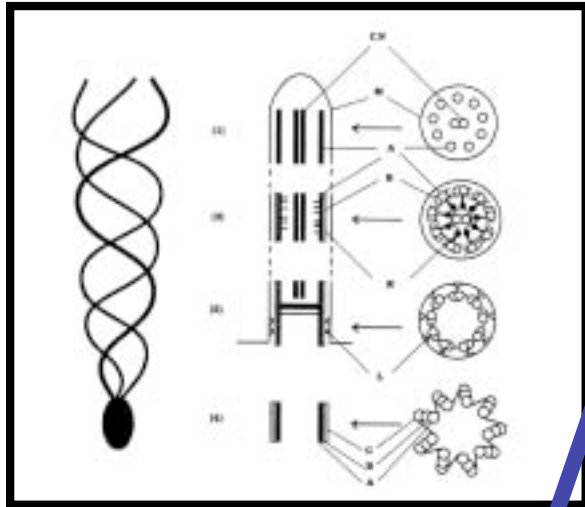


Two waves propagating in the opposite directions do not annihilate on collision.



M. Murase
Wiley (1992)

Emergence of order as an exo-endo transition

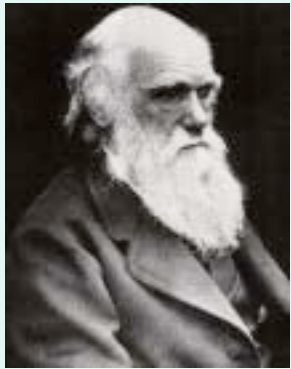


M. Murase
Prog. Theor. Phys
Suppl.173, 1-10 (2008)

Supra-structural polarity can control spatiotemporal chaos.

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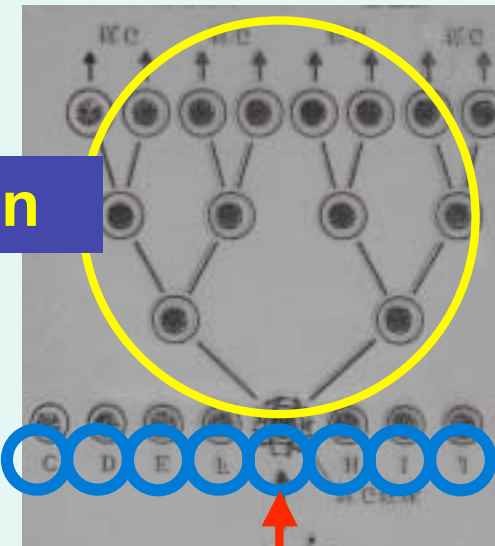
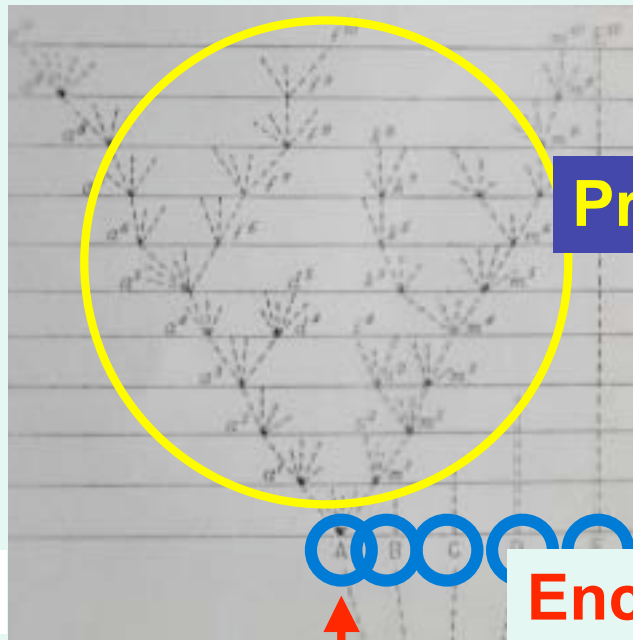
Charles Darwin
(1809 – 1882)

Rediscovery of Darwin's natural selection in different contexts



F. M. Burnet
Nobel Prize winner

Oppositions of 'life' and 'death'



Proliferation

Encounter with environment

Preexisting variability

Ecosystem

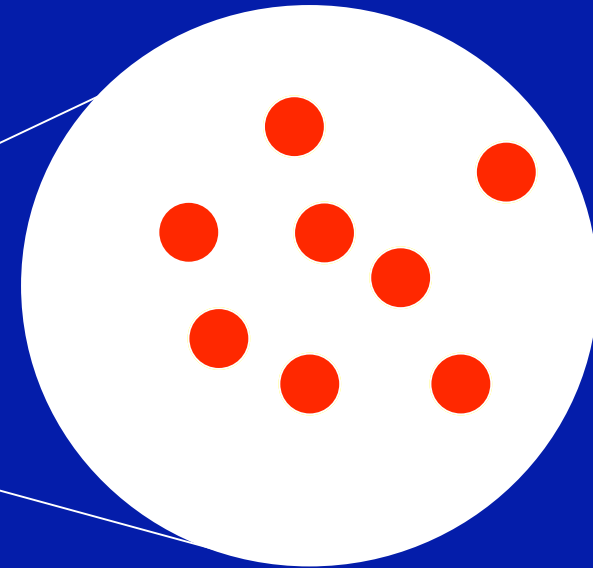
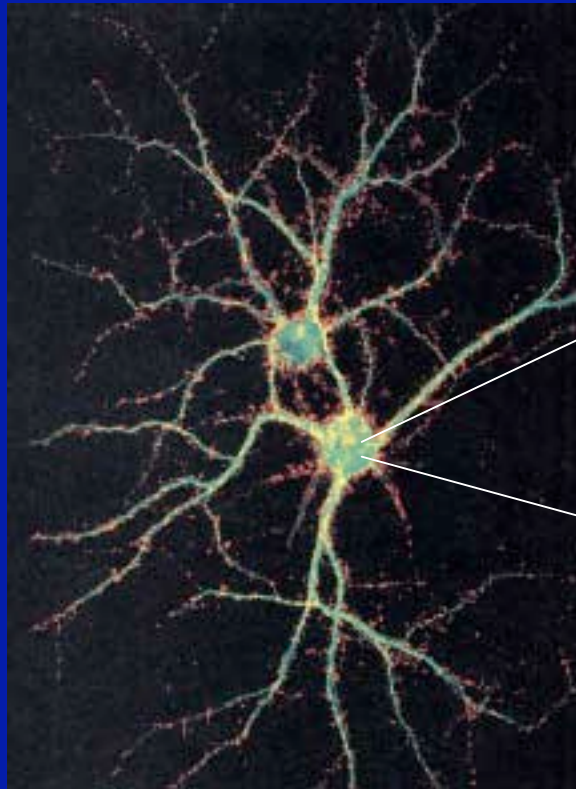
Immune system

Cancer as cellular evolution

1976

Intra-cellular Selection Theory

Masatoshi Murase: *Prog. Theor. Phys.* **95**, 1-36 (1996)



Aging as intra-individual evolution

Preexisting polymorphism

Encounter with intra-cellular environment

Accumulation → Prion Disease **Nobel Prize awarded (1997)**

Towards the Frontiers in Theoretical Physics

1996

INVITED PAPERS

Progress of Theoretical Physics, Vol. 95, No. 1, January 1996

Alzheimer's Disease as Subcellular 'Cancer'

The Scale-Invariant Principles Underlying the Mechanisms of Aging

Masatoshi MURASE

Yokawa Institute for Theoretical Physics
Kyoto University, Kyoto 606-01

(Received October 18, 1995)

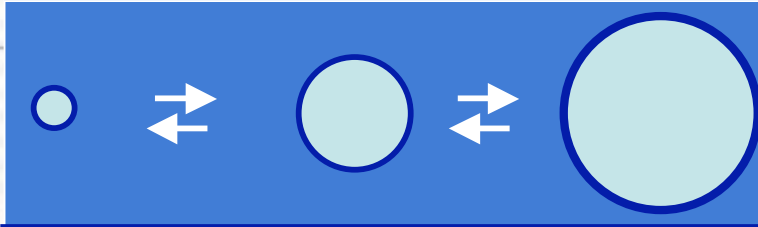
Alzheimer's disease (AD) is characterized by the slow onset of neurodegeneration leading to dementia in many elderly people.¹ The pathological hallmarks of AD are the extracellular amyloid deposition in the senile plaques,² the β -amyloid deposition in cerebral blood vessel walls especially in hereditary cerebral hemorrhage with amyloidosis of the Dutch type (HCHWA-D),³ the intracellular neurofibrillary tangle formation composed of paired helical filaments (PHF), the principal component of which is a hyperphosphorylated form of the microtubule-binding protein, tau,⁴ and neurological dysfunction and neuronal cell death in limited regions and pathways of the central nervous system.⁵ Note that β -amyloid is a truncated form of a cell surface integral membrane glycoprotein: amyloid precursor protein (APP).⁶ Despite these hallmarks, the pathogenesis of AD has been obscurely understood.

In the course of prion (protein) propagation, prions (protein) reproduce themselves. Surprisingly, prions reproduce themselves in a manner that follows the general principles of self-organization at different levels and scales.

Several paradigm shifts are, however, required to realize selection can be extensible to non-DNA molecules which self-reproduction. One of them is, from the traditional gene-molecules are the ultimate unit of heritable variations and natural selection to the epigenetic (non-genetic) inheritance view^{7,8,9} that any heritable variations and molecular selection to accumulate in certain biospherical environment. Because they are all enriched with a β -sheet content, ready to readily interact with one another, different denatured proteins like β -amyloid, PrP^{Sc} and prions can individually undergo self-templating or self-aggregating processes out of gene-control.^{10,11} Other paradigm shifts requisite for a breakthrough in the etiology of neurodegenerative disorders will be discussed.

As it is based on the scale-invariant principles, the present theory also predicts plausible mechanisms underlying quite different classes of disorders such as amyotrophic lateral sclerosis (ALS), Alzheimer's disease, senile cataract and many other symptoms of aging. The present theory, thus, provides the consistent and comprehensive account of the origin of aging by means of natural selection and self-organization.

Towards the Frontiers of Theoretical Physics



The scale-invariant principle

Seemingly "opposite" phenomena – aging and evolution – are very likely different aspects of the same biological process.

Complementarity principle

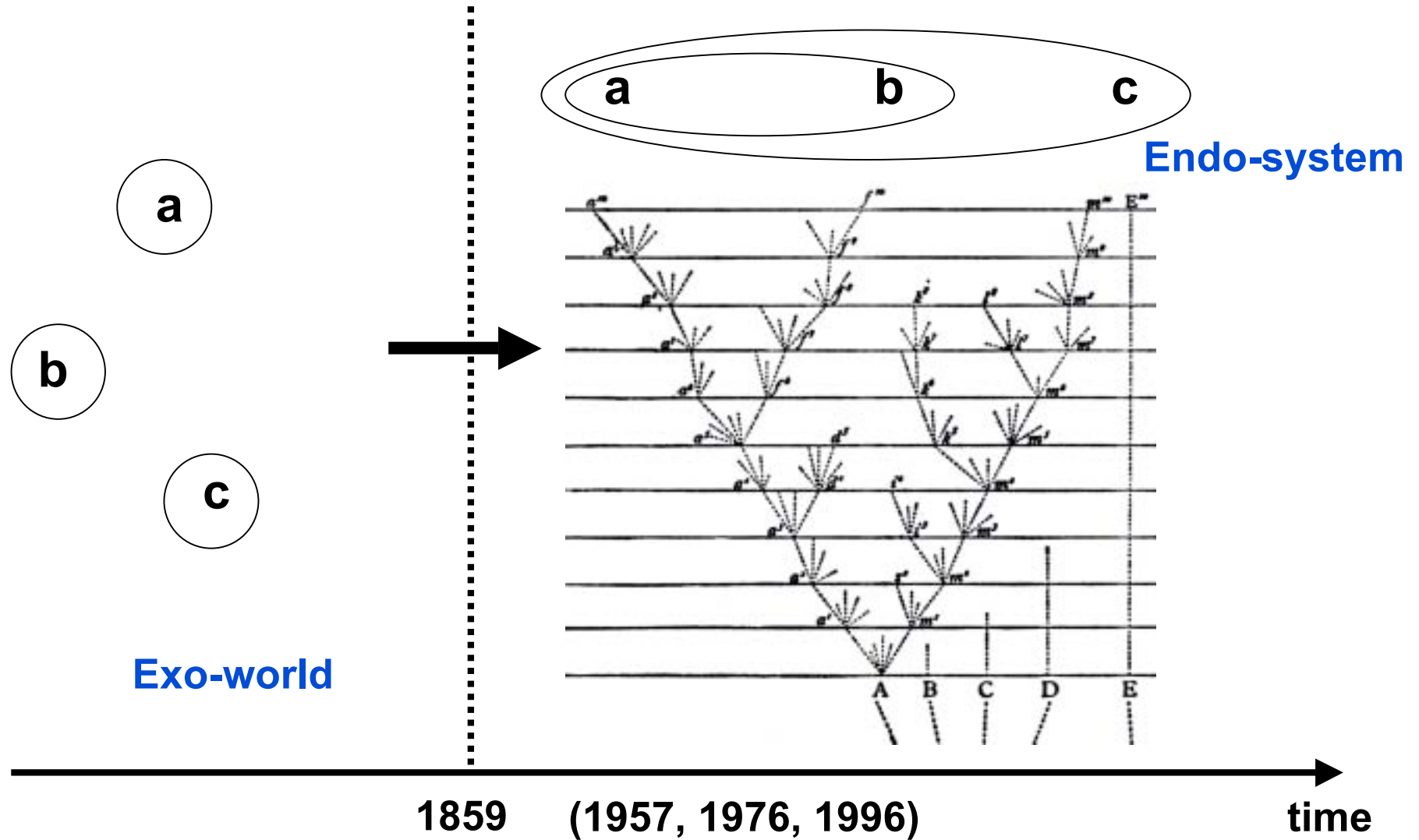
What is life? This long-standing problem has attracted many physicists especially in the last few decades. Nevertheless, this complete knowledge because we lack a we have been too res identifying the ending the relations ctionism, however, ing things, because life itself, we must within the organ- cent states can be processes as well ermal environment

remains constant or not, the organism is continually subject to the intrinsic variability at any level and scale. It therefore must be emphasized that transients and variations are essential and advantageous to life, because changes in the environment are important for successful adaptation. In this sense, we should not always expect that any biological system will show the same responses to the same stimuli. This situation apparently isolates the reproducibility of the same events under the same

we lack complete knowledge of compo- or individuals— at different levels of we integrating the fragments of knowl- become hierarchically organized during both evolution¹² and development,¹³ we need the global view to understand the pathogenesis of AD and many other complex biological phenomena. Lessons learned from past breakthroughs in biology and medicine can give insights into better understanding of how we attack the long-standing mystery of AD.

Without complete knowledge of molecules or cells, we have indeed made successive breakthroughs in immunology and oncology in the context of natural selection since Charles Darwin's book¹⁴ of "The Origin of Species by Means of Natural

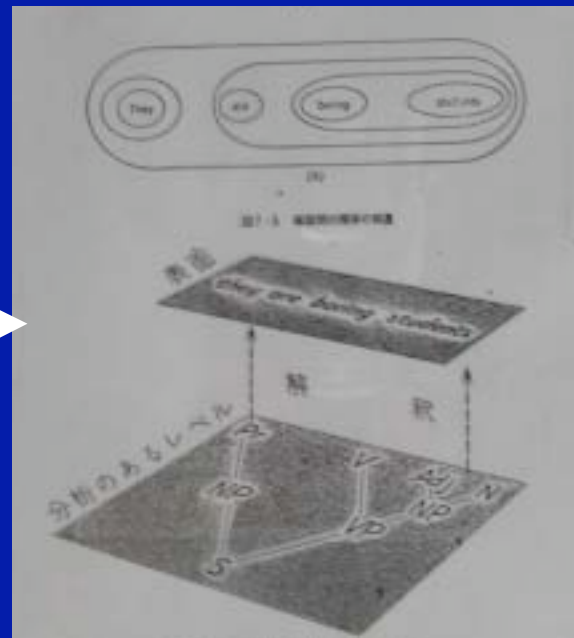
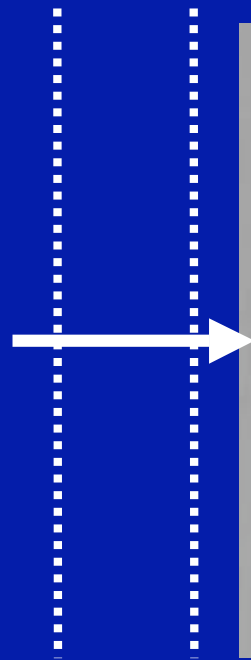
Rediscovery of Darwin's natural selection



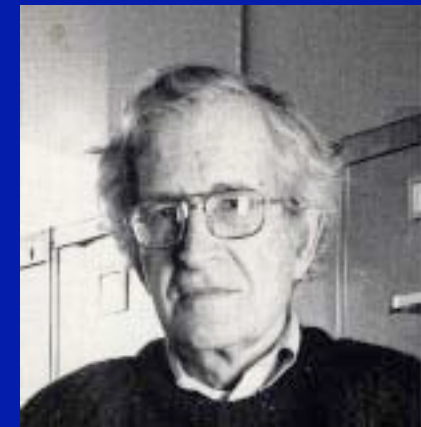
An exo-endo transition

Acquisition of natural language

they
are
boring
students



Generative grammar



Norm Chomsky
Shigeru Miyagawa
Adrian David Cheok

2 ~ 12- year-old

time

Exo-world

Endo-system

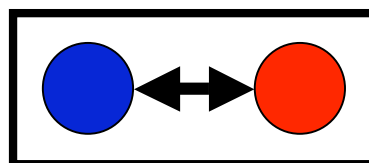
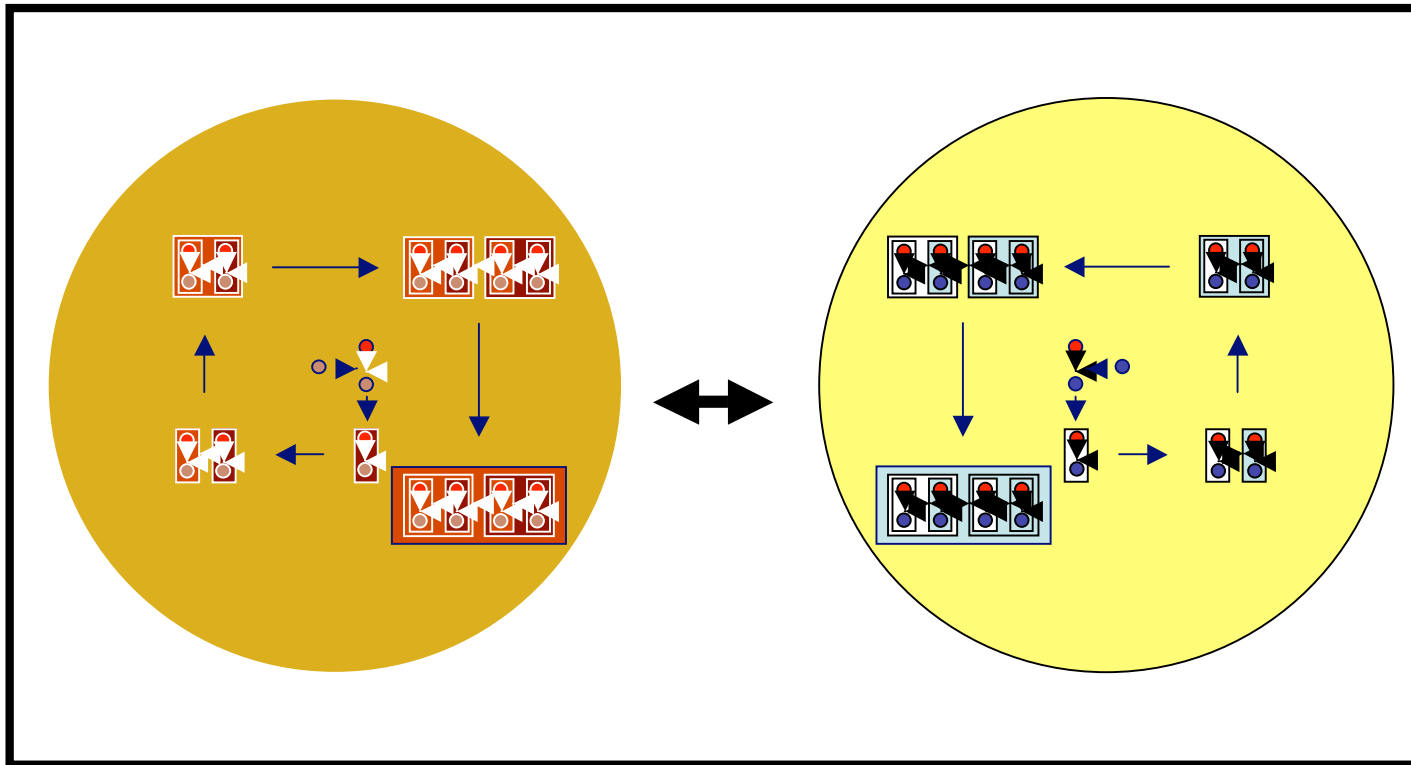
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- **Creativity as the emergence of hidden dynamics with a double-edged sword**



Absolutely contradictory self-identity

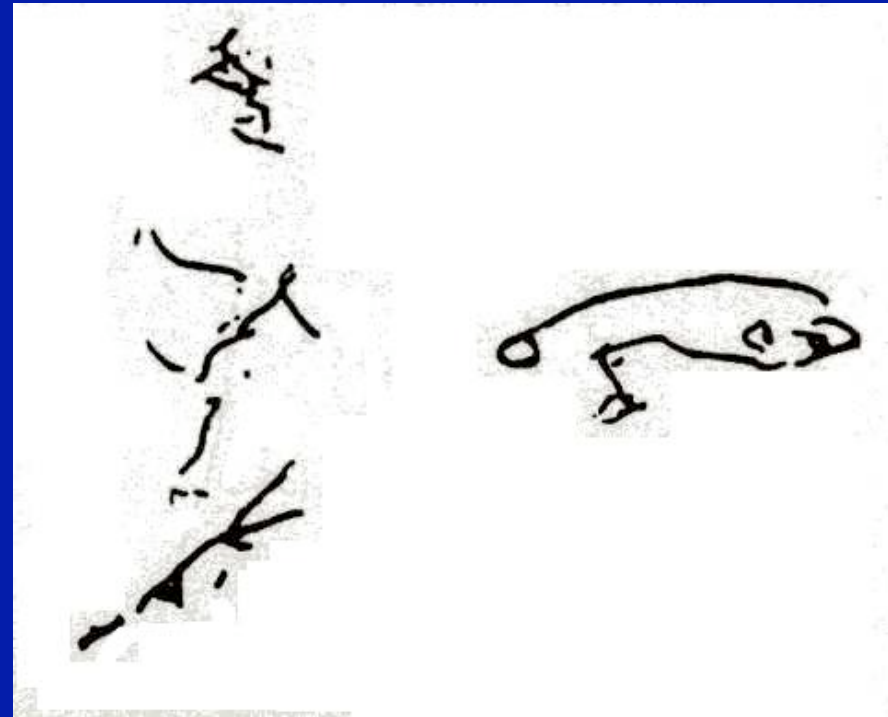
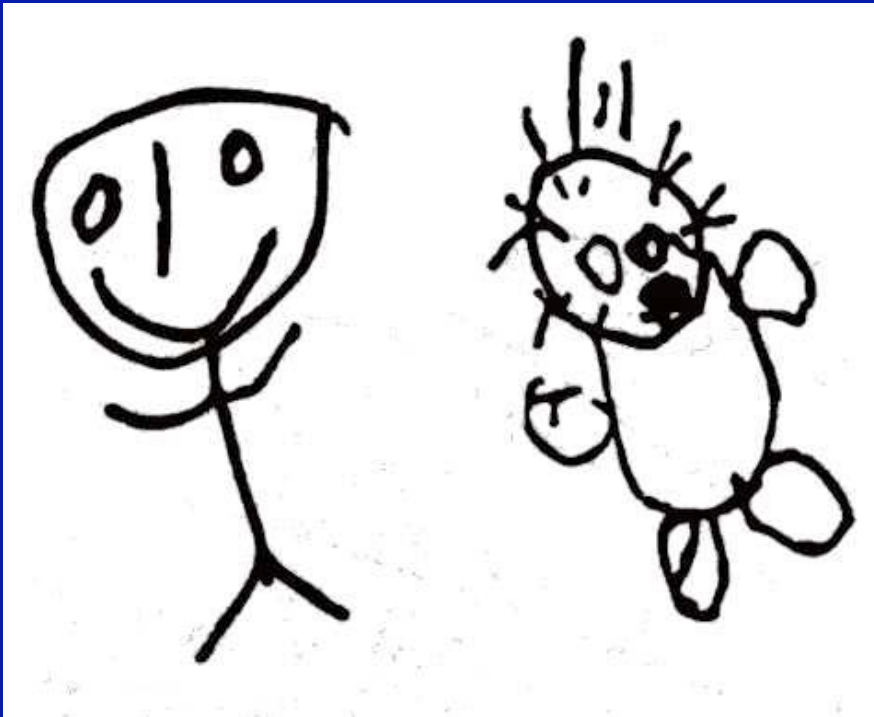
Kitaro Nishida
1870-1945



Another Inconvenient Truth

Unpolluted Environment

Polluted Environment



54-month

55-month

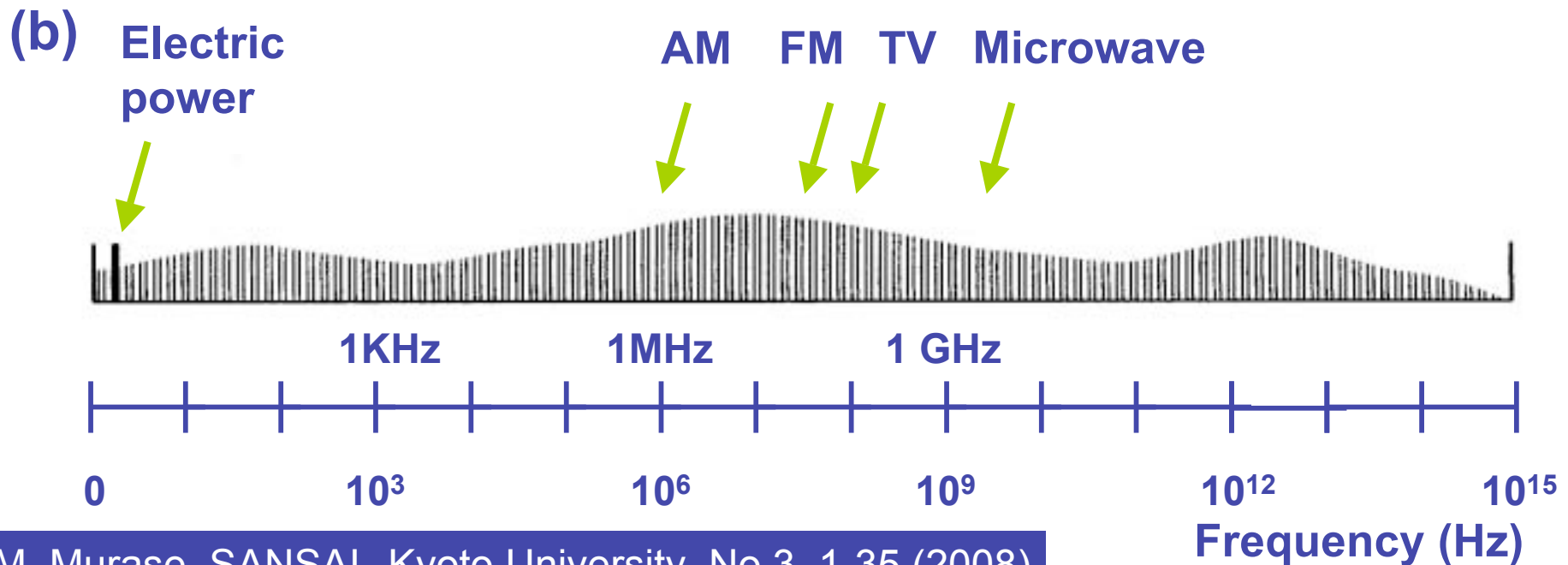
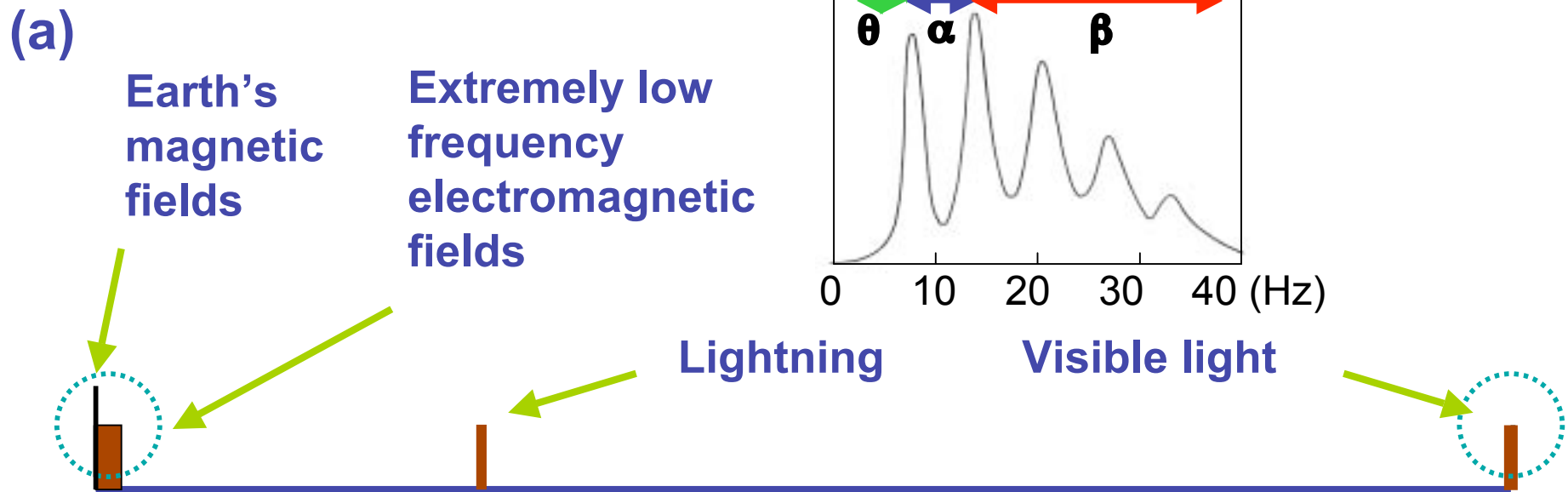
54-month

53-month

E. A. Guillette et al.

Environmental Health Perspectives **106**, 347 (1998)

Spectrums for earth's natural and artificial electromagnetic fields



Hypersensitivity

William J. Rea



**Director
Environmental Health
Center, Dallas, Texas**

***Chemical Sensitivity*
Vol.1 (1992), Vol.2 (1994)
Vol.3 (1996), Vol.4 (1997)
CRC Press, Inc.**

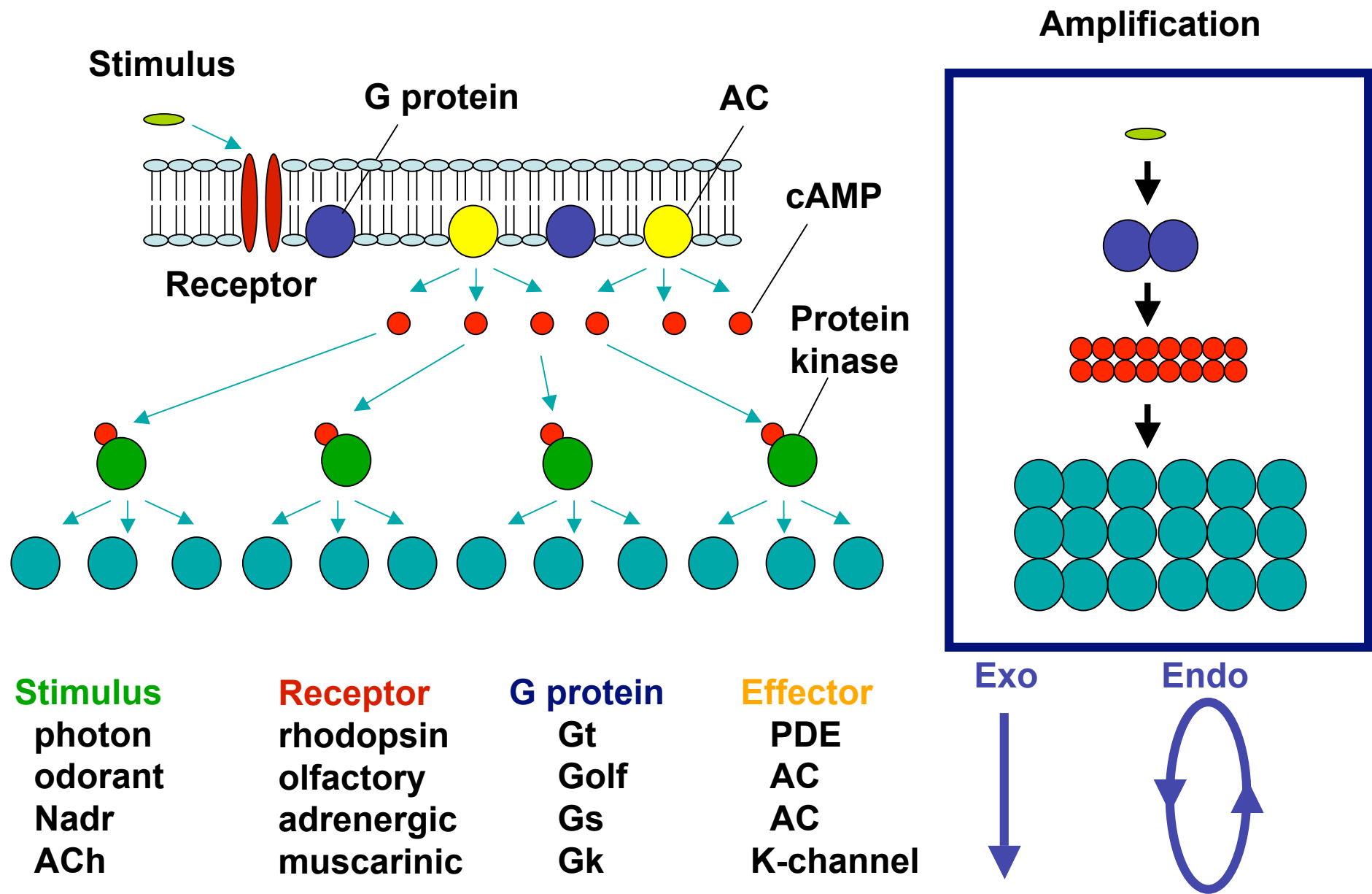
V. Segabeck



**A past engineer of the
mobile phone company**

From T. Okubo (2005)

A common signal transduction pathway among diverse cell types



Stimulus
 photon
 odorant
 Nadr
 ACh

Receptor
 rhodopsin
 olfactory
 adrenergic
 muscarinic

G protein
 Gt
 Golf
 Gs
 Gk

Effector
 PDE
 AC
 AC
 K-channel

Exo
 ↓

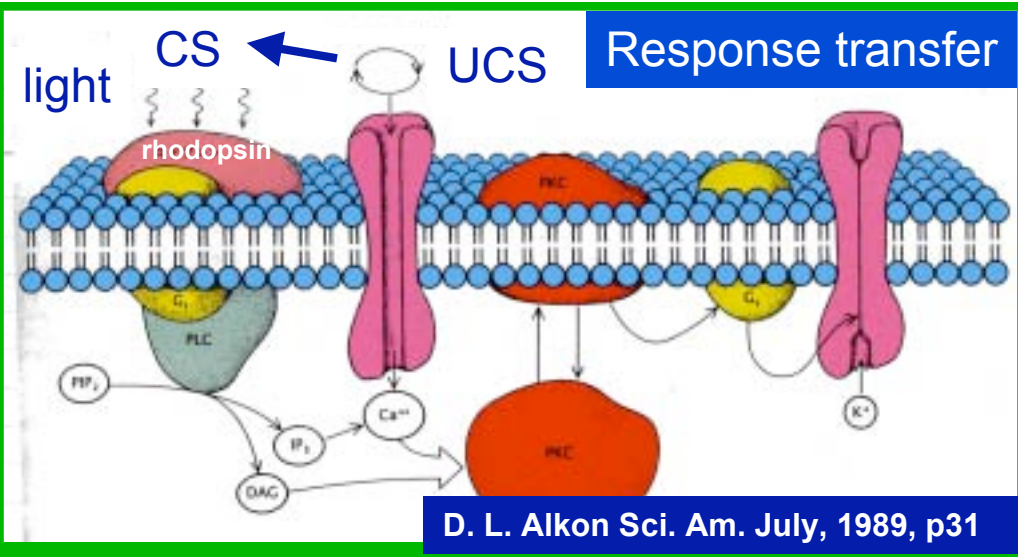
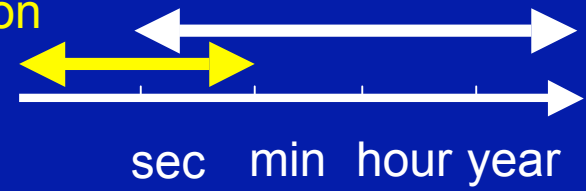
Endo
 ↻

Memory as an exo-endo transition

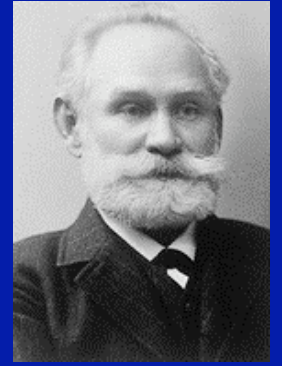
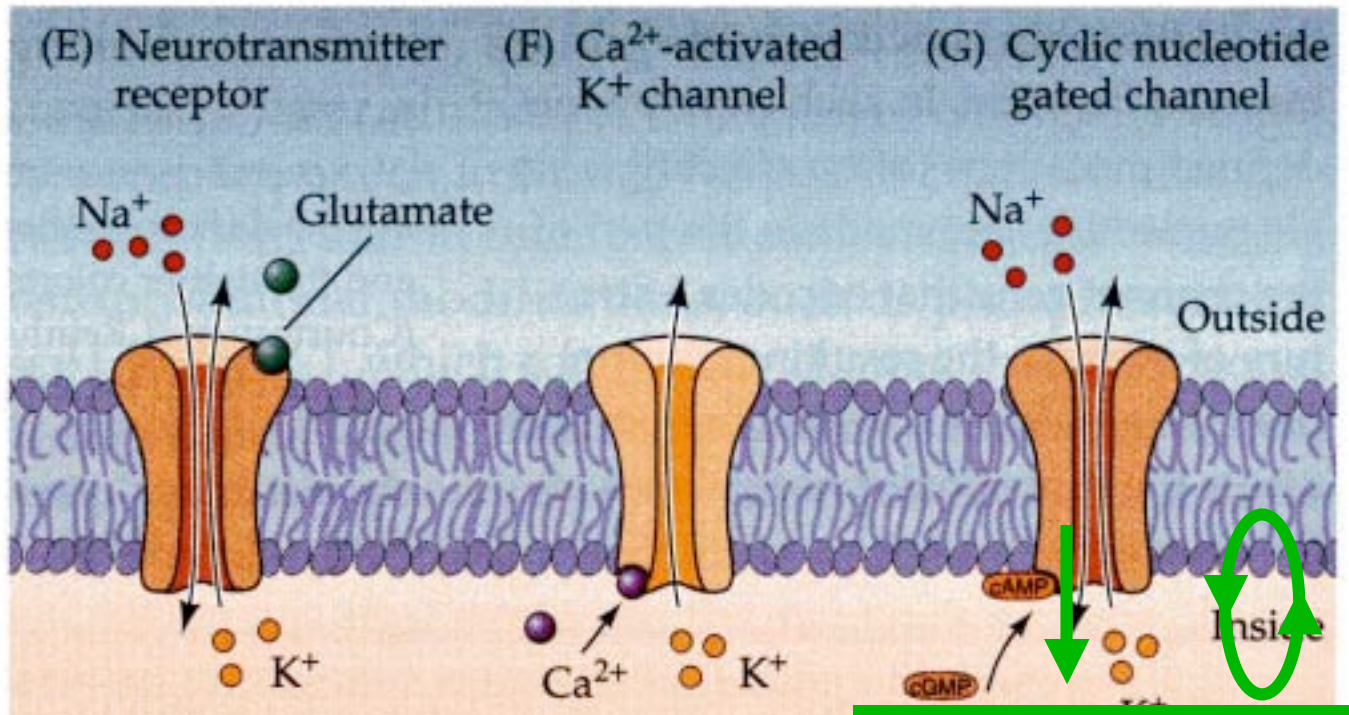
Pavlovian conditioning

Associative memory formation

Acute response with nongenomic action Chronic response with genomic action



D. Purves, et al. (eds.) Neuroscience 3rd ed. Sinauer Associates p 76, p 180

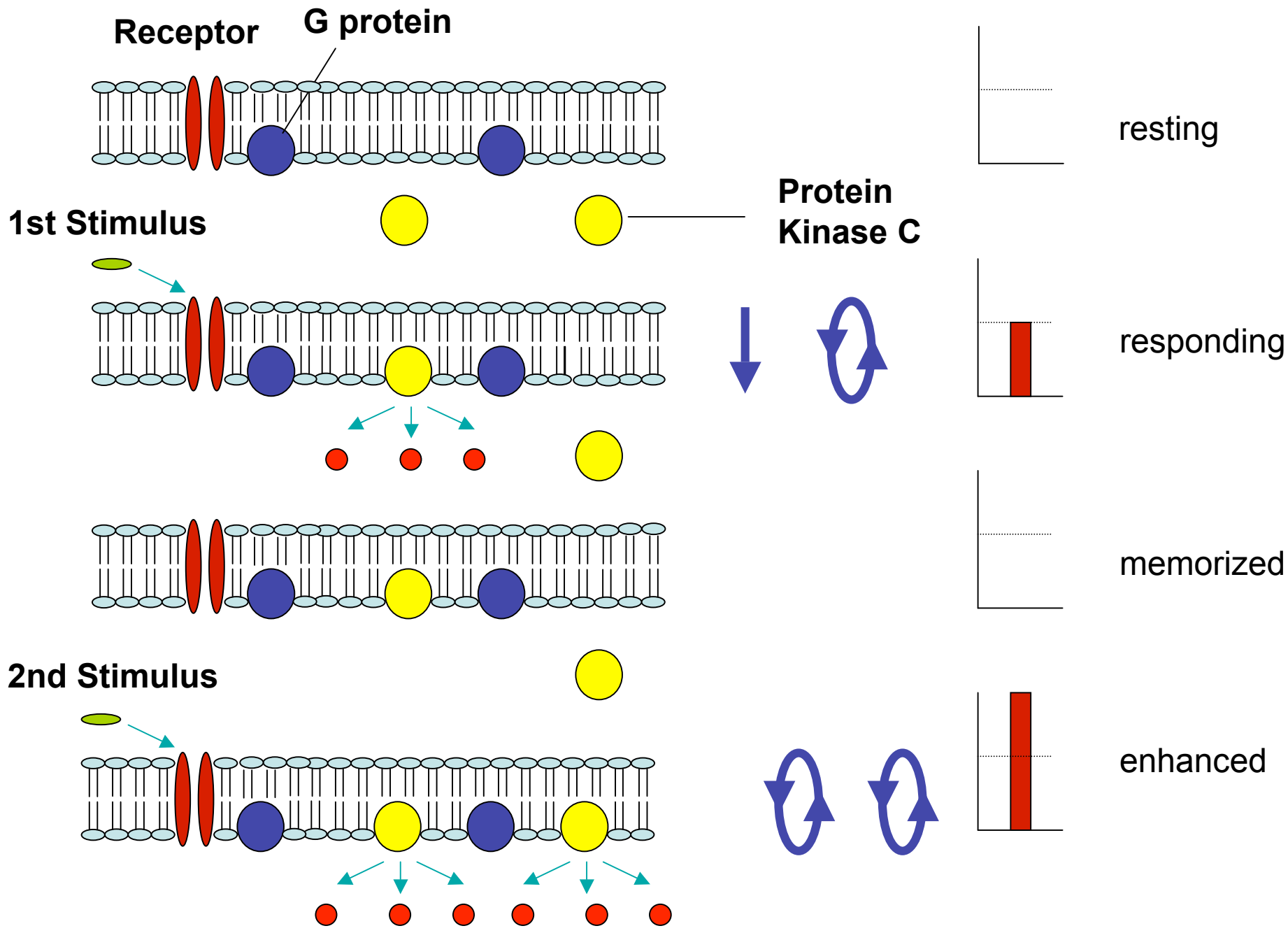


Ivan Pavlov
1849 - 1936

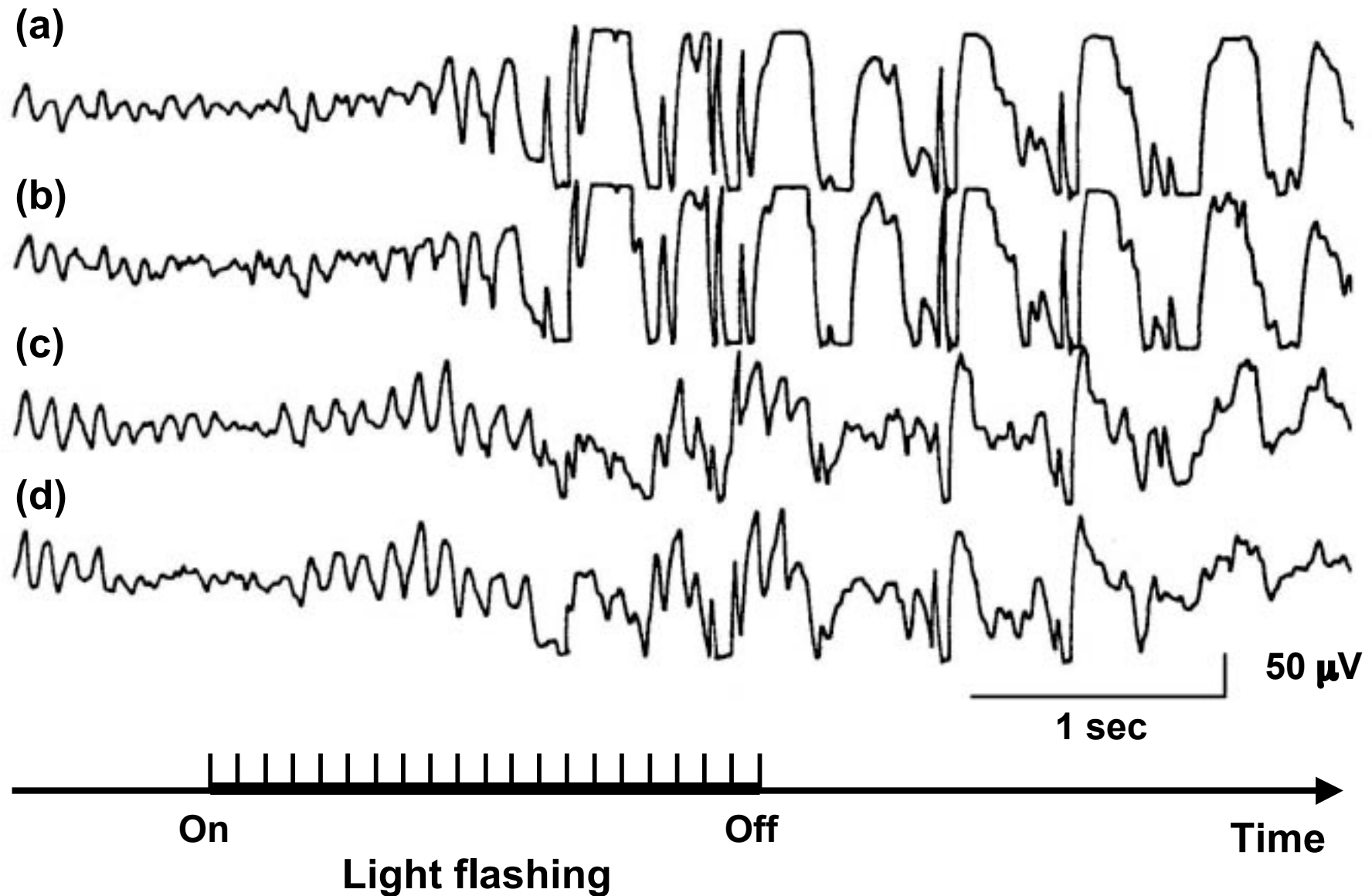
Reconstitution of membrane depends on temporal relation of the stimuli, but not on the stimuli

Memory as an exo-endo transition lives.

Cellular Memory due to repetitive stimuli



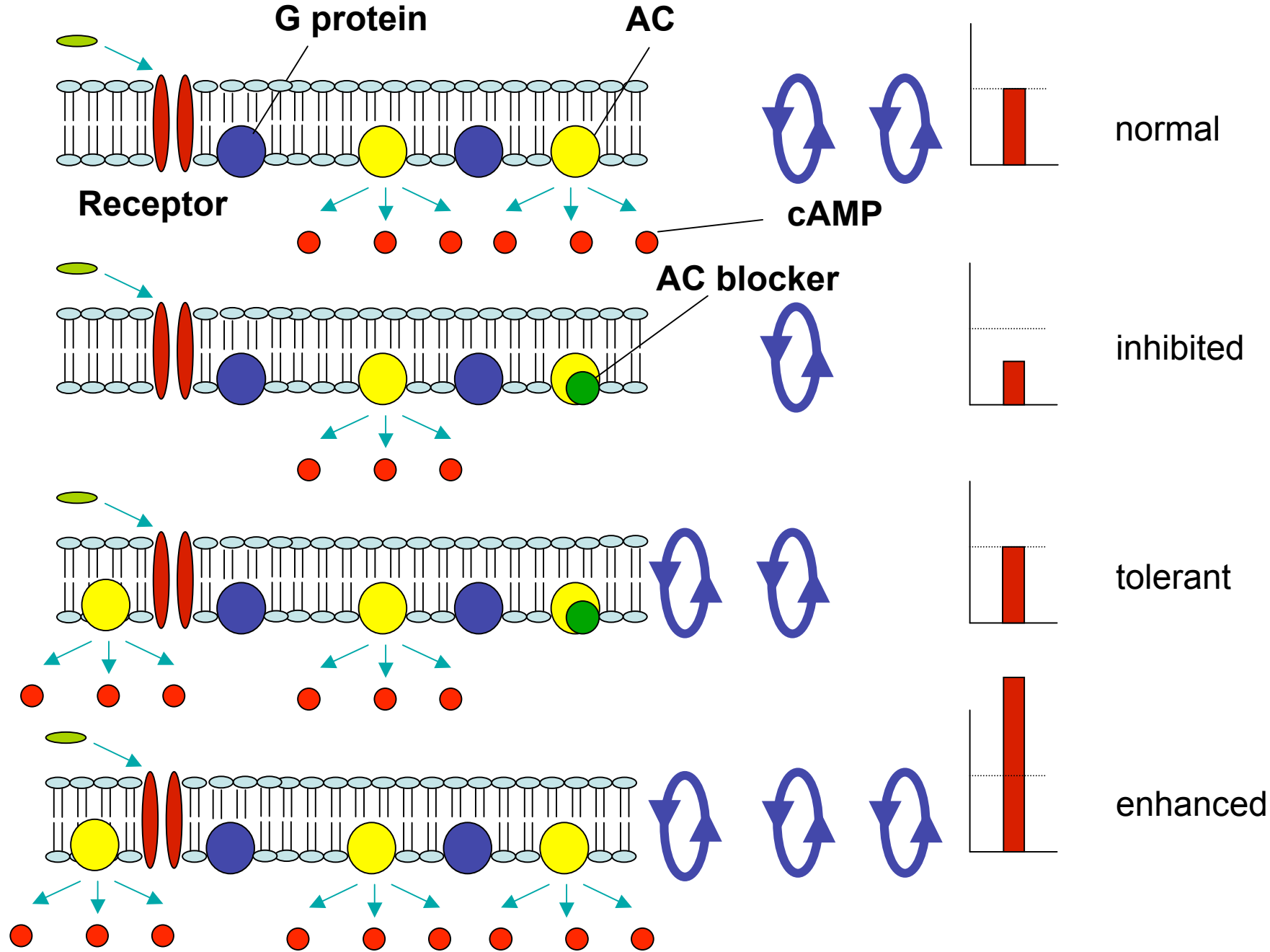
A seizure of photosensitive epilepsy



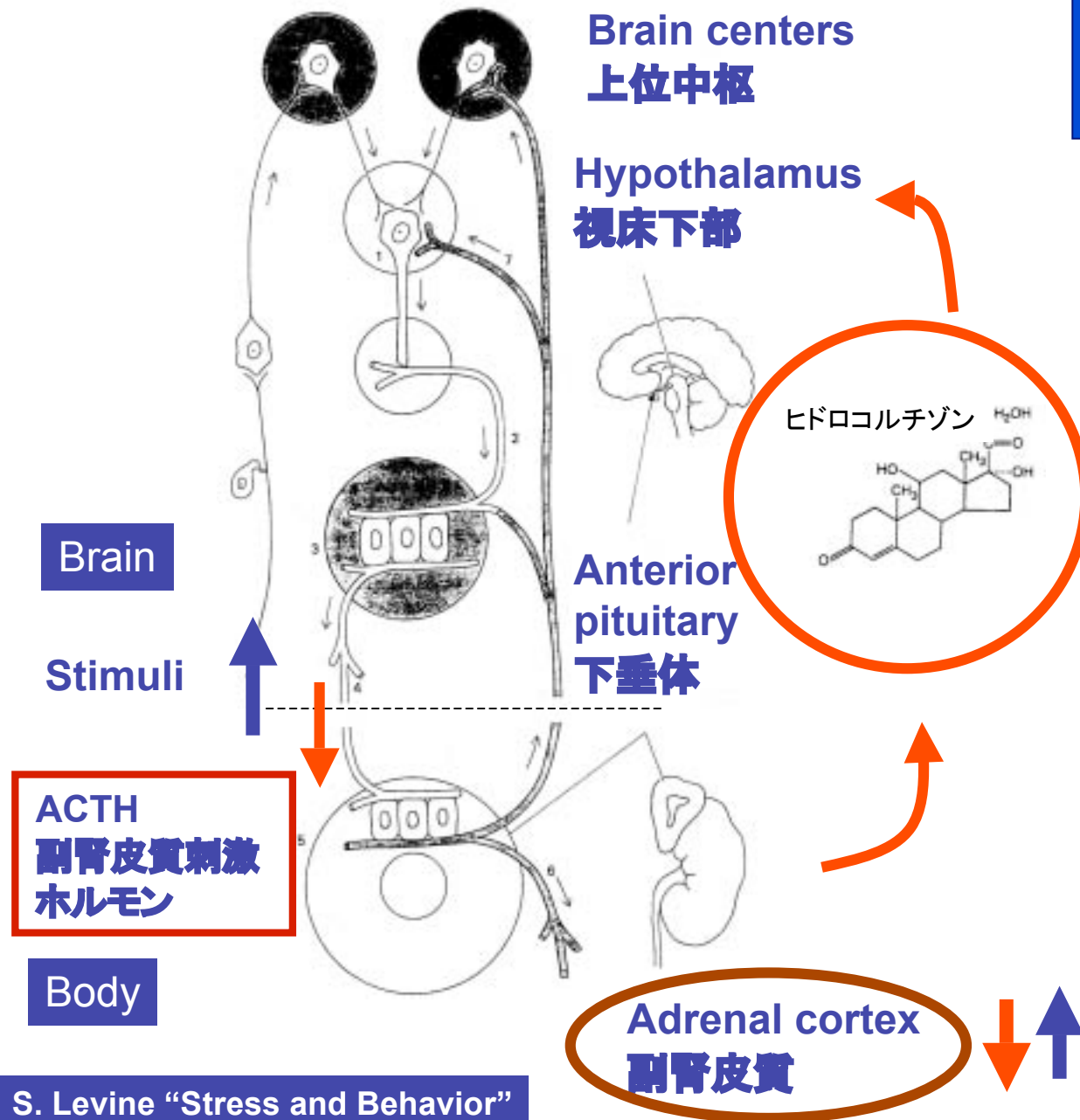
From M. Konagaya (1996), cf. M. Murase, SANSAI Kyoto University, No.3, 1-35 (2008)

Cellular Tolerance due to sustained stimuli

Stimulus

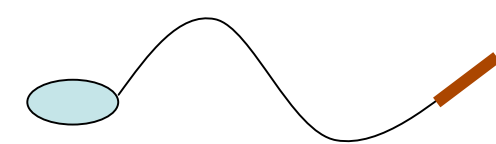


The emergence of disorder as an endo-exo transition



Cushing's syndrome
Excessive secretion from
the adrenal cortex

Dulling of the sense
鈍感化



Enhanced sensing of signals
鋭敏化

Poorly functioning of the
adrenal cortex
過敏症候群：
副腎摘出や機能低下
味覚、嗅覚、聴覚、体性感覚
の鋭敏化と情報統合能力の
低下（話言葉の理解困難、音
調や音の大きさの変化が把
握困難）

S. Levine "Stress and Behavior"
Sci. Am. 26-31, 1971

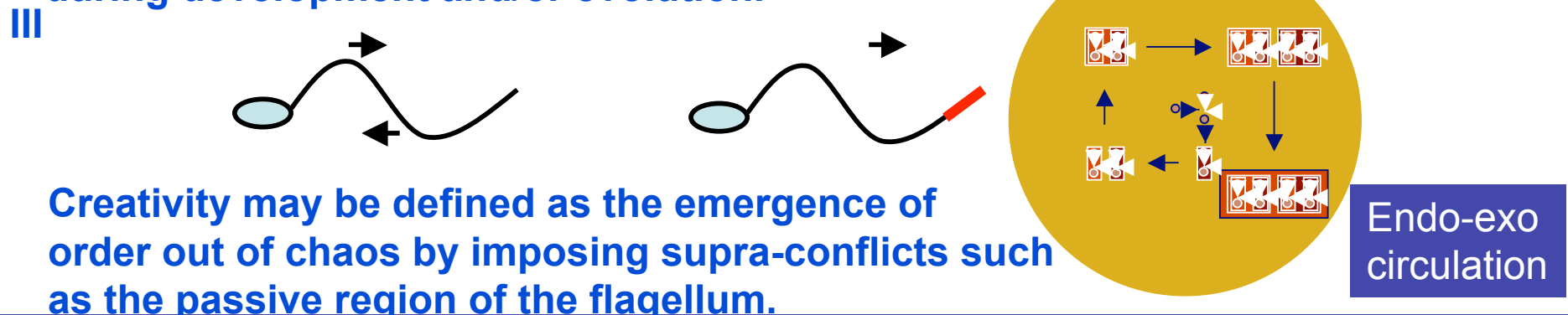
Creativity as the exo-endo transition



Creativity such as memory formation or hypersensitivity may be defined as the emergence of hidden dynamics through the interplay between external stimuli and internal properties.



Creativity is responsible for the acquisition of natural language as well as number concept, and even breakthroughs in studies during development and/or evolution.



Creativity may be defined as the emergence of order out of chaos by imposing supra-conflicts such as the passive region of the flagellum.

Thank you !



**An Interdisciplinary Class on “What is Creativity?”
2008. 4.15.**

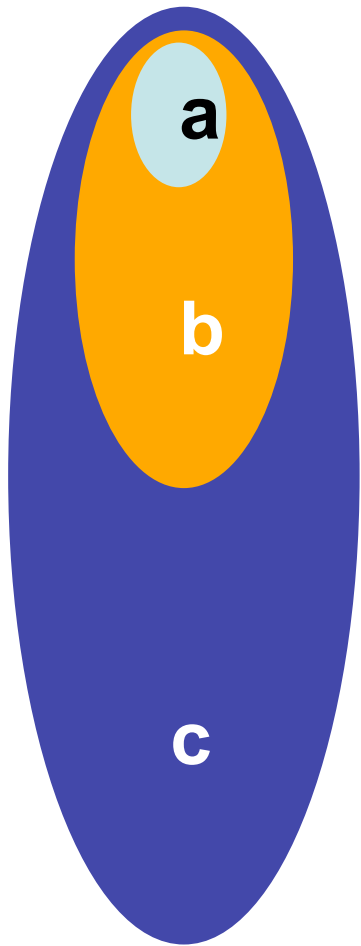


**An interdisciplinary class
on “What is life?”
June 19, 2007**

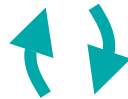
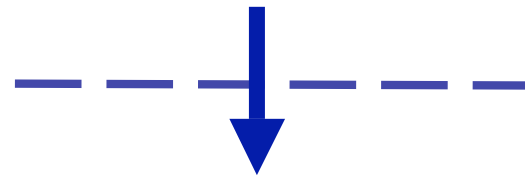
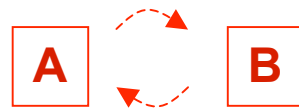


**An interdisciplinary class
on “What is creativity?”
May 20, 2008**

Hidden dynamics



$$1 = \infty$$

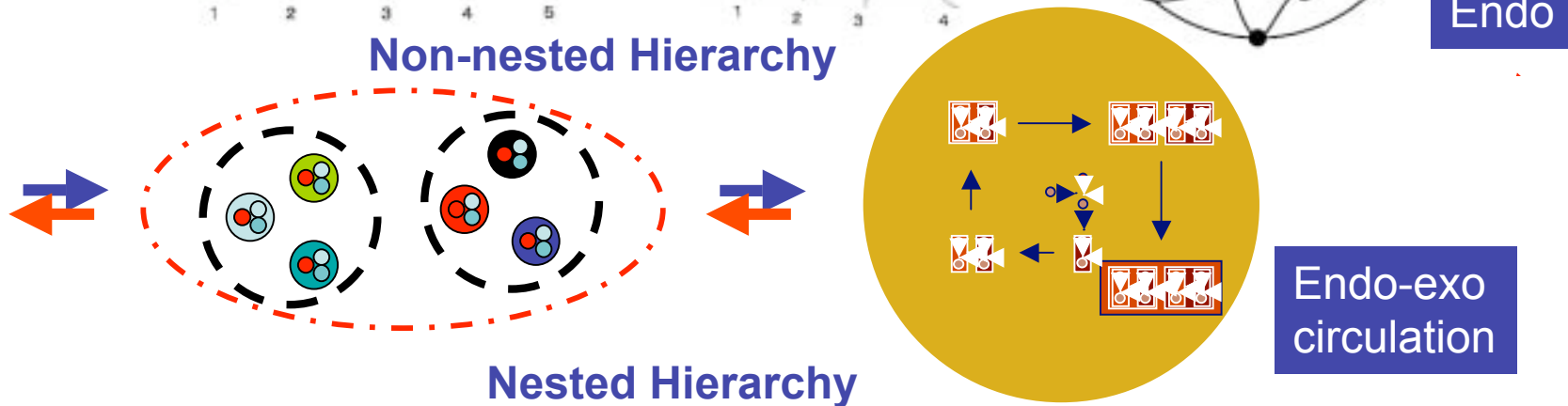
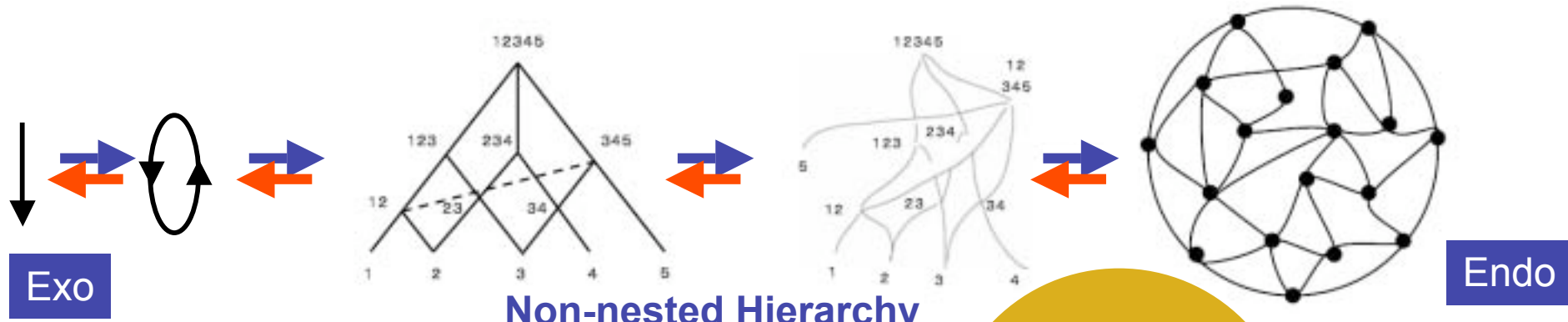
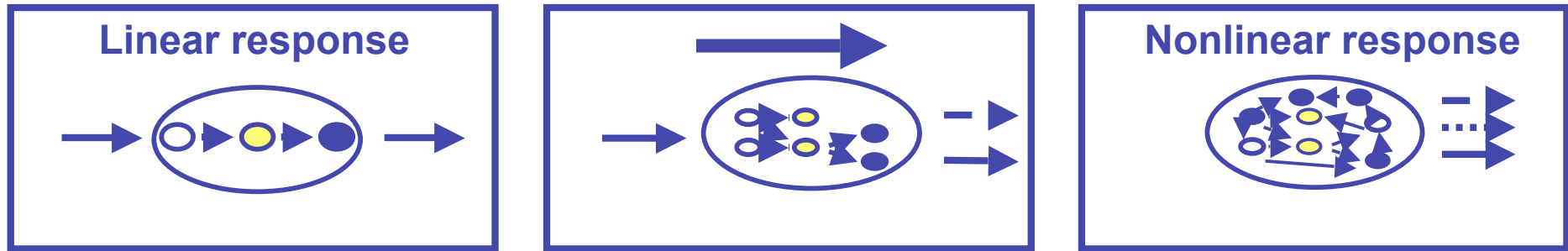


Linear process

Nonlinear process
(Memory formation)

Creativity as the emergence of hidden dynamics

Evolution, development and emergence of diseases as exo-endo transitions due to the intrinsic nature as well as extrinsic stimuli including environmental pollution



A serious dilemma

- Without knowledge, we cannot observe an object precisely.
- Without observation, we cannot obtain precise knowledge.



**“Drawing Hands” by M.C.
Escher (1898 —1972)**

