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 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

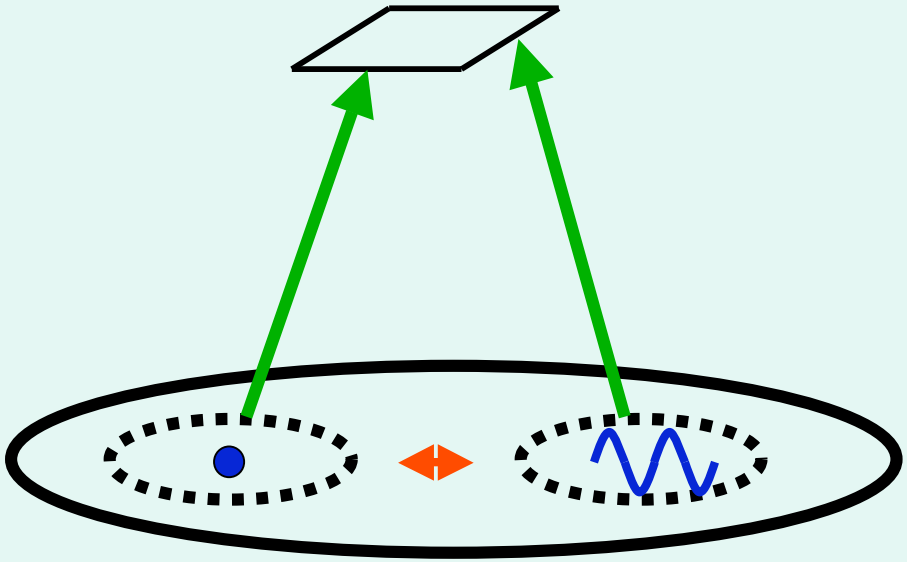
Photo: by Ms. Nosaka

Science

Conflicts are driving forces of Scientific evolution

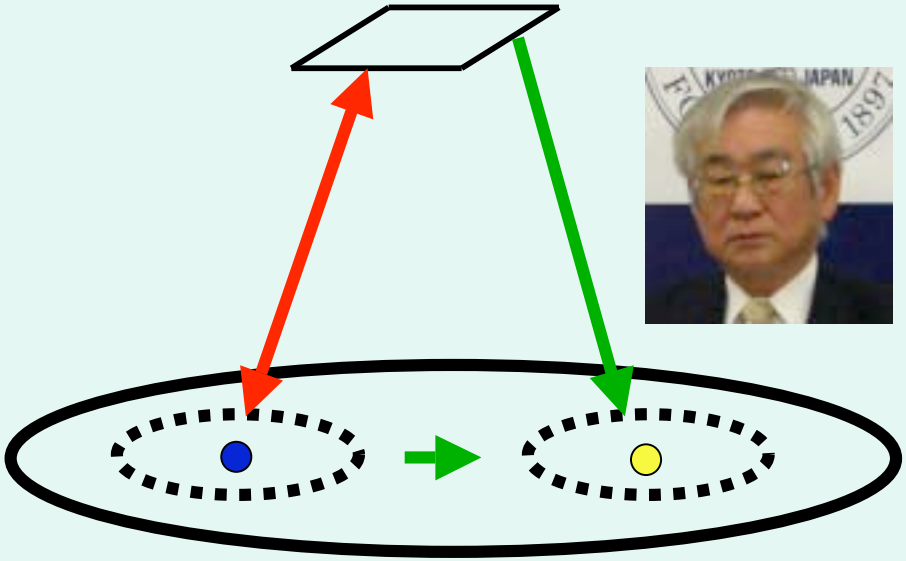
Niels Bohr
1885 ~1962

Quantum Theory



Particle Wave

A Unified Theory



Known Particle

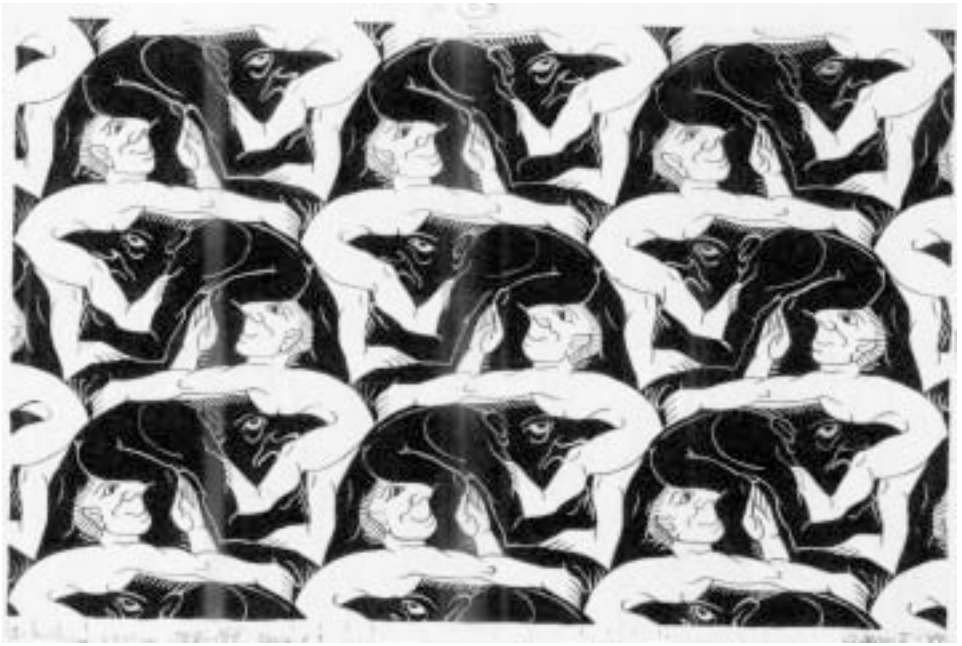
Unknown Particle

Opposites are complementary

出所 http://upload.wikimedia.org/wikipedia/commons/6/6d/Niels_Bohr.jpg

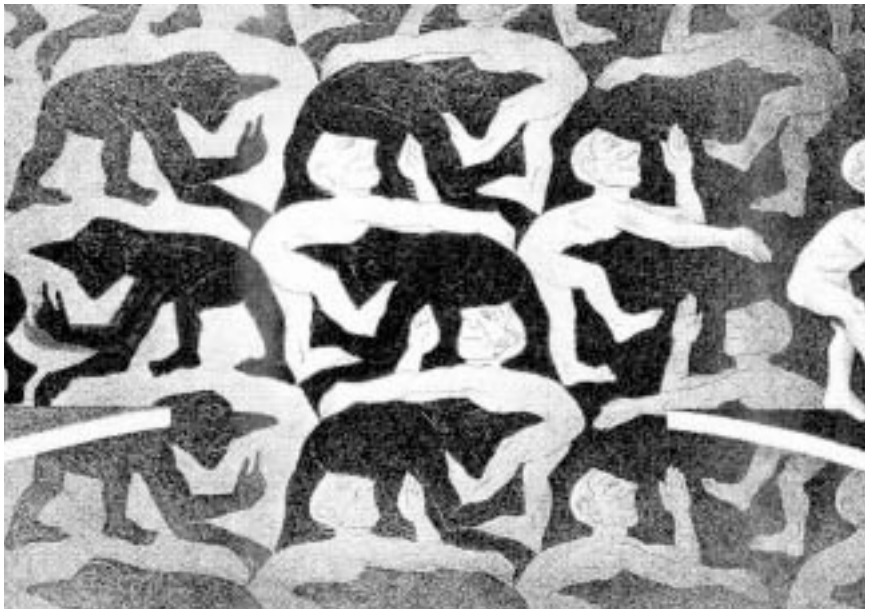
Arts

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



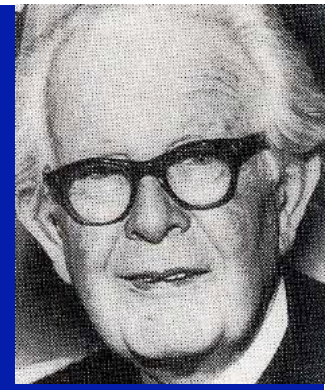
Opposites are complementary

Escher No. 62, 1944



Escher No. 63, 1944

Developmental Psychology



Jean Piaget
1806-1980

Mark S. Blumberg

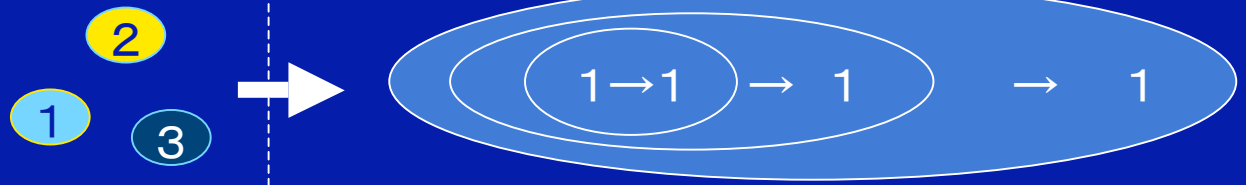
Theoretical domain

Specialization

generalization

Empirical space

Time

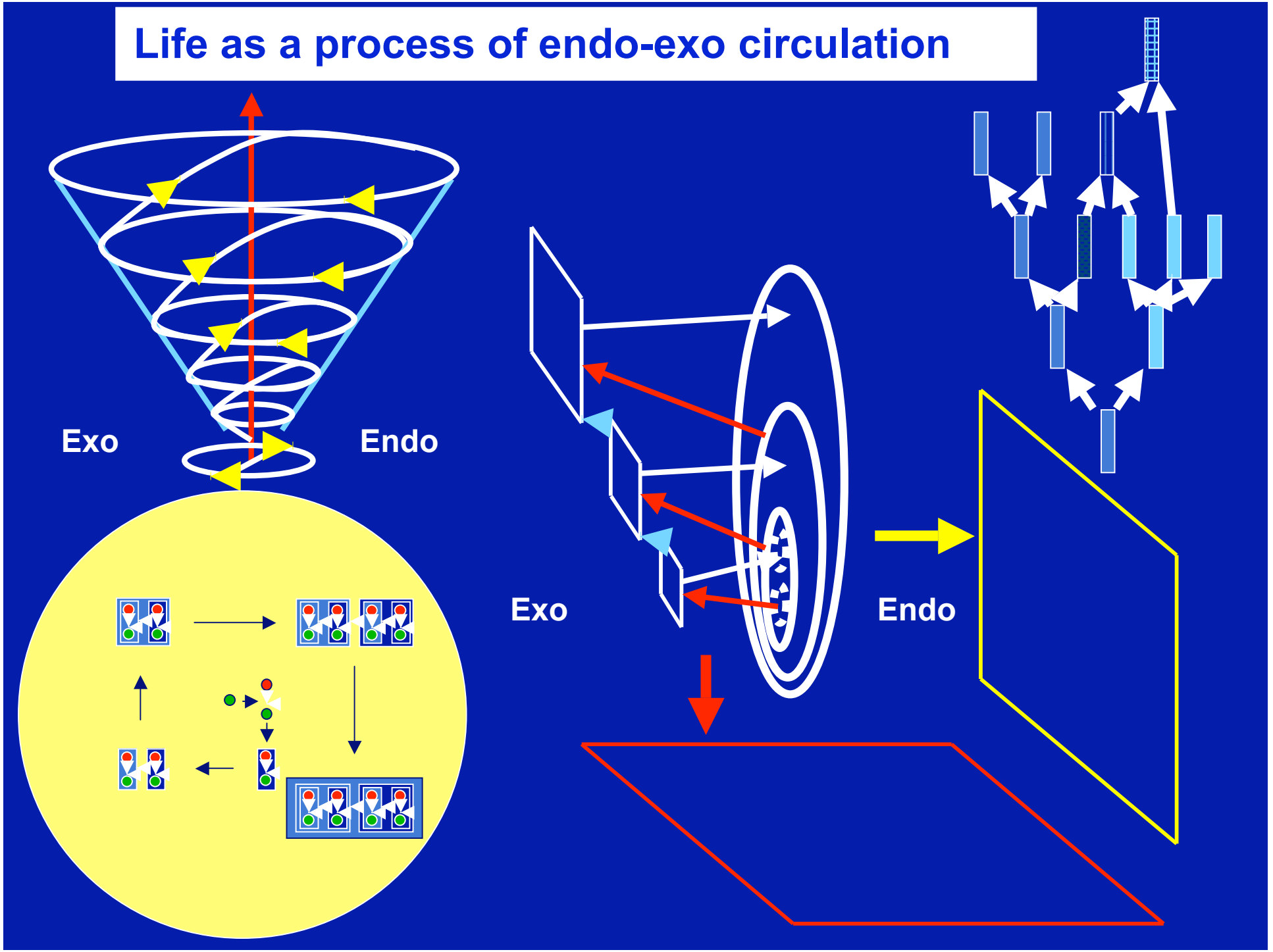


Critical Period

Concept of Number

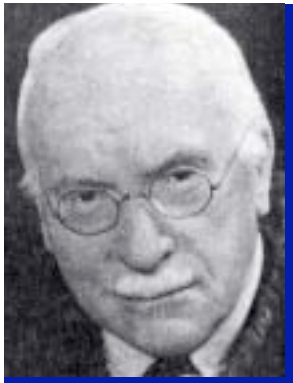
出所：ピアジェ 『精神発生と科学史』 新評論

Life as a process of endo-exo circulation



出所 http://www.personal-values.info/Data/Images/cgjung4.jpg

出所 http://www.igpp.de/english/tda/cv/Atmanspacher.jpg



C. G. Jung
1875-1961

Religion

Connection of oppositions

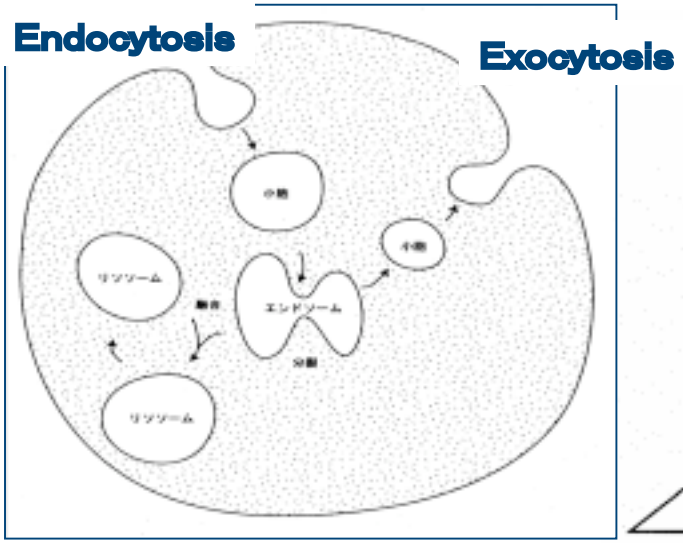
Mandala as a symbol of
“Opposites are Complementary”

Harald
Atmanspacher

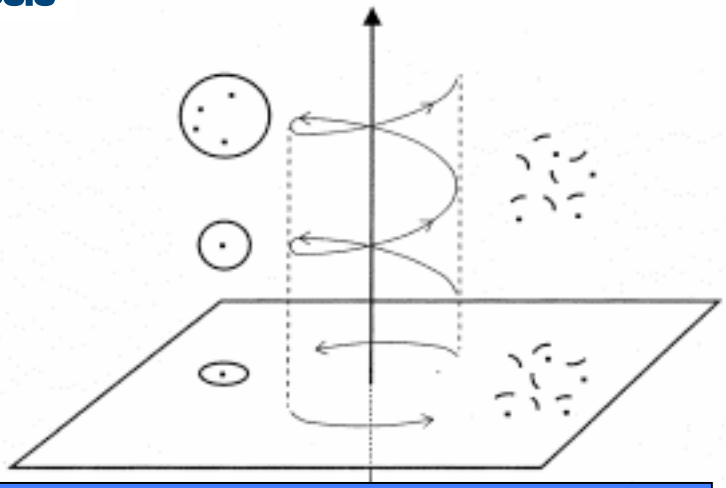
Consciousness process

Unconsciousness structure

Murase (2001)

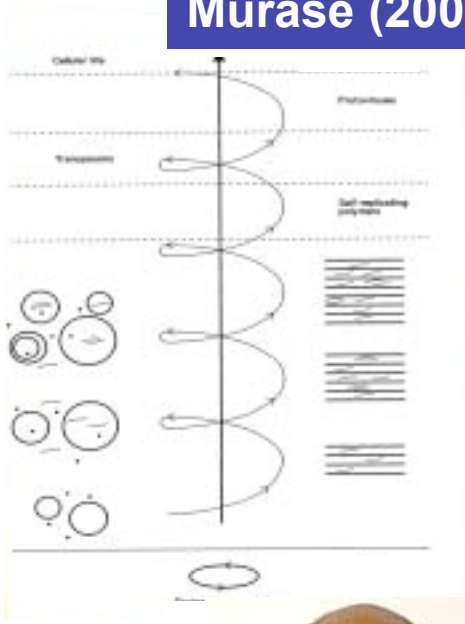


Evolution



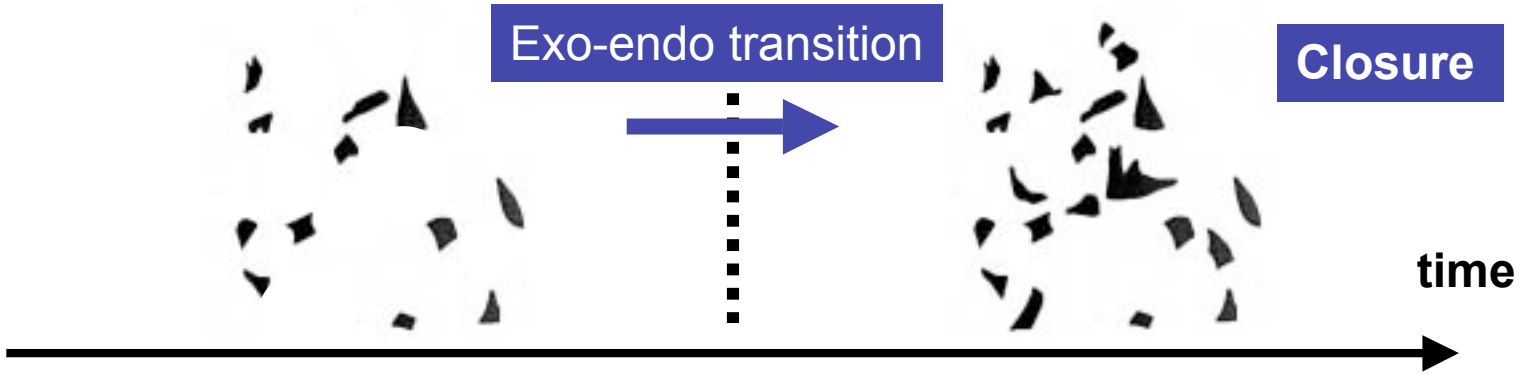
End-exo circulation

Murase (2000)



Ludwik Leibler

Emergence of order is associated with an exo-endo transition



R. L. Solso ‘Cognition and the visual arts’ MIT 1994

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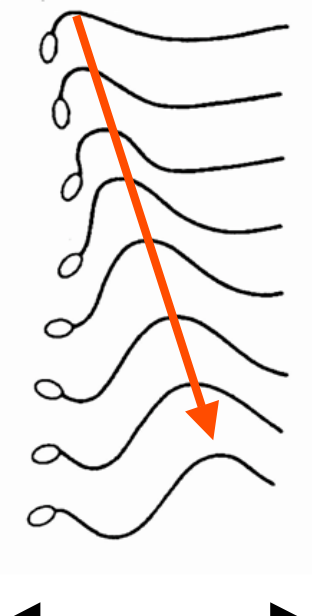
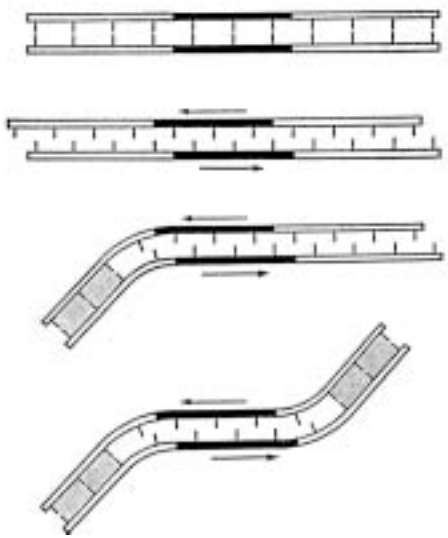
C. J. Brokaw
J. Cell Biol. 114, 6 (1991)



R. Rikmenspoel
J. Cell Biol. 76,
310-322 (1978)

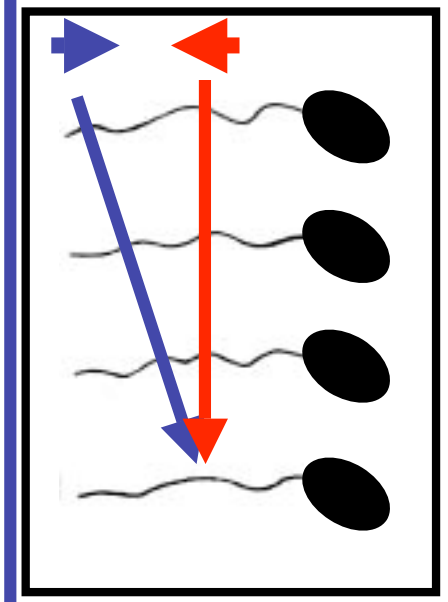
Sliding filament model



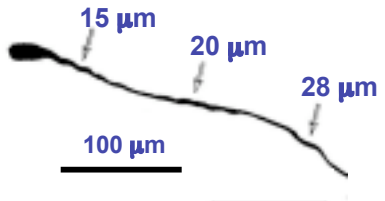
C. Shingyoji, et al.
Nature 265,
269-270 (1977)

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)

Different sections have different wavelengths and different frequencies. **Spatio-temporal irregularity**

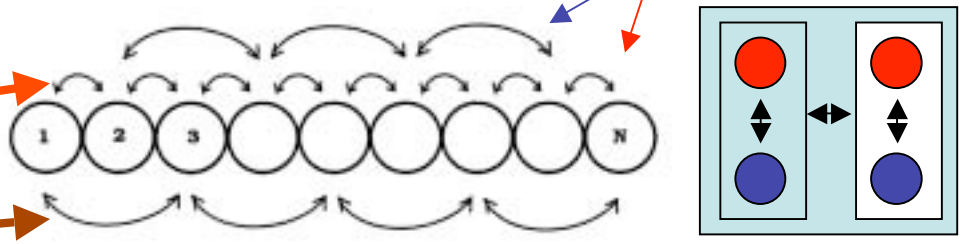
Moment-balance equation

$$M_S + M_E + M_V = 0$$

Flagellar equation

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

Inter-subsystem conflicts



S = S (n, σ)
shear force

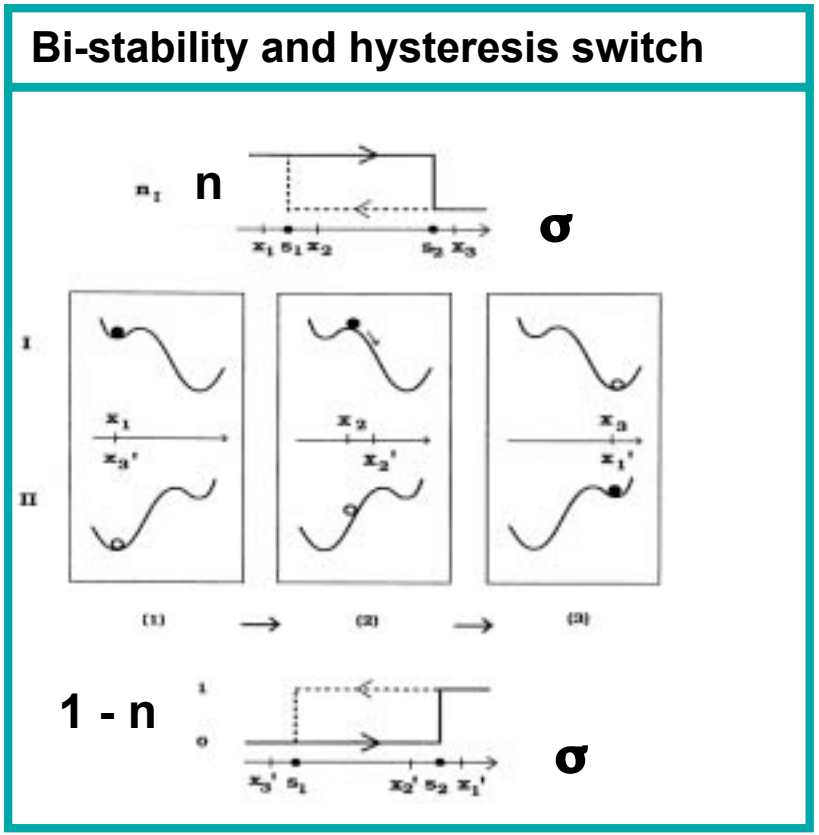
n: fraction of active molecule

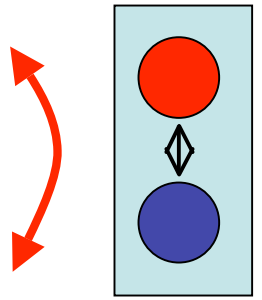
σ: shear displacement

E_B: bending resistance

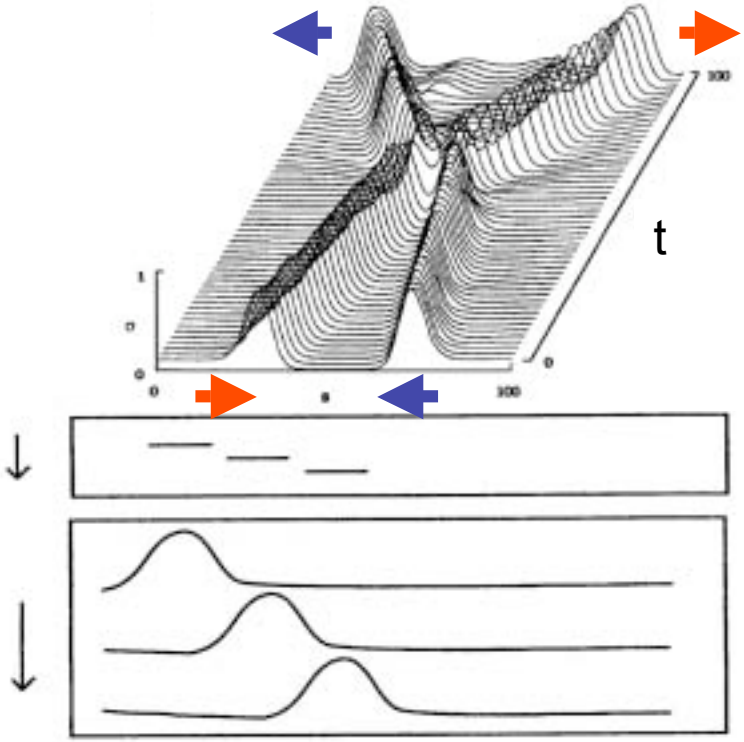
C_N: viscous resistance

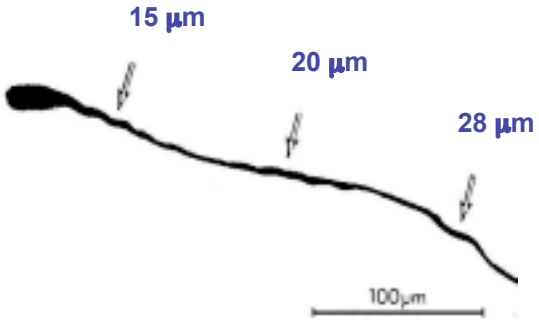
Bi-stability and hysteresis switch



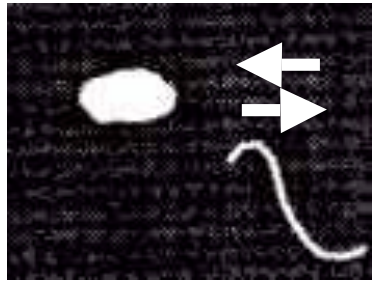


Intra-subsystem conflicts

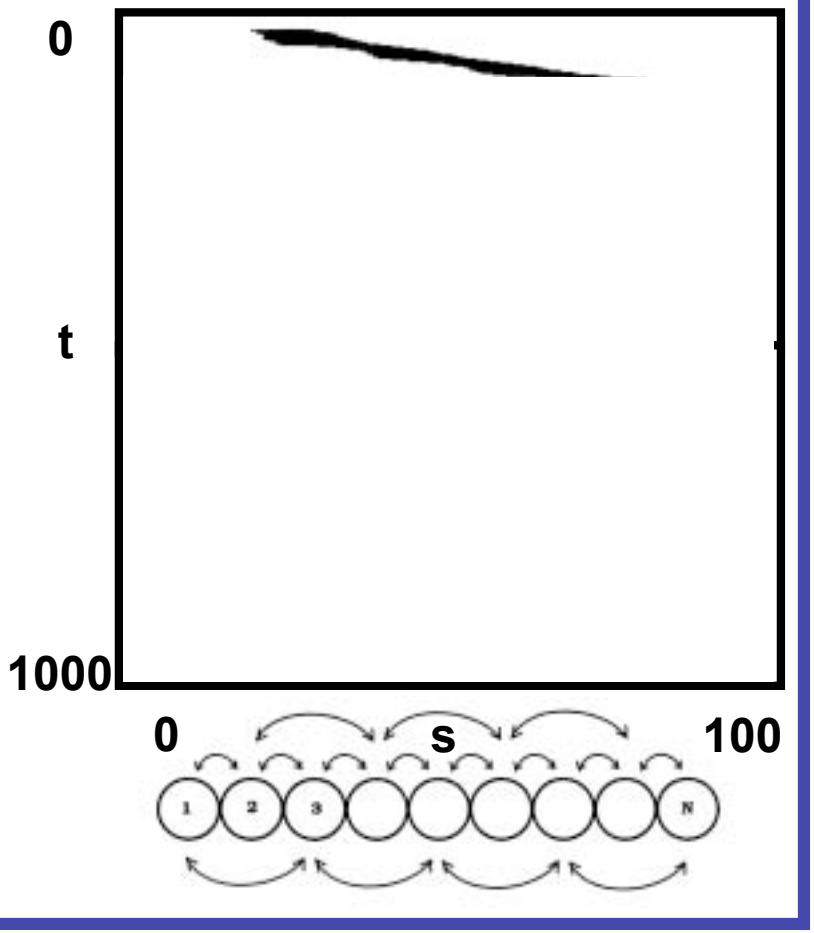




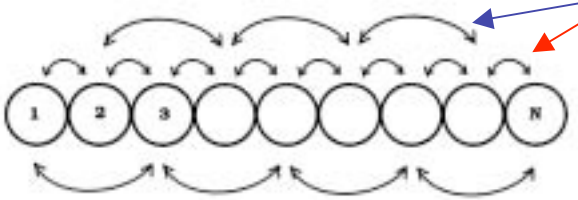
S. F. Goldstein
et al. *J. Exp. Biol.*
53, 401 – 409 (1970)



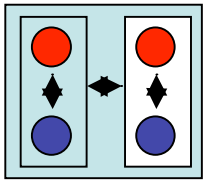
$$S(\sigma)_{ss} + E_B \sigma_{ssss} + C_N \sigma_t = 0$$



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



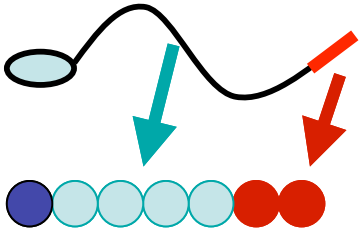
Inter-subsystem conflicts

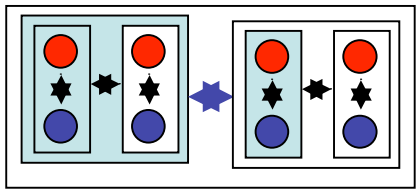


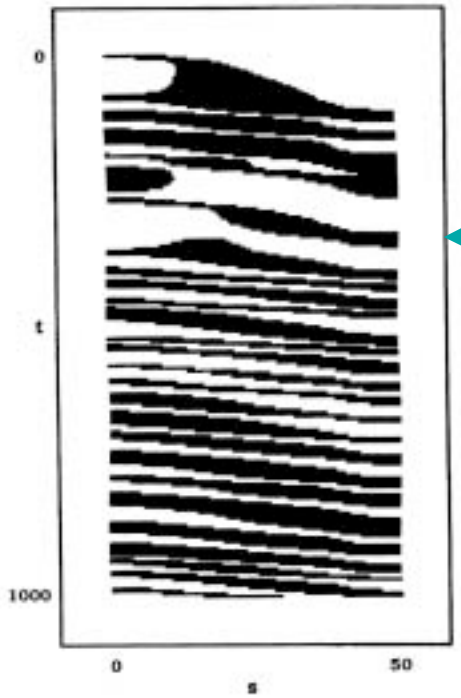
Further conflicts regulate intrinsic instability.

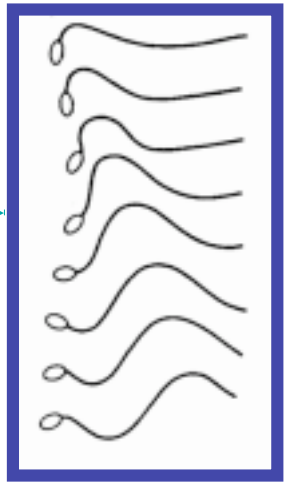
Trans-subsystem conflicts

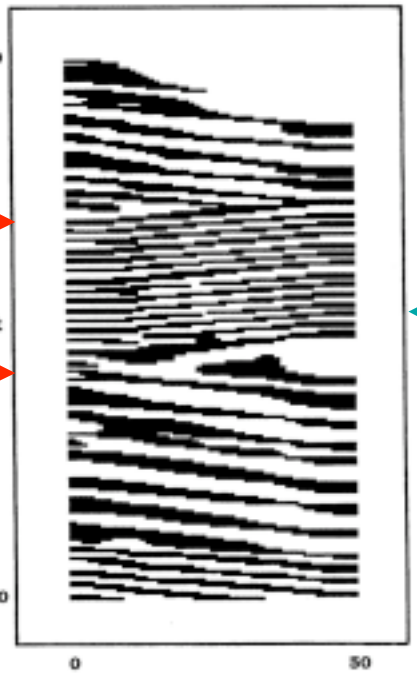
$$S(\sigma)_{ss} + E_B\,\sigma_{ssss} + C_N\,\sigma_t = 0$$

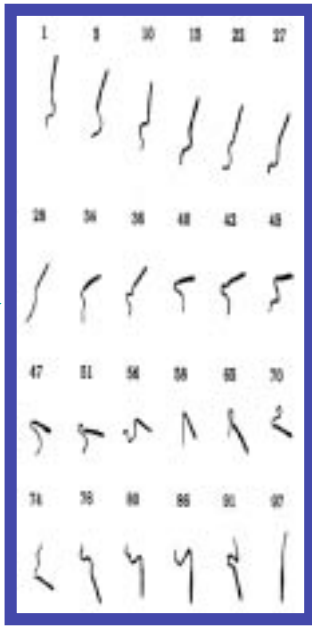




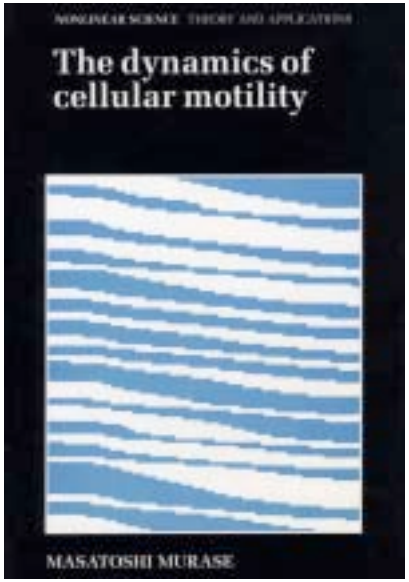






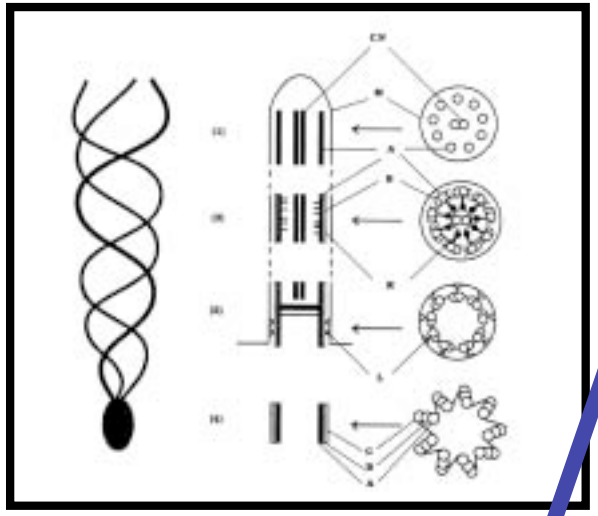


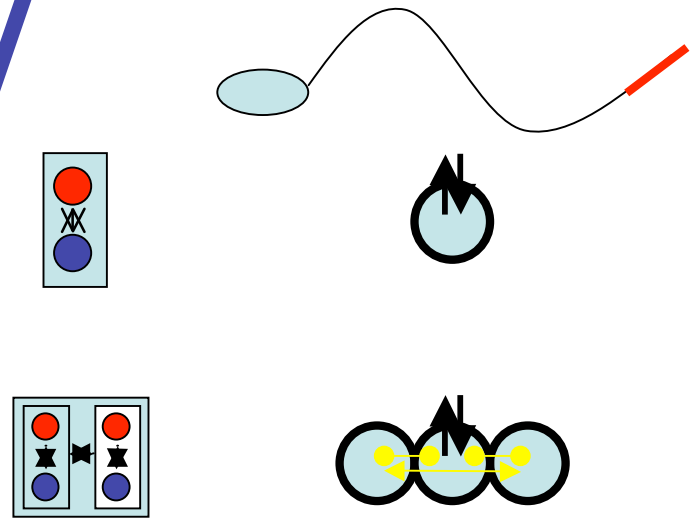
Two waves propagating in the opposite directions do not annihilate on collision.

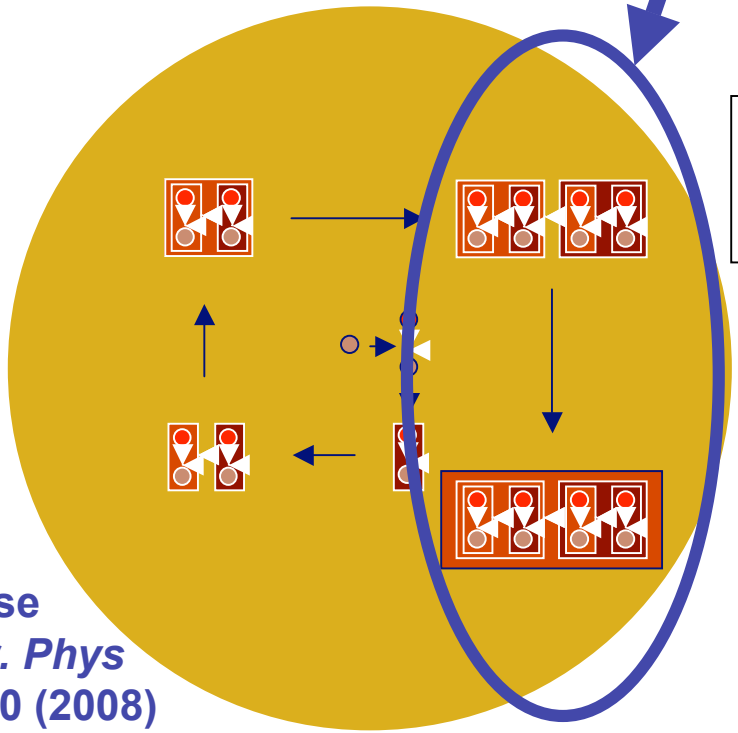


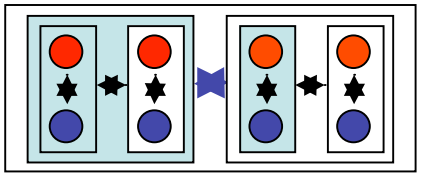
M. Murase
Wiley (1992)

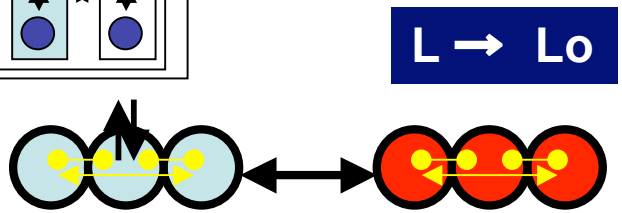
Energence of order as an exo-endo transition











Supra-structural polarity can control spatiotemporal chaos.

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

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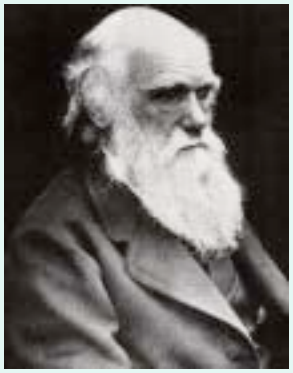
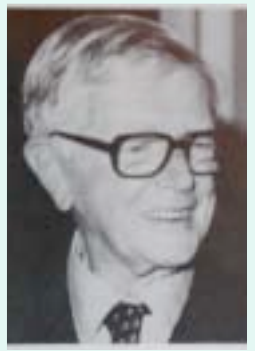
Rediscovery of Darwin's natural selection in different contexts

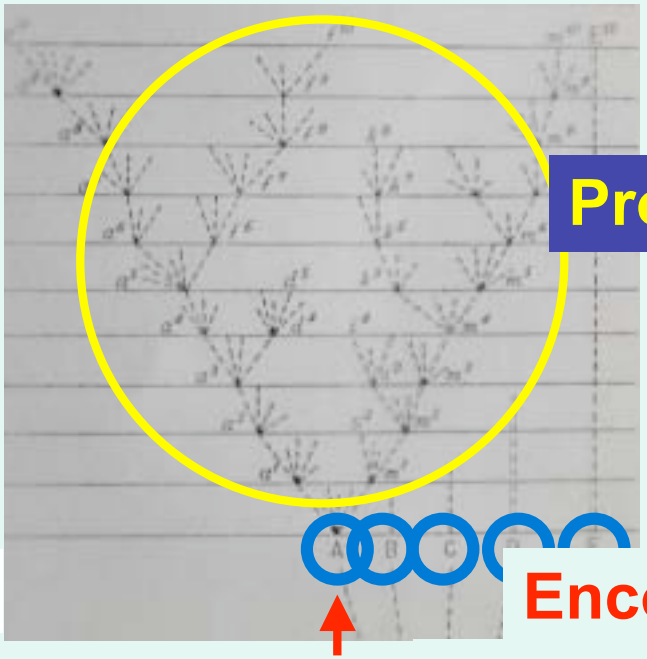


Charles Darwin
(1809 – 1882)



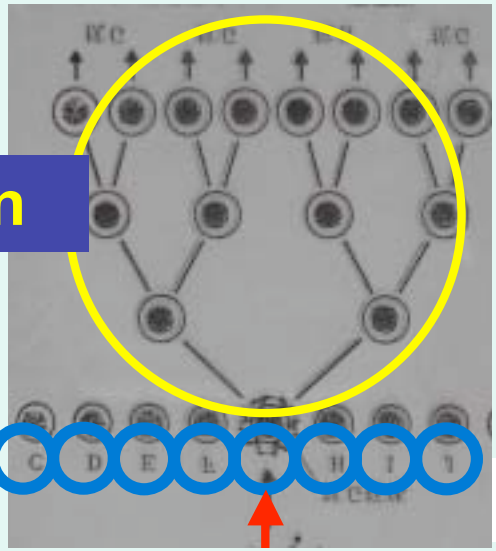
F. M. Burnet
Nobel Prize winner

Oppositions of 'life' and 'death'



1859

Proliferation



1957

Encounter with environment

Preexisting variability

Ecosystem

Immune system

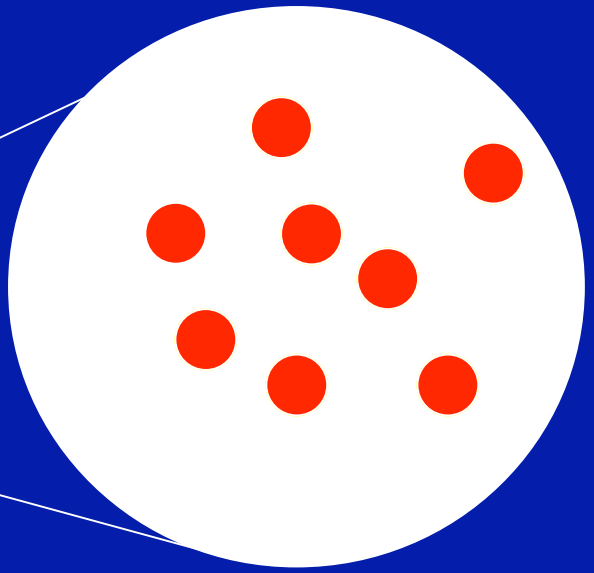
Cancer as cellular evolution **1976**

出所 http://www.msnbc.msn.com/id/17047120/

出所：別冊　日経サイエンス　「最新の免疫学」　１８ページ

Intra-cellular Selection Theory

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



Aging as intra-individual evolution

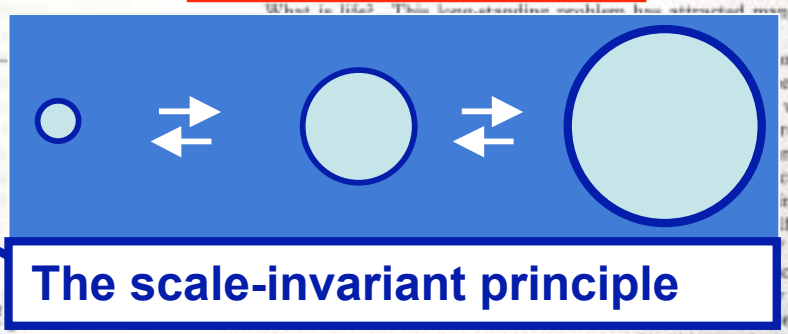
Preexisting polymorphism

Encounter with intra-cellular environment

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

Towards the Frontiers in Theoretical Physics

1996



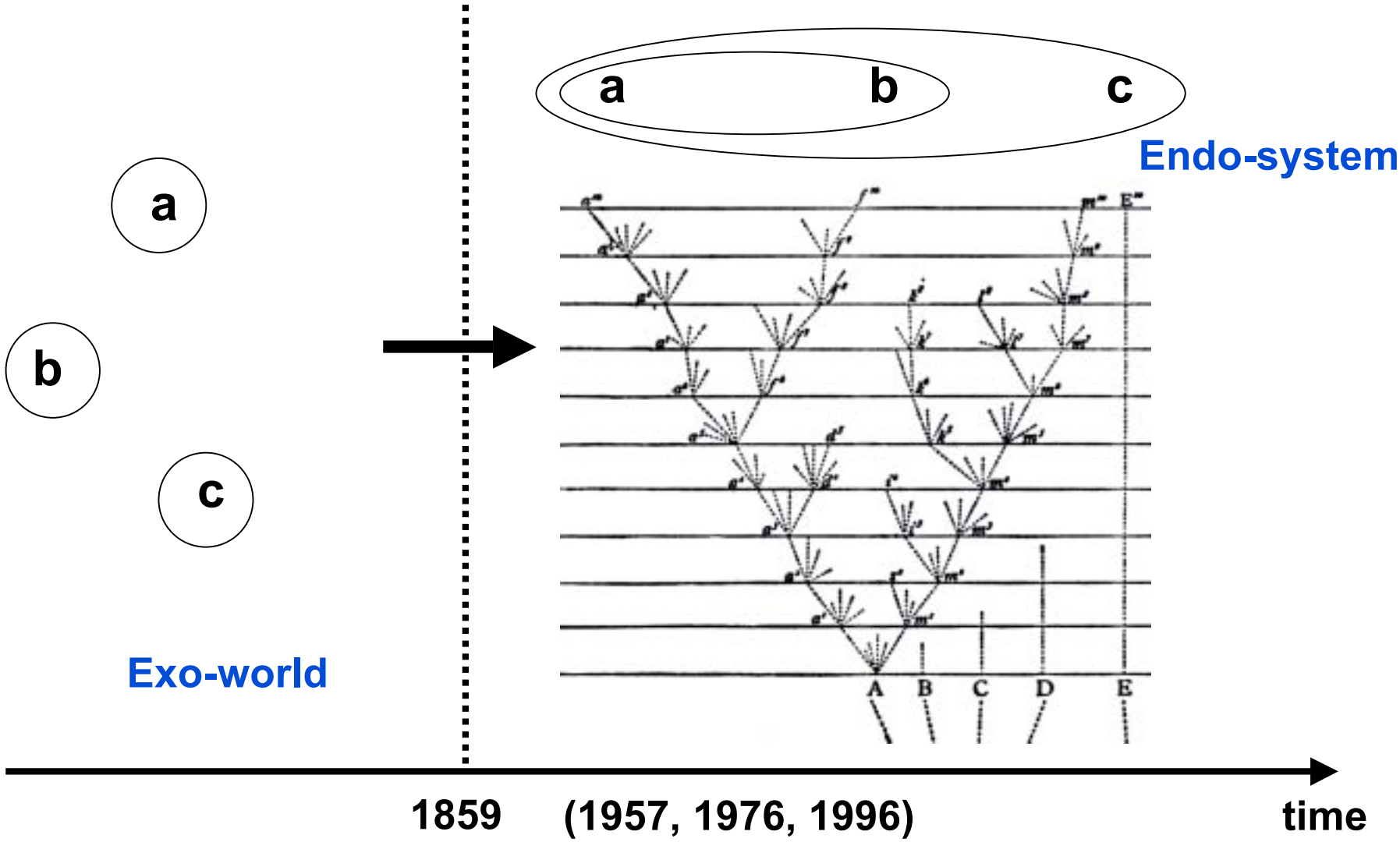
The scale-invariant principle

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

Complementarity principle

M. Murase *Prog. Theor. Phys.* 95, 1～36 (1996)

Rediscovery of Darwin's natural selection



An exo-endo transition

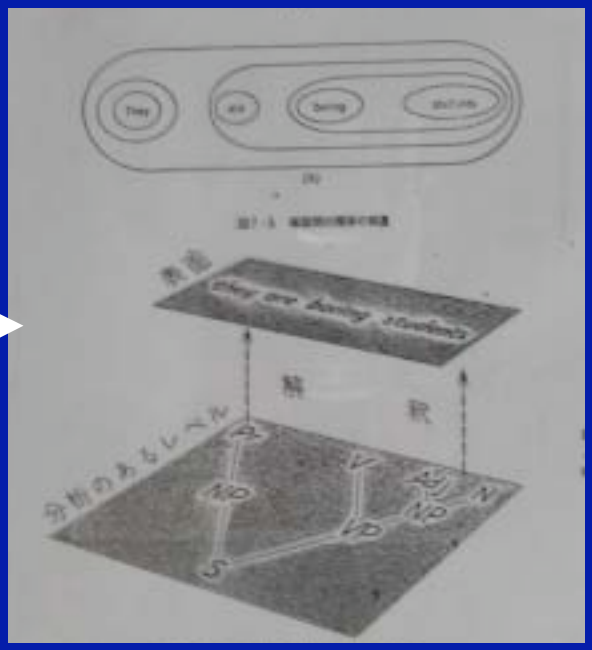
Acquisition of natural language

they

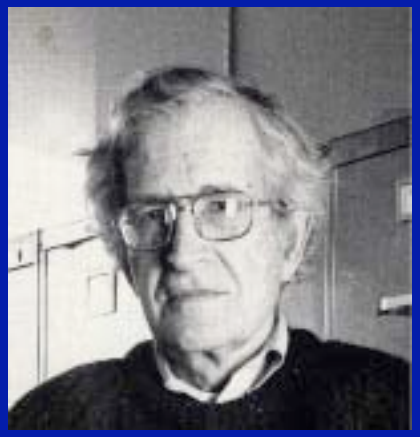
are

boring

students



Generative grammar



Norm Chomsky

Shigeru Miyagawa

Adrian David Cheok

2 ～ 12- year-old

time

Exo-world

Endo-system

出所：最新　脳科学　学研　３３ページ

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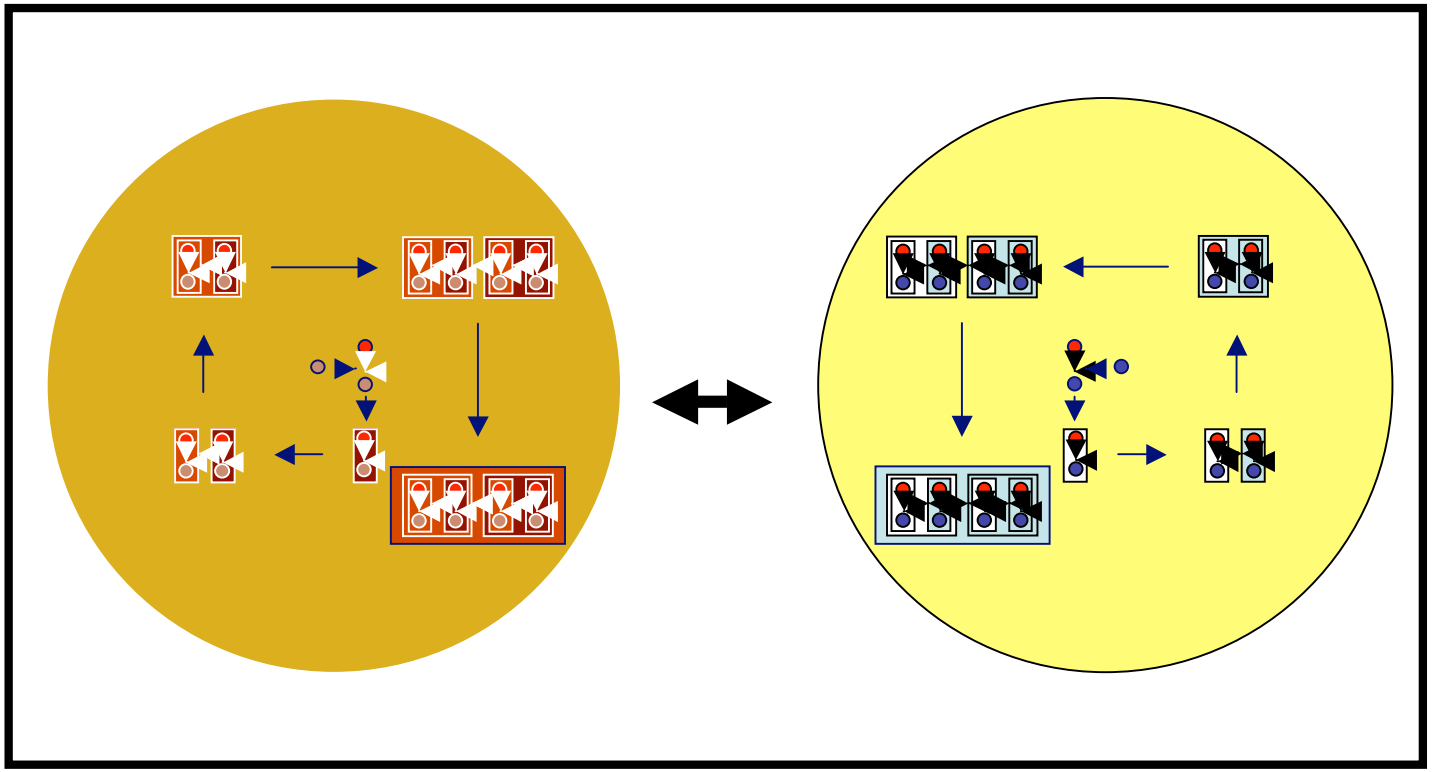
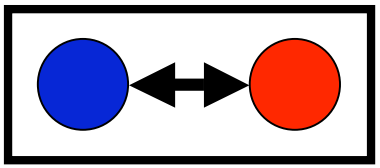
Kitaro Nishida
1870-1945

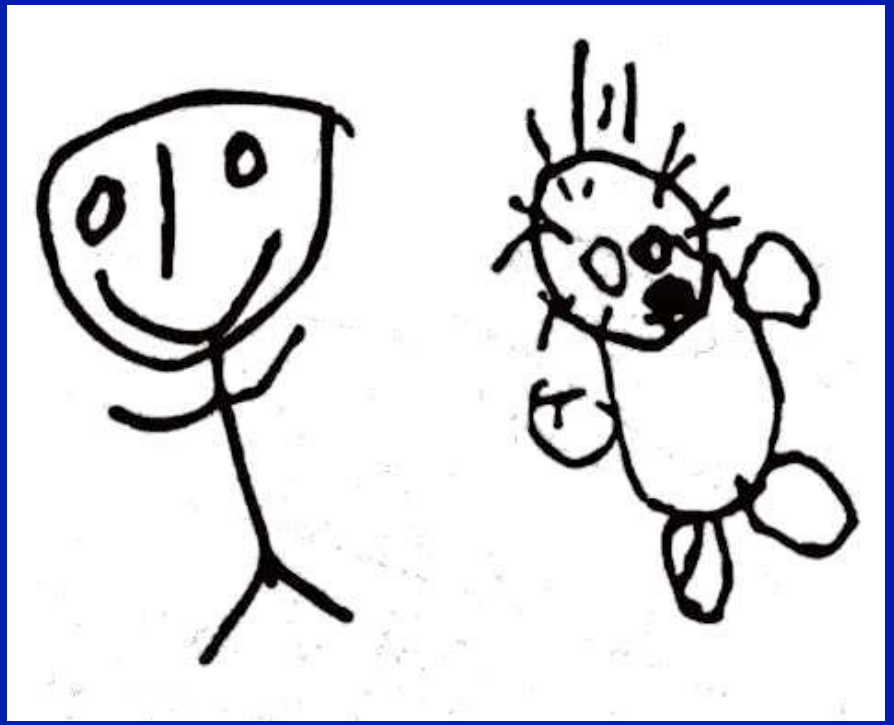
Absolutely contradictory self-identity





Another Inconvenient Truth

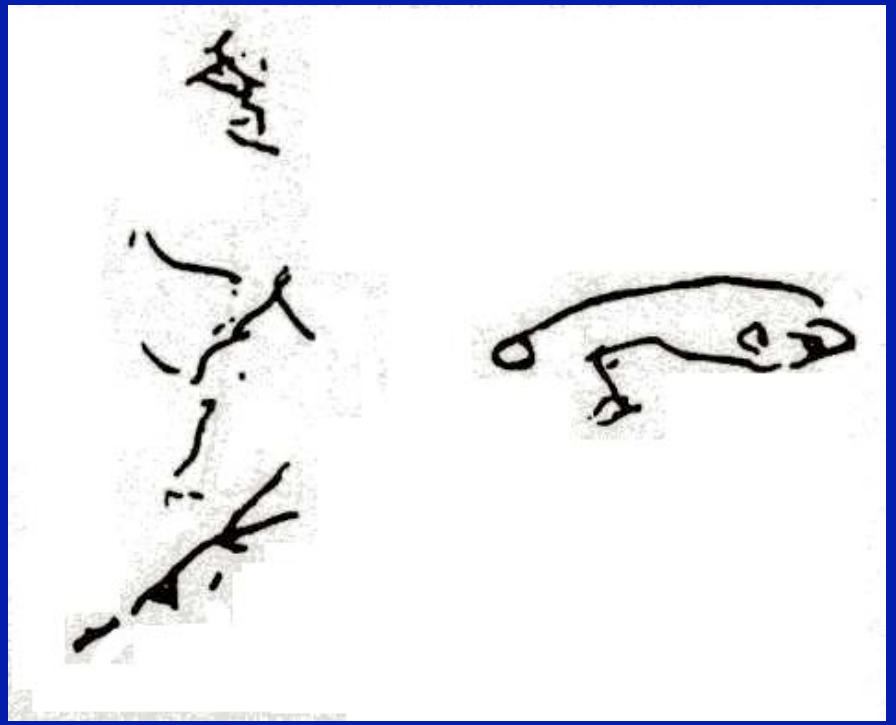
Unpolluted Environment



54-month

55-month

Polluted Environment



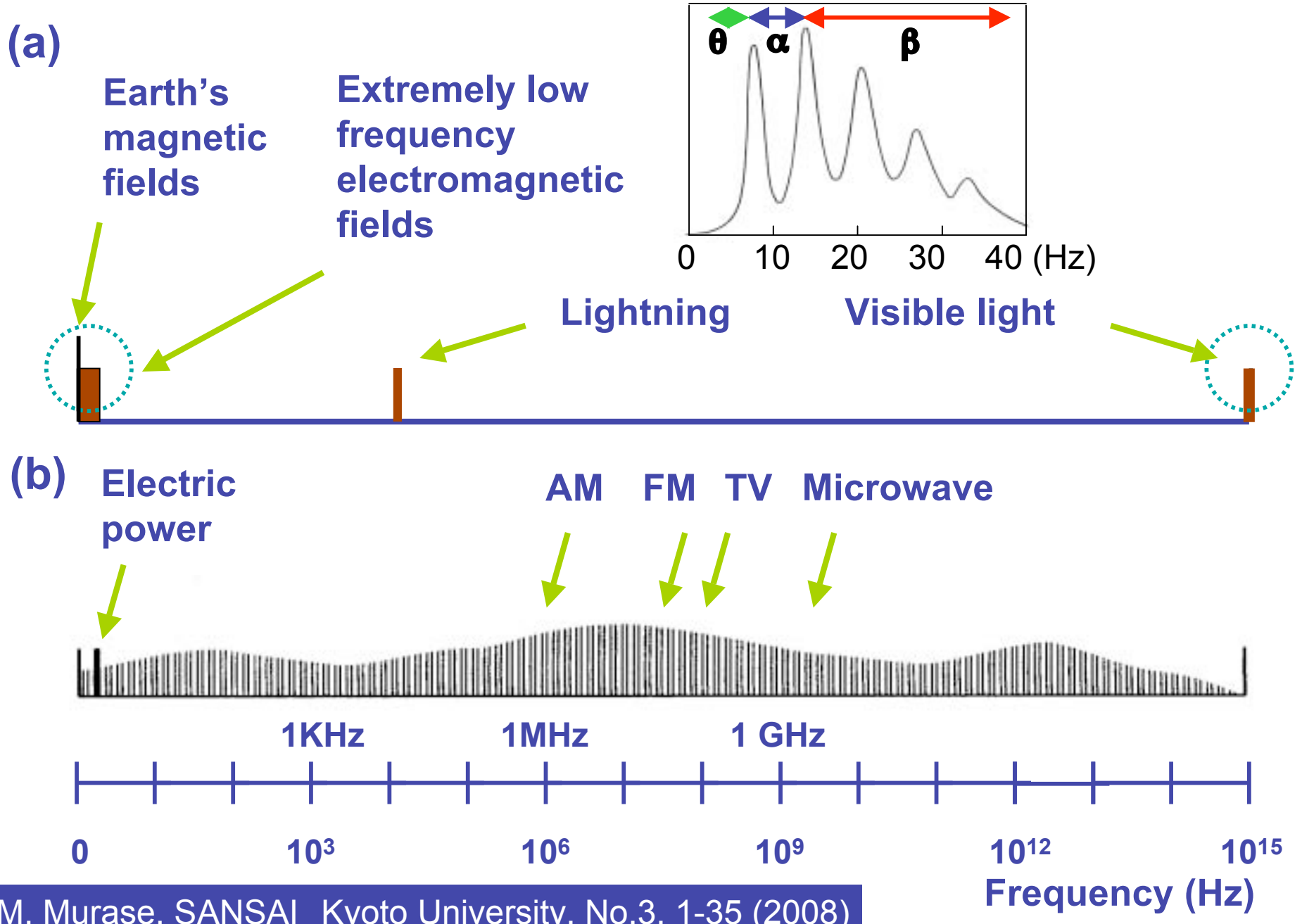
54-month

53-month

E. A. Guillette et al.

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

Spectrums for earth's natural and artificial electromagnetic fields



M. Murase, SANSAI Kyoto University, No.3, 1-35 (2008)

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

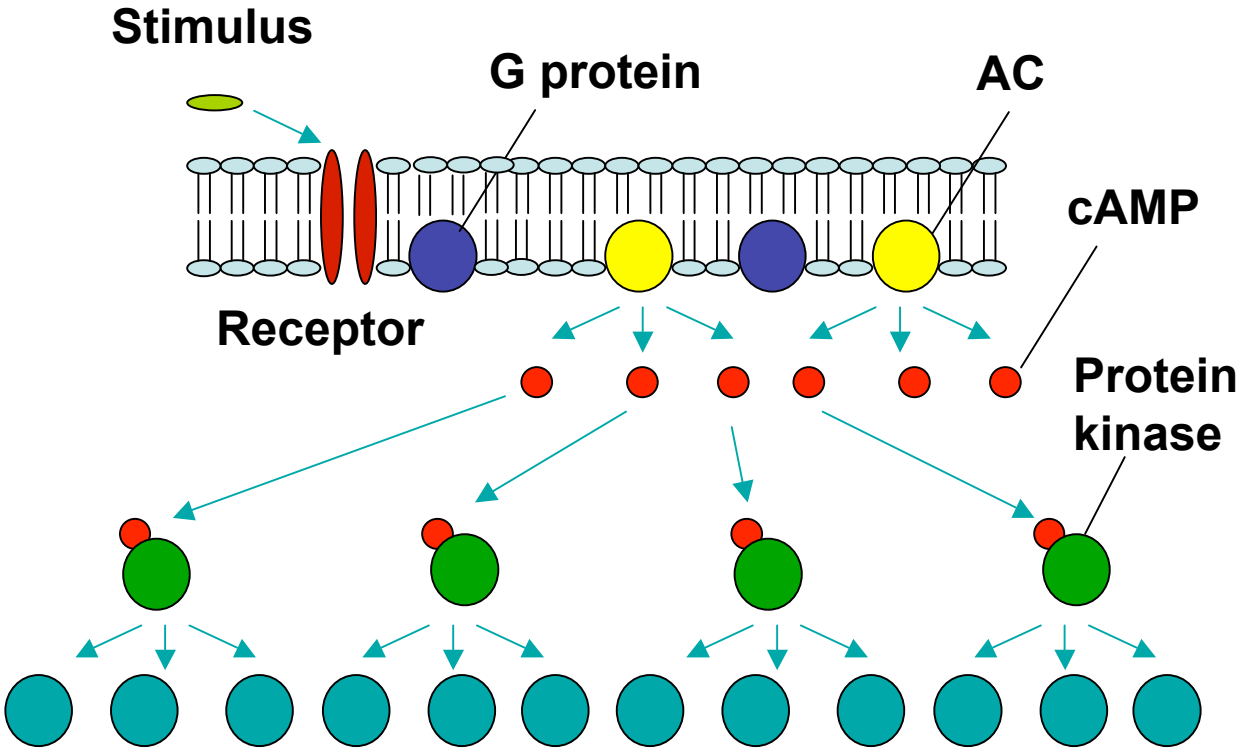
A past engineer of the mobile phone company

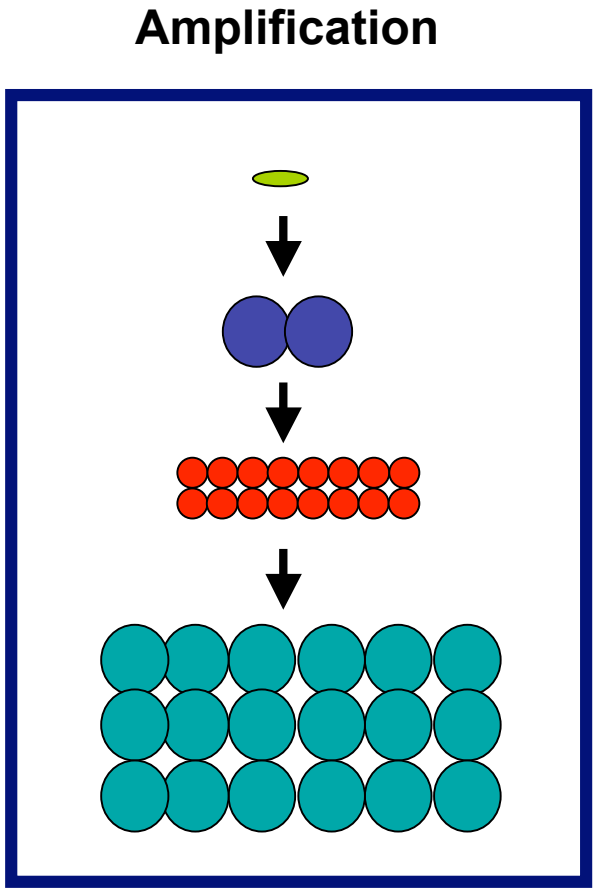
From T. Okubo (2005)

出所 :William Rea "Chemical Sensitivity" 1992 CRC Press

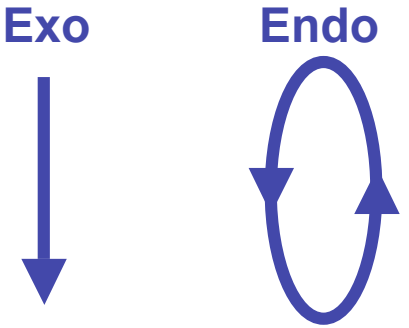
出所 : 大久保貞利　電磁波過敏症　緑風出版　１５５ページ

A common signal transduction pathway among diverse cell types





Stimulus	Receptor	G protein	Effector
photon	rhodopsin	Gt	PDE
odorant	olfactory	Golf	AC
Nadr	adrenergic	Gs	AC
ACh	muscarinic	Gk	K-channel



Memory as an exo-endo transition

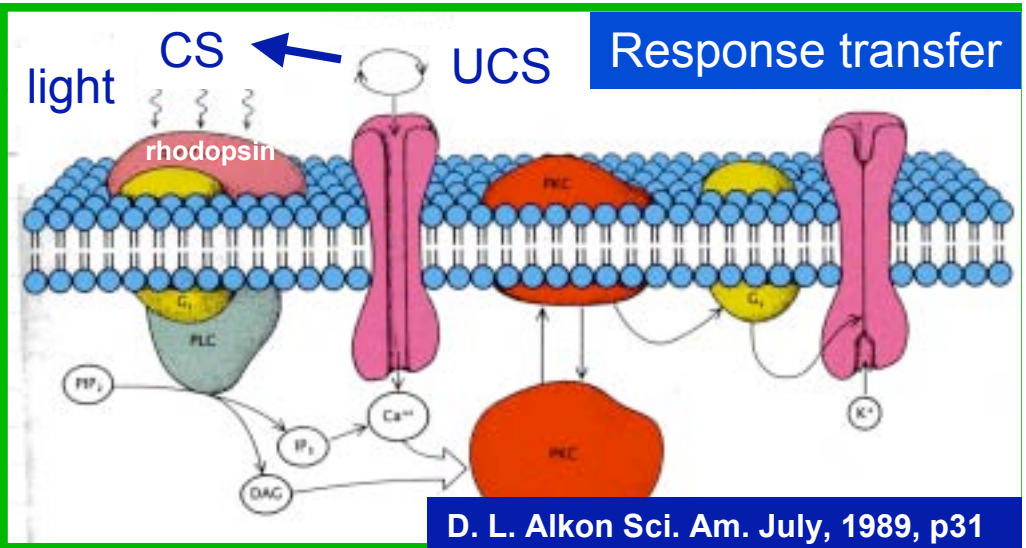
Pavlovian conditioning

Associative memory formation

Acute response with nongenomic action

Chronic response with genomic action

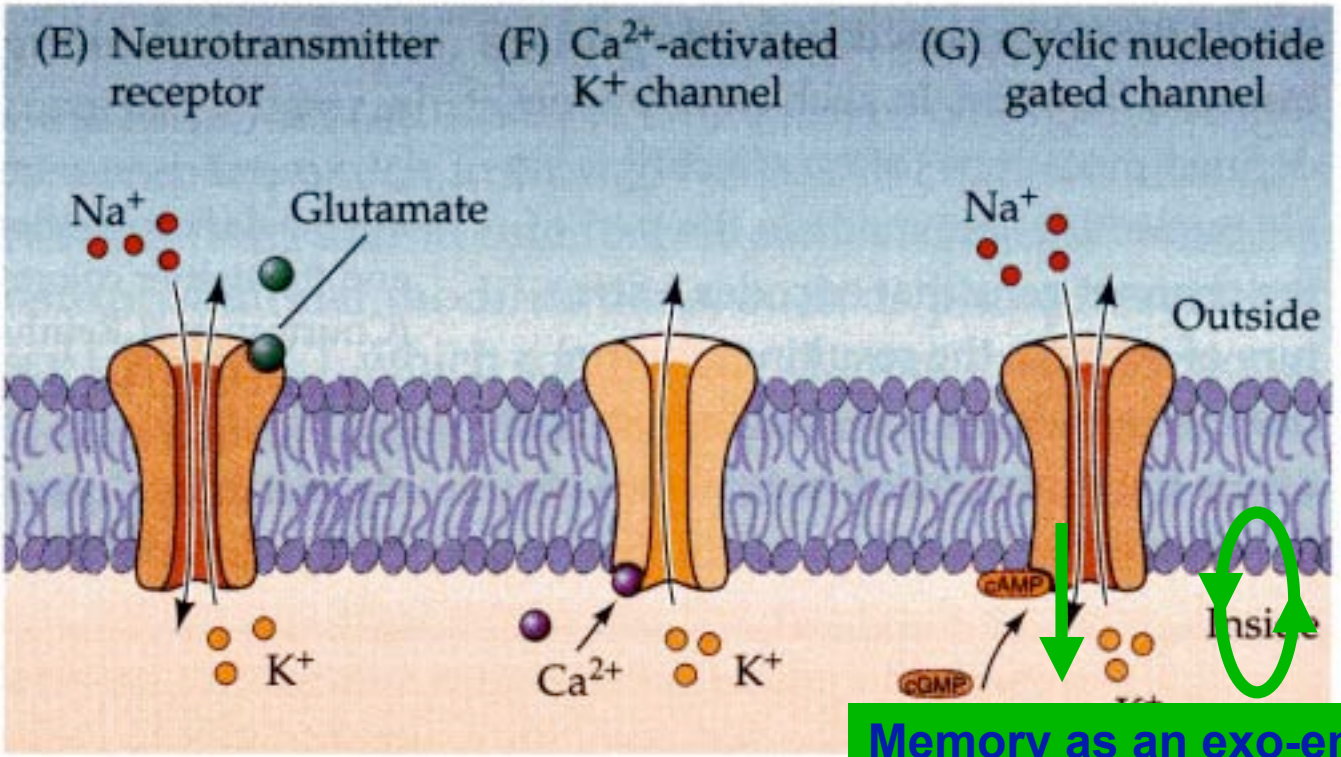
sec min hour year

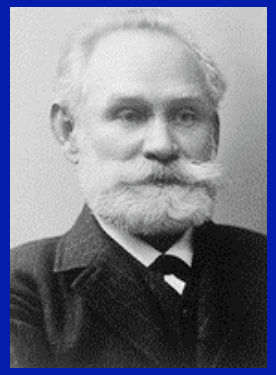


Response transfer

D. L. Alkon Sci. Am. July, 1989, p31

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





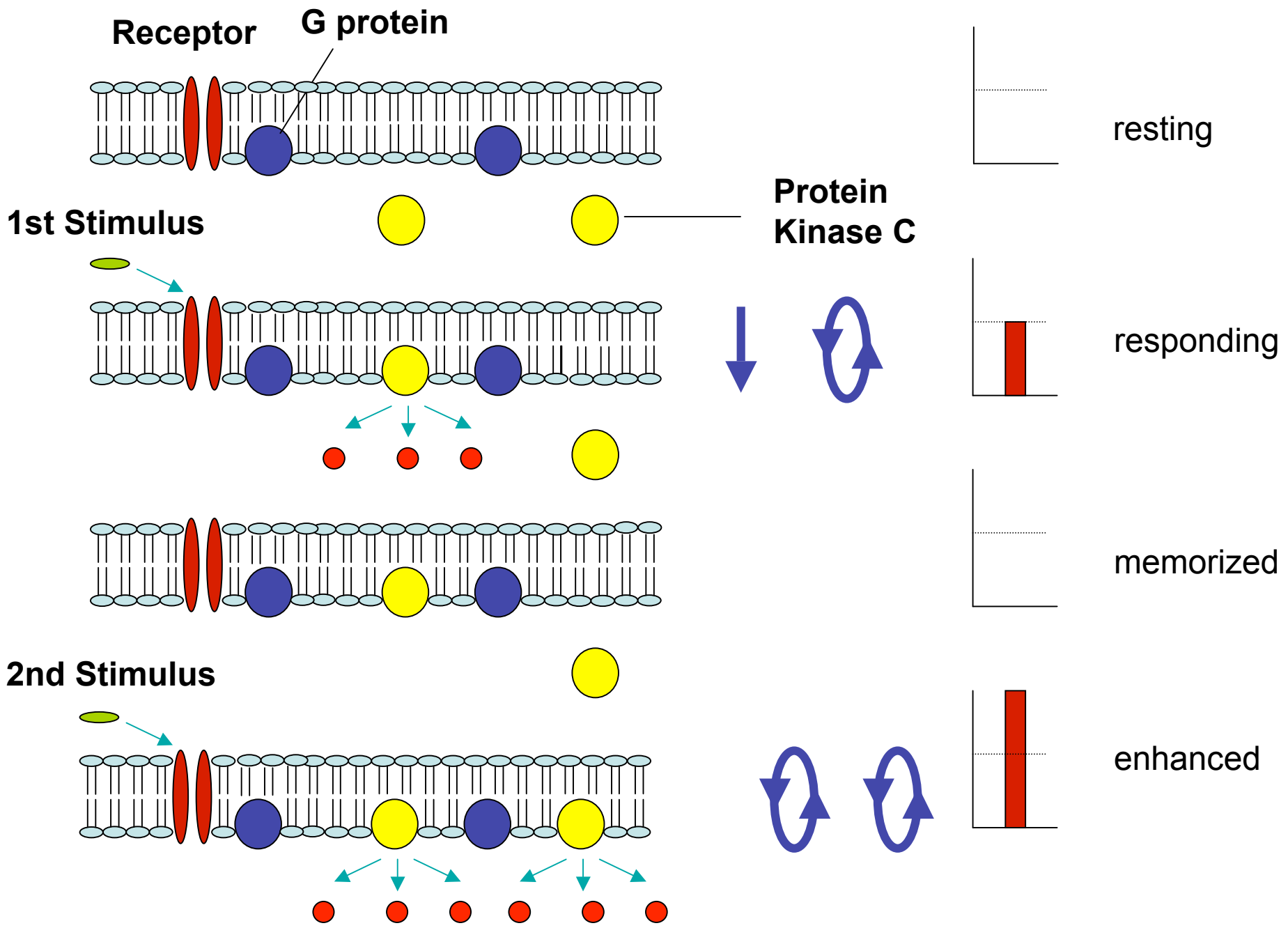
Ivan Pavlov
1849 - 1936

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

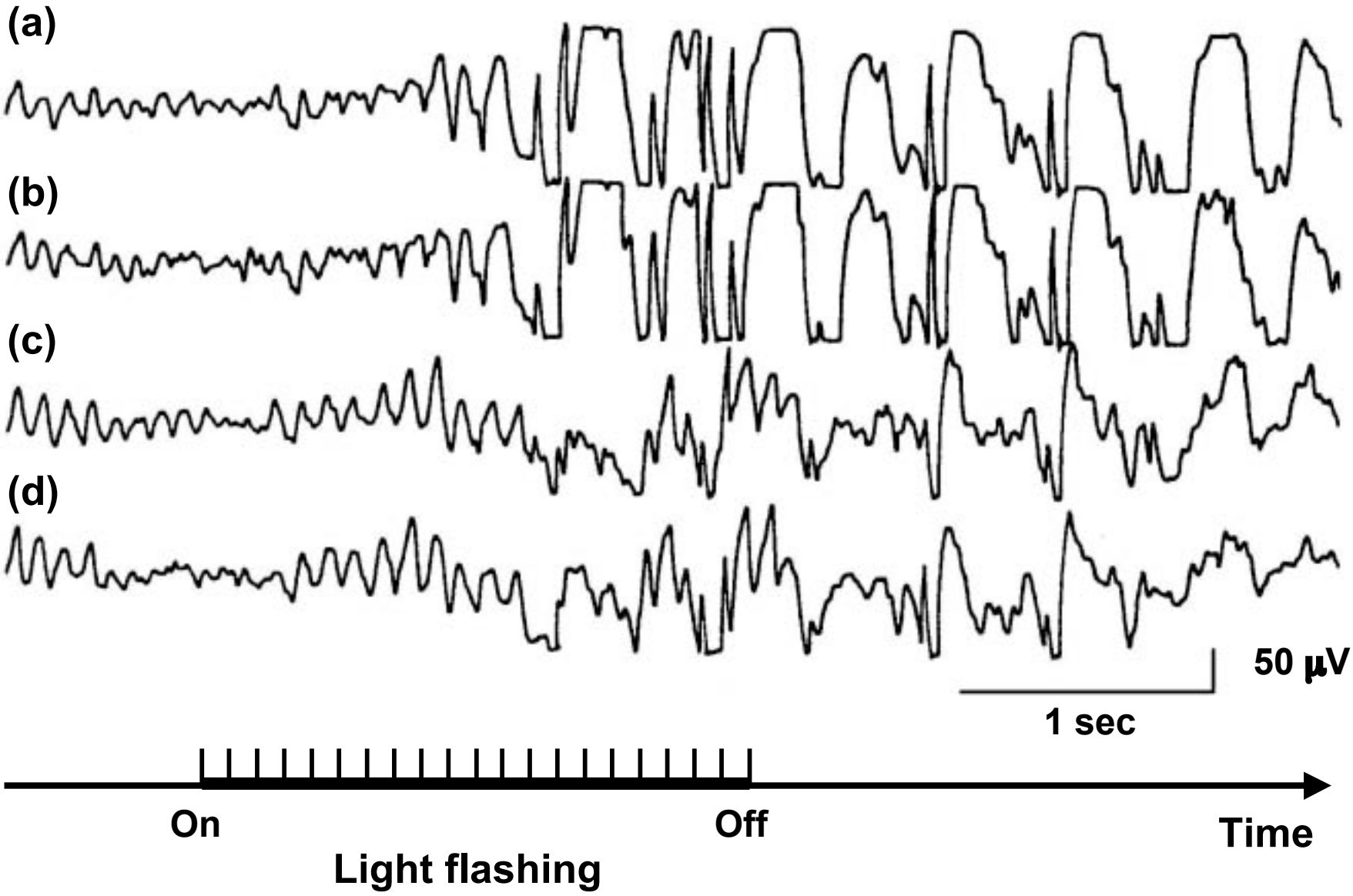
Memory as an exo-endo transition

出所 http://en.wikipedia.org/wiki/Ivan_Pavlov

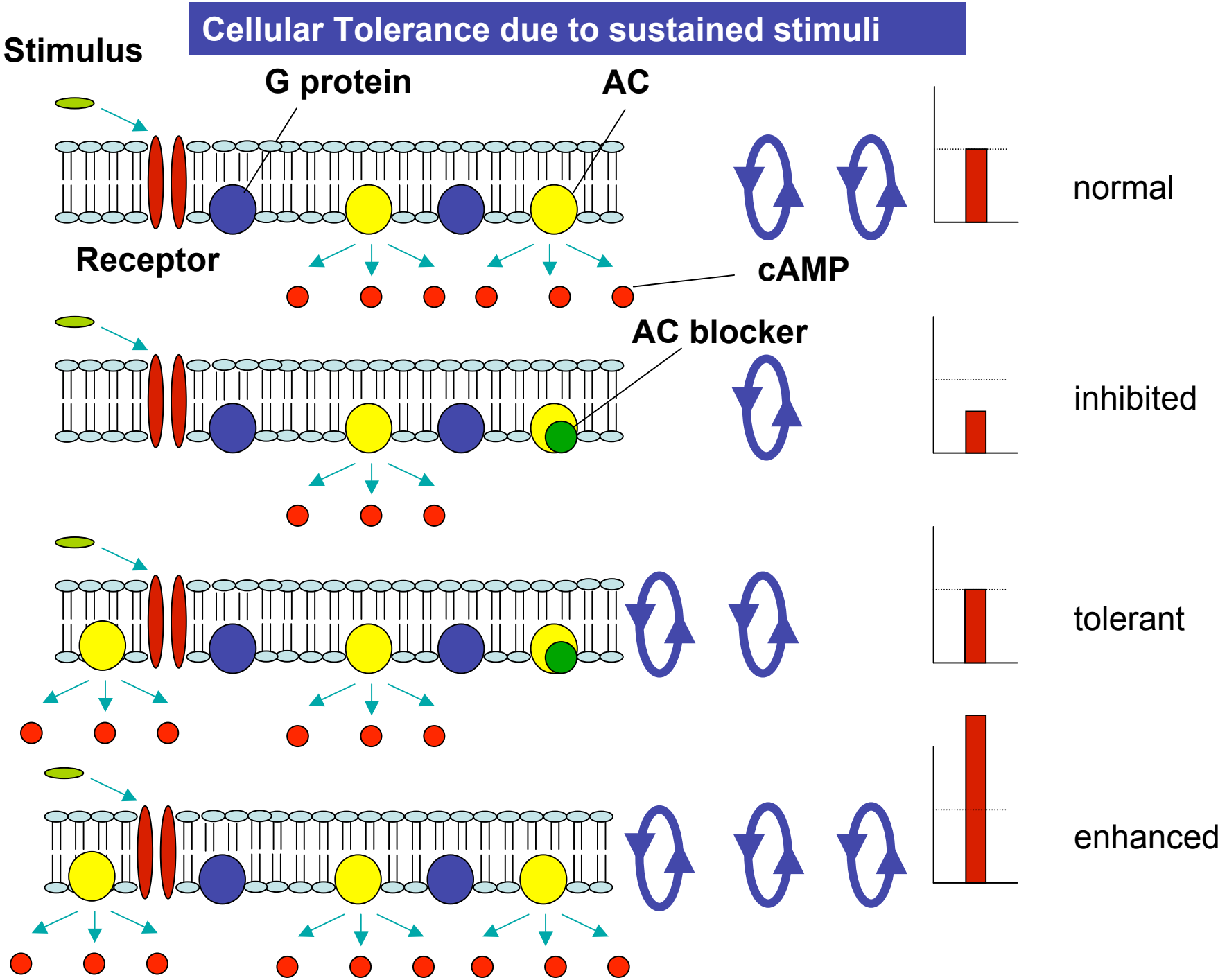
Cellular Memory due to repetitive stimuli



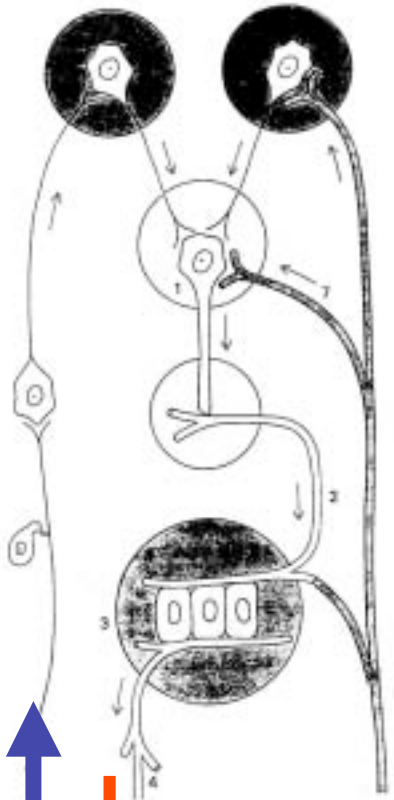
A seizure of photosensitive epilepsy



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


Cellular Tolerance due to sustained stimuli
Stimulus
G protein
AC
Receptor
cAMP
AC blocker
normal
inhibited
tolerant
enhanced

The emergence of disorder as an endo-exo transition



Brain centers
上位中枢

Hypothalamus
視床下部

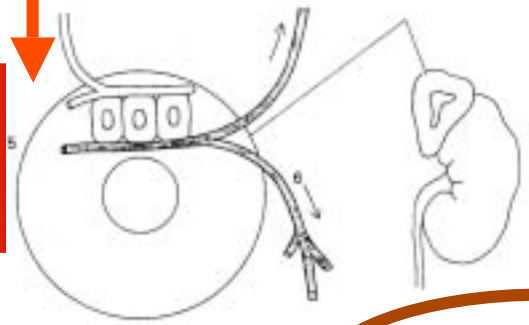
Anterior pituitary
下垂体

Brain

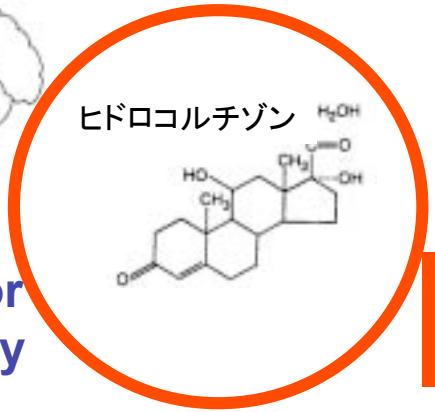
Stimuli

ACTH
副腎皮質刺激ホルモン

Body

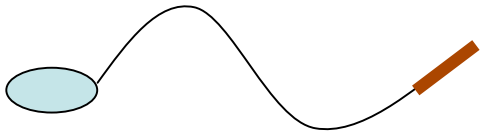


Adrenal cortex
副腎皮質



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

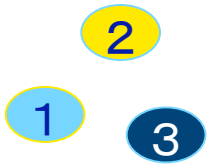
I

Exo → Endo

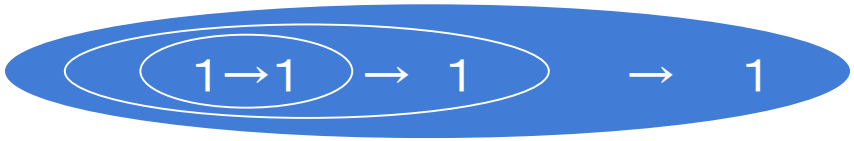
Creativity such as memory formation or hypersensitvity may be defined as the emergence of hidden dynamics through the interplay between external stimuli and internal properties.

II

Exo-world

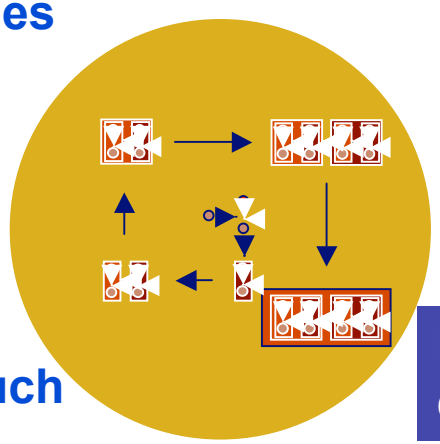


Endo-system



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

III



Endo-exo circulation

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

M. Murase, SANSAI: An Environmental Journal for the Global Community, No.3, 1- 35 (2008)

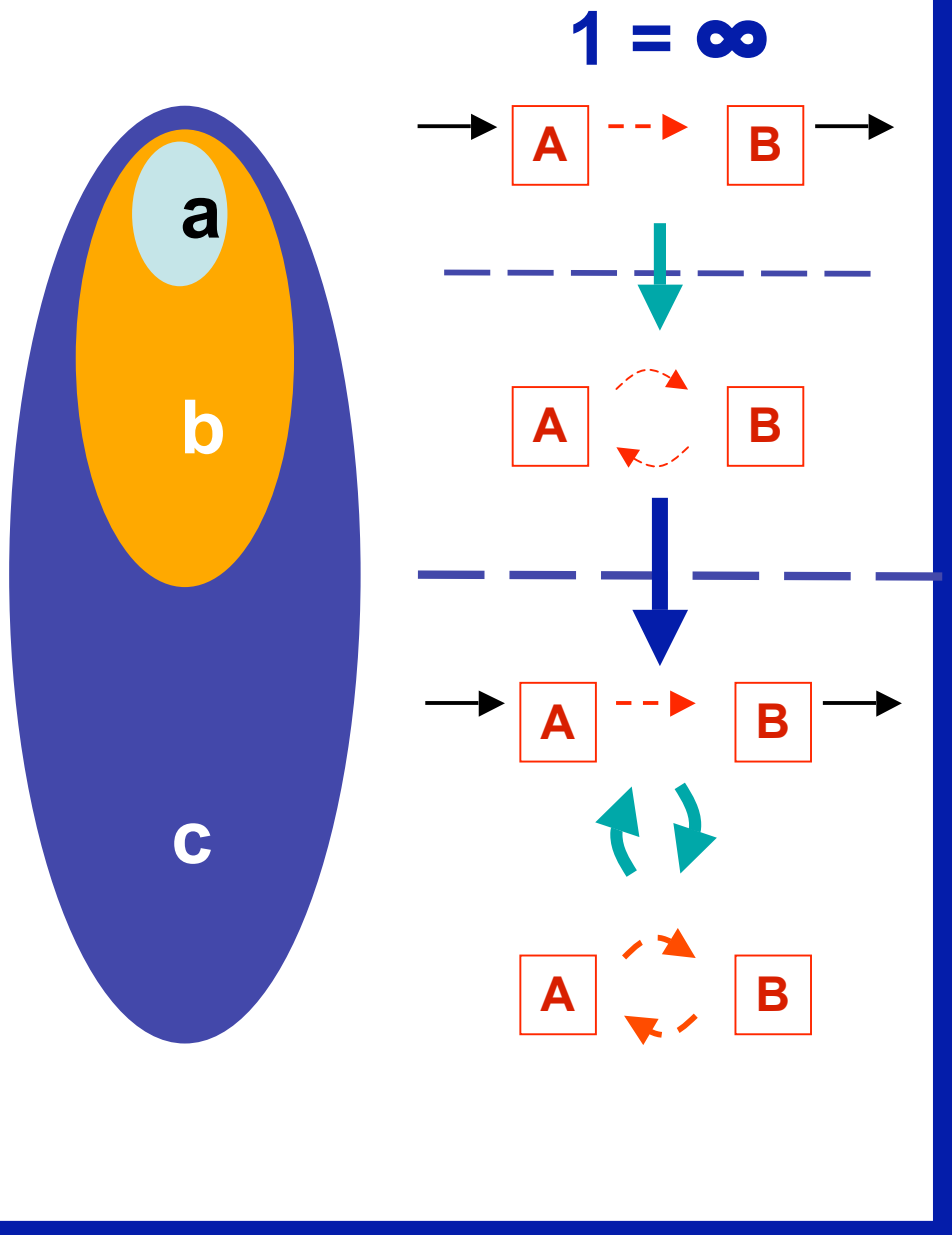
Thank you !

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

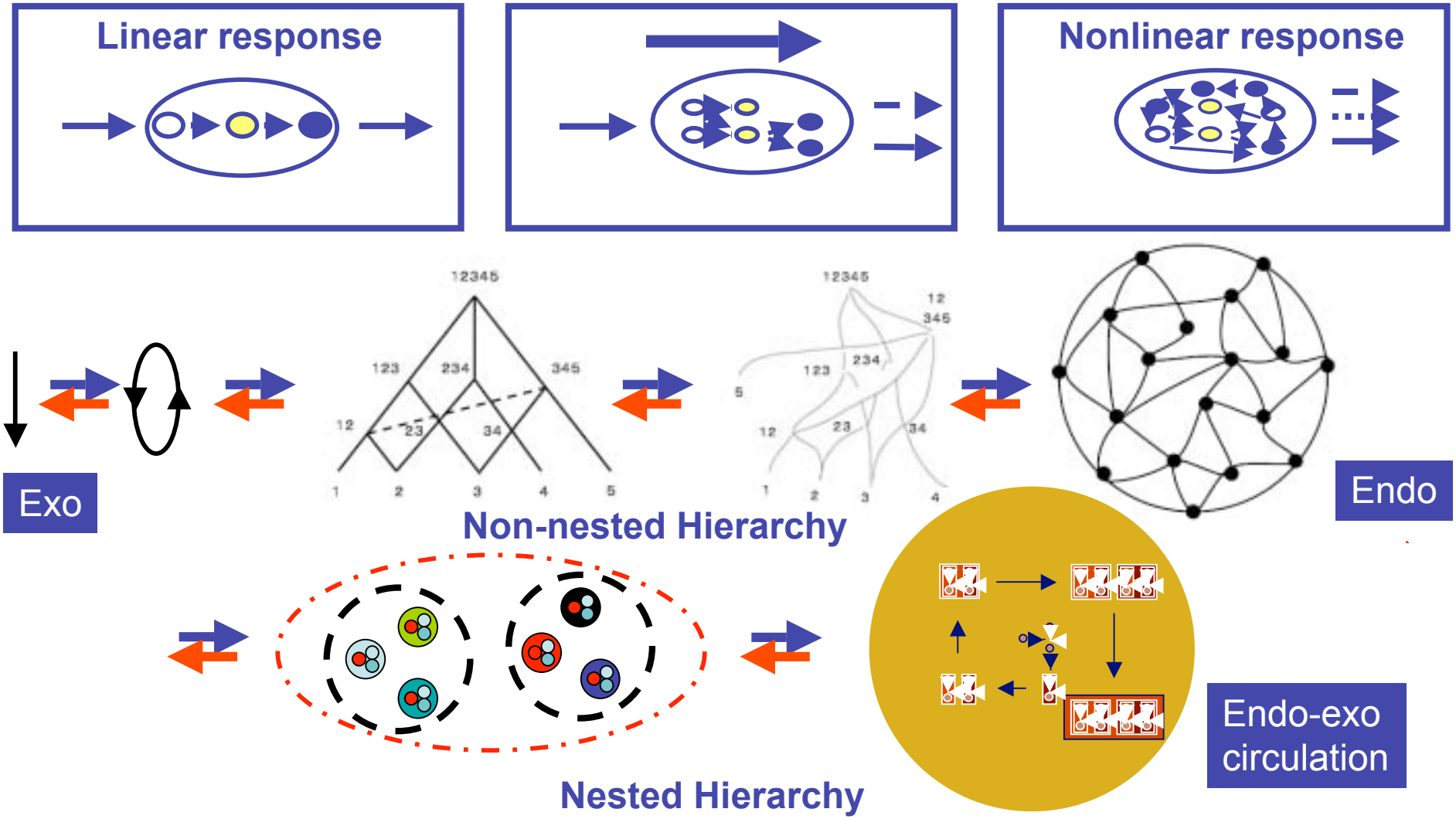


Linear process

Nonlinear process
(Memory formation)

Creativity as the emergence of hidden dynamics

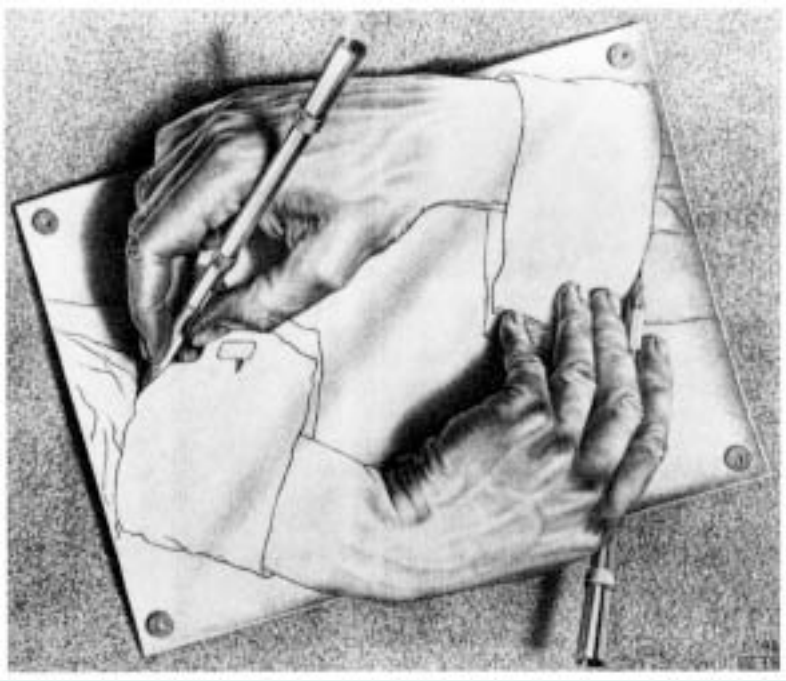
Evolution, development and emergence of diseases as exo-endo transitions due to the intrinsic nature as well as extrinsic stimuli including environmental pollution



M. Murase, SANSAI: An Environmental Journal for the Global Community, No.3, 1- 35 (2008)

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)