

Generarea, transmiterea și procesarea semnalului în sistemul nervos

Informație – Semnal – Viață



*Halobacterium
salinarium*



Sea squirt



Natura semnalului

- *Semnal electric*
- *Semnal chimic*
- *Semnal magnetic*
- *Câmp de informatie*

Semnal electric

- mecanisme de generare***
- relația stimul-răspuns***
- generarea spontană***

Semnalul electric

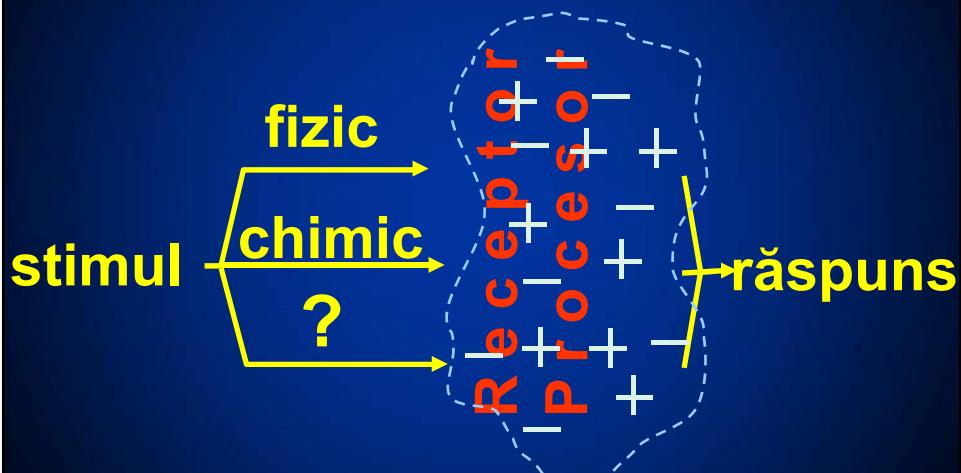
Luigi Galvani (1791-97) - curentul bioelectric

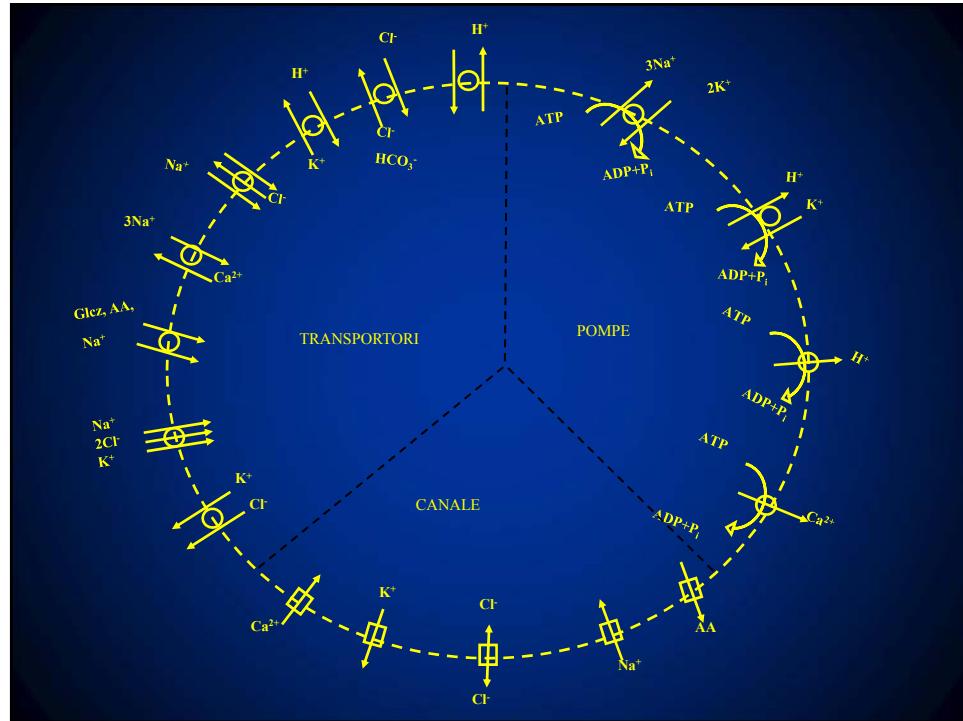
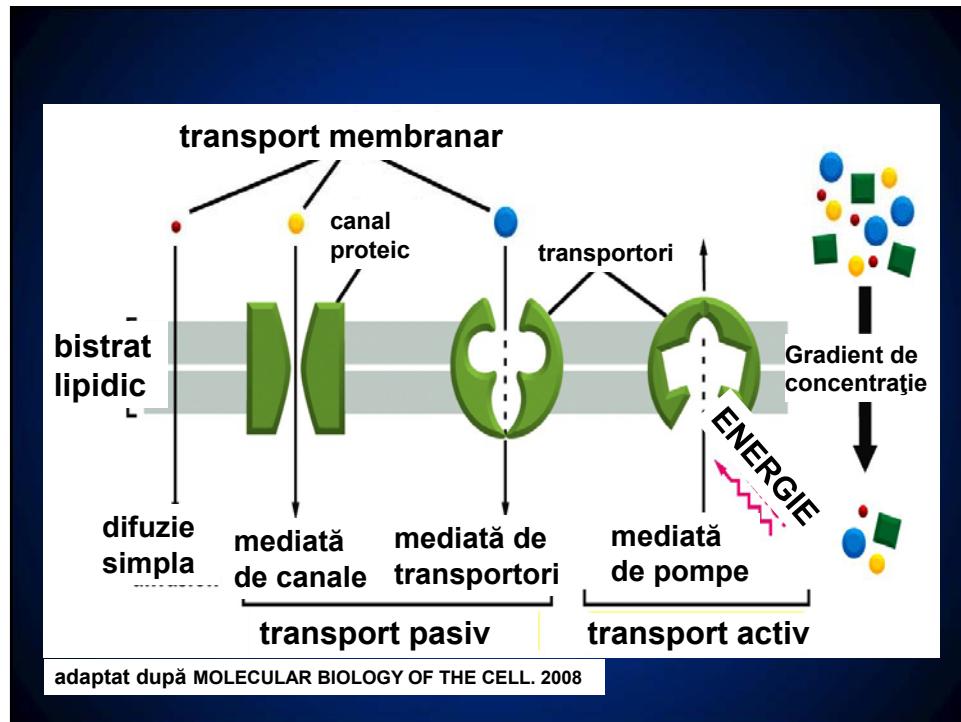
A. Volta-bateria electrică -1800

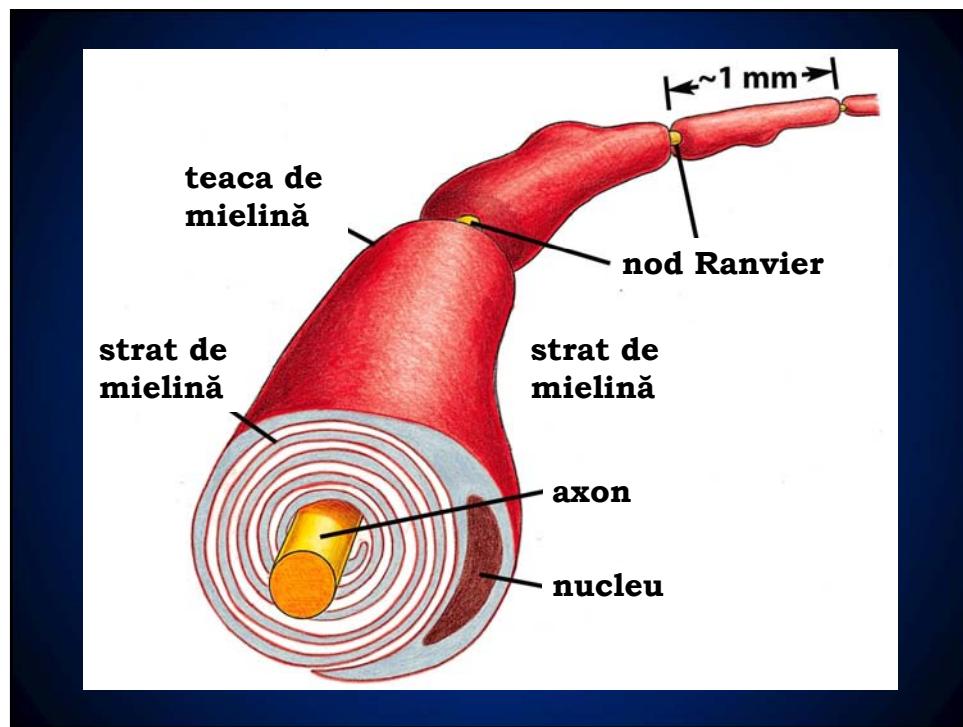
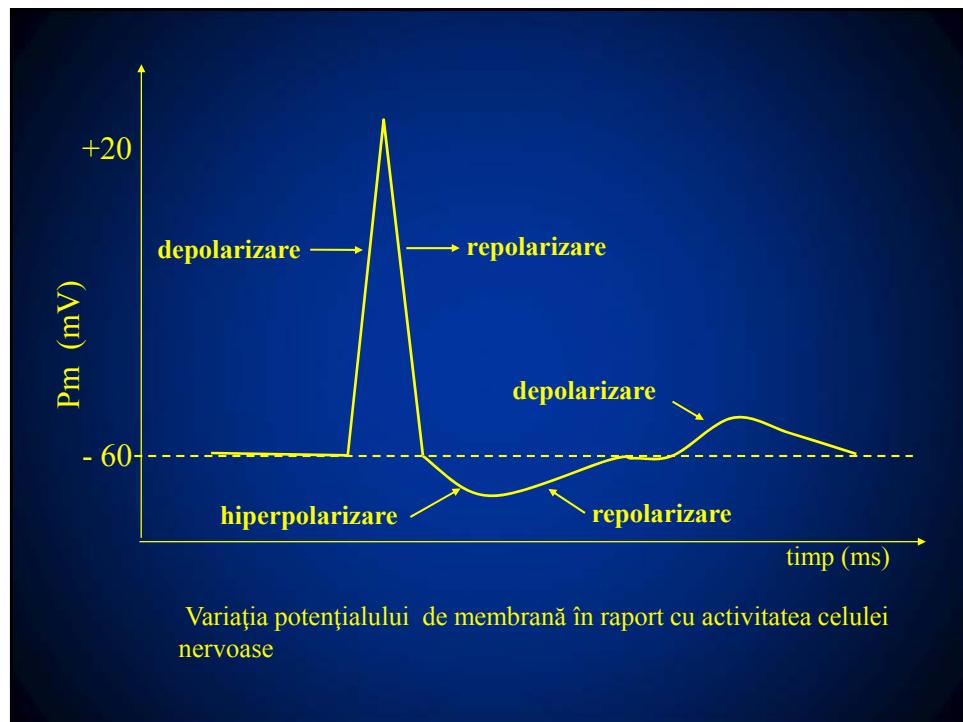
**Cole și Curtis -1939,
Hodkin & Katz 1949- PA / Na**

H. Berger- de la telepatie la EEG

Interacțiunea stimul - receptor - răspuns



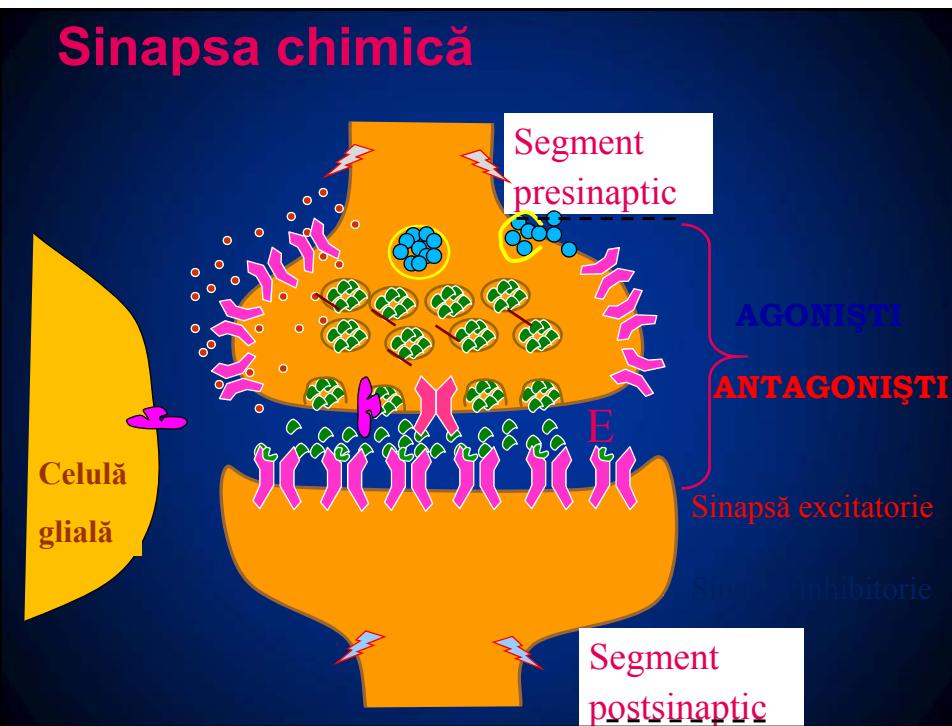




Semnal chimic

- eliberarea semnalului chimic**
- mecanisme de control și stimulare**
- relația semnal electric-chimic**

Transmiterea sinaptică chimică



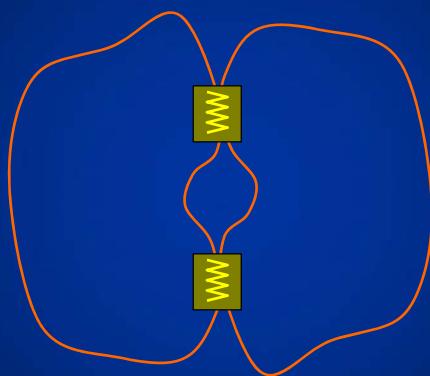
Neurotransmițători cu moleculă mică și enzimele lor de biosintează

| Neurotransmițător | Enzime | Activitate |
|----------------------|--|------------------------------|
| ACETIL COLINĂ | Colin acetyltransferază | Specifică |
| AMINE BIOGENE | | |
| Dopamină | Tirozin hidroxilază | Specifică |
| Epinefrină | Tirozin hidroxilază și dopamin b hidroxilază | |
| Norepinefrină | Tirozin hidroxilază și dopamin b hidroxilază | Specifică |
| Serotonină | Triptofan hidroxilază | Specifică |
| Histamină | Histidin decarboxilază | Specifitate incertă |
| AMINOACIZI | | |
| GABA | Glutamat decarboxilază | Specifitate probabilă |
| Glutamat | Enzime din metabolismul general | Cale specifică nedeterminată |
| Glicină | Enzime din metabolismul general | Cale specifică nedeterminată |

**Peptide cerebrale neuroactive
clasificate după localizarea tisulară**

| Categorie | Peptide |
|---|--|
| HORMONI ELIBERATORI HIPOTALAMICI | TRH, GnRH, Somatostatin, CRH, GH-RH |
| HORMONI NEUROHIPOFIZARI | Vasopresină, Oxitocină |
| PEPTIDE HIPOFIZARE | ACTH, B-endorfină, A-MSH, Prolactină, LH, GH, TSH |
| PEPTIDE GASTROINTESTINALE | VIP, CCK, Gastrină, Neurotensină, Met-Enkefalină, Leu-Enkefalină, SP, Insulină, Glucagon, Bombezină, Secretină, SST, TRH, Motilină |
| PEPTIDE CARDIACE | PAN |
| ALTELE | Angiotensina II, Bradikinină, Calcitonină, CGRP, NPYY, Galanină, Substanța K (Neurokinina A), Peptide de somn |

Transmitere efaptică



Myoclonus of peripheral origin: two case reports.

Tyvaert L, Krystkowiak P, Cassim F, Houdayer E, Kreisler A, Destée A, Defebvre L. *Mov Disord*. 2009 Jan 30;24(2):274-7

Bilateral processing in chemical synapses with electrical

'ephaptic' feedback: a theoretical model. Savchenko LP.

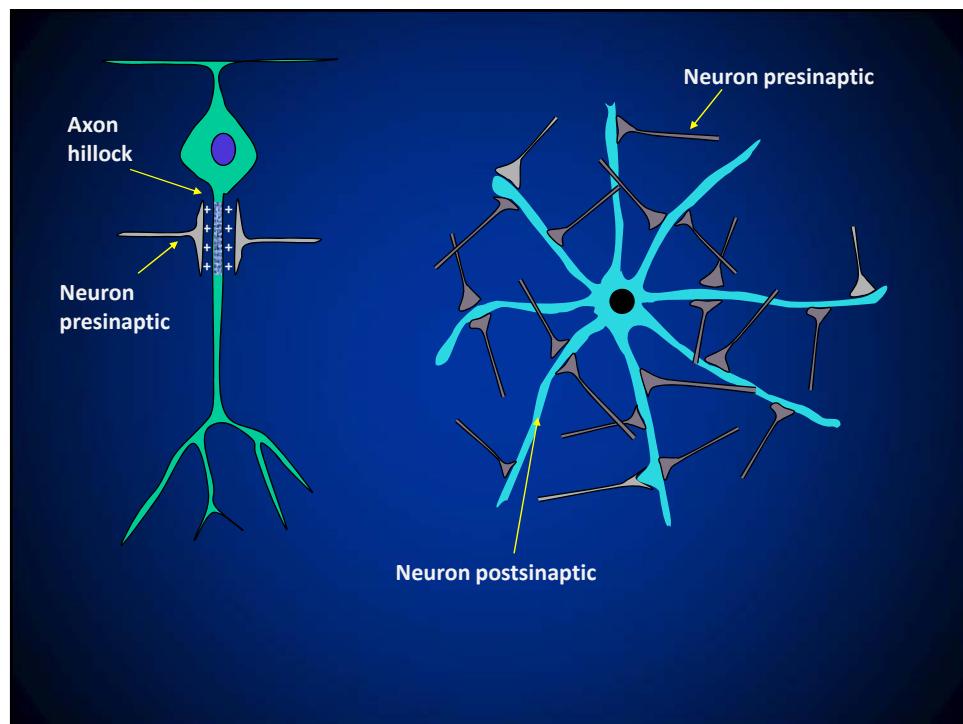
Math Biosci. 2007 May;207(1):113-37. Epub 2006 Oct 7. PMID: 17112549

Rhythmic neuronal discharge in the medulla and spinal cord

of fetal rats in the absence of synaptic transmission. Ren J,

Momose-Sato Y, Sato K, Greer JJ. *J Neurophysiol*. 2006

Jan;95(1):527-34. Epub 2005 Sep 7



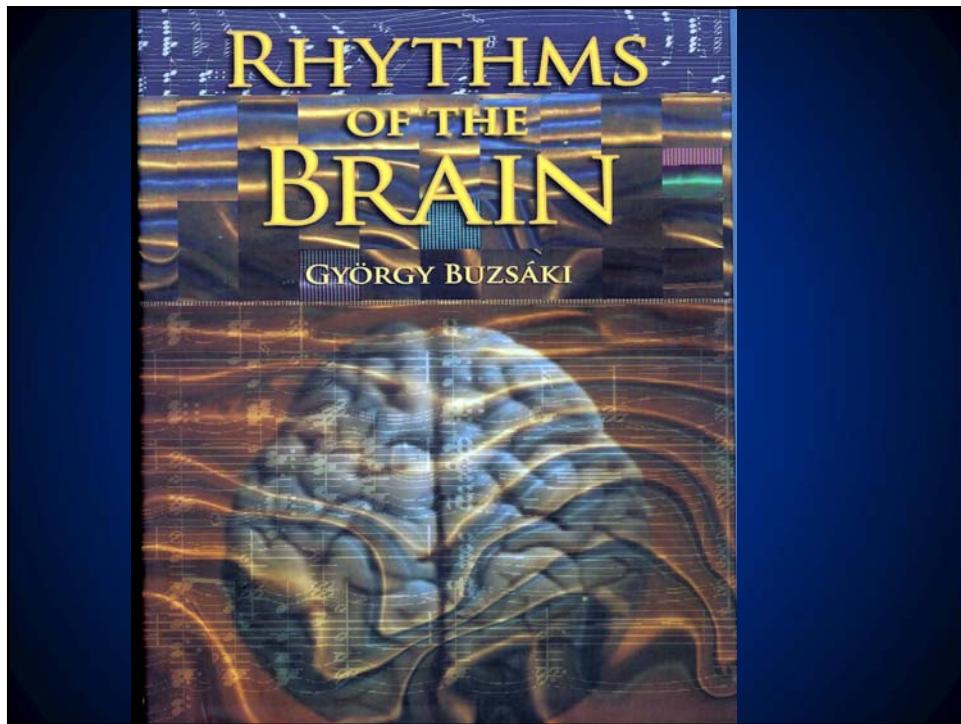
Activitatea electrică spontană a creierului

...Due to its ability to give rise to spontaneous activity, the brain does not simply process information but also generates information.

...spontaneous neuron activity, far from being mere noise, is actually the source of cognitive abilities.

...the source of spontaneous neuron activity (noise), has never been identified and has been assumed to result from brain's imperfections.

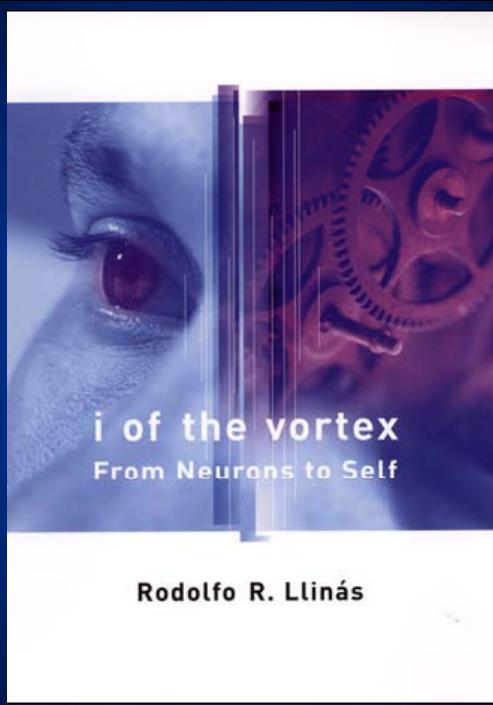
György Buzsáki



The central generation of movement and generation of mindness are deeply related; they are in fact different parts of the same process... Mindness is the internalization of movement

Prediction is ultimate Function of the Brain

How the mind came to us or we to it is a rich and beautiful story that is over 700 million years old – and, like all things biological, is still being written



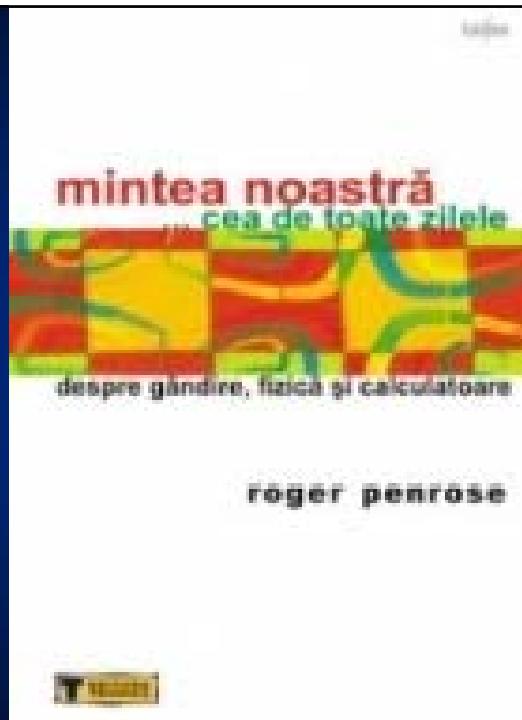
Simultaneity of neuronal activity, brought into existence not by chance but by intrinsic oscillatory electrical activity, resonance and coherence are at the root of cognition. Indeed, such intrinsic activity forms the very foundation of the notion that there is such a thing called our "selves"

... understanding the brain/body-mind complex is possible only when these three are considered as a holistic entity and not as discrete structures or functions.

Neuroscience is awaiting for a breakthrough: an essay bridging the concepts of Descartes, Einstein, Heisenberg, Hebb and Hayek with the explanatory formulations in this special issue. E. Başar, Karakaş . Intern. J. Psychophysiology. 60 (2006) 194–201

*...există încă o mare necunoscută în
înțelegerea lumii fizice, exact la un nivel
ce ar putea fi relevant pentru modul în care
operează gândirea umană și conștiința, și
care se găsește chiar în fața nasului nostru
(sau mai exact în spatele)!*

*Problemele de filozofie și de psihologie își
vor avea locul lor de cinste atunci când
vom încerca să înțelegem natura și funcția
conștiinței*



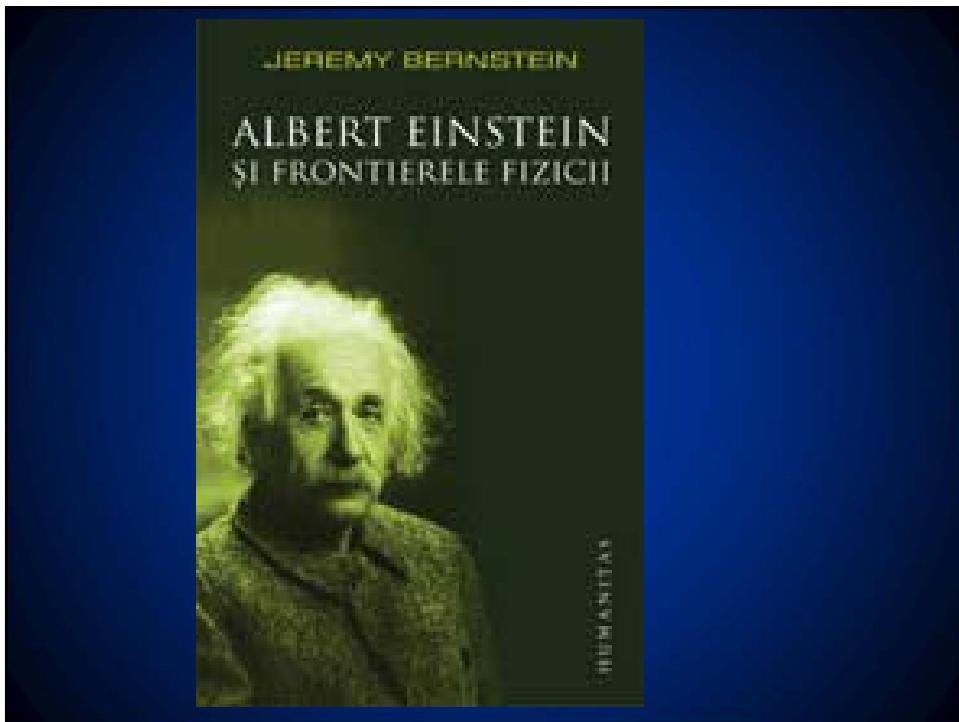
Penrose face parte dintr-un mare grup de fizicieni, în continuă creștere, care consideră că Einstein nu a fost îcăpățanat sau aiurit atunci când a spus că “degetul cel mic” i-a spus despre mecanica cuantică că este incompletă.

Realizările lui Penrose izvorăsc din capacitatea sa de a se mira în fața misterului și a frumuseții existenței Cine este reprezentantul misterului ?

Bătrânul- un spirit organizator al Universului - Universul pare să asculte de legi precise și că acestea puteau fi înțelese de oameni.

Acest Tânăr a “ridicat un colț al vălului cu care este acoperit Bătrânul”

Răspunsul lui Einstein la solicitarea lui Paul Langevin, cu privire la formula “lungimii de undă” a unei particule de materie -1924



The conception of the objective reality of the elementary particles has thus evaporated not into the cloud of some obscure new reality concept, but into the transparent clarity of a mathematics that represents no longer the behavior of the particle but rather our knowledge of this behavior.

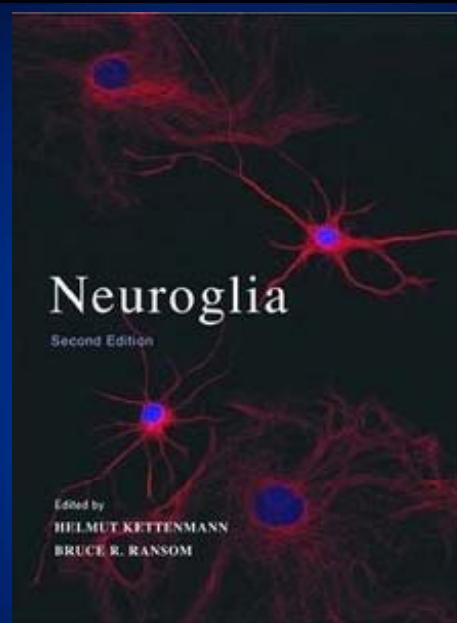
(Heisenberg 1958, p. 100).

I. Elemente morfolo-funcționale ale sistemului nervos

Structura cuantică

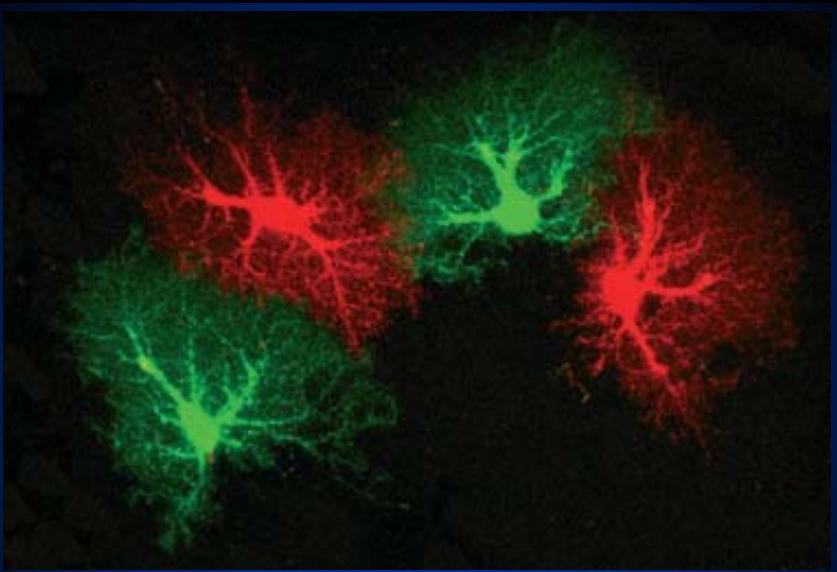
“As impressive as our gains in glial cells knowledge have, the next is yet to come. Glial researchers have struggled with our own version of the Heisenberg uncertainty principle.”

Neuroglia (second edition) H. Kettenman, B R Ransom

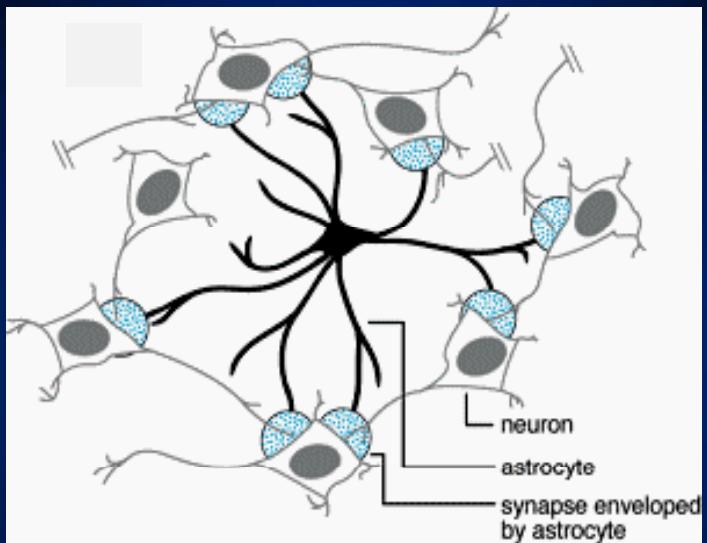


- <http://www.ucl.ac.uk/npp/da.html>

In substanță cenușie a mamiferelor o singură celulă de tip astrocit poate contacta 20-100000 de sinapse la rozătoare și peste 2000000 la primate și om. (Oberheim et al. 2006; Verkhratsky et al. 2011).



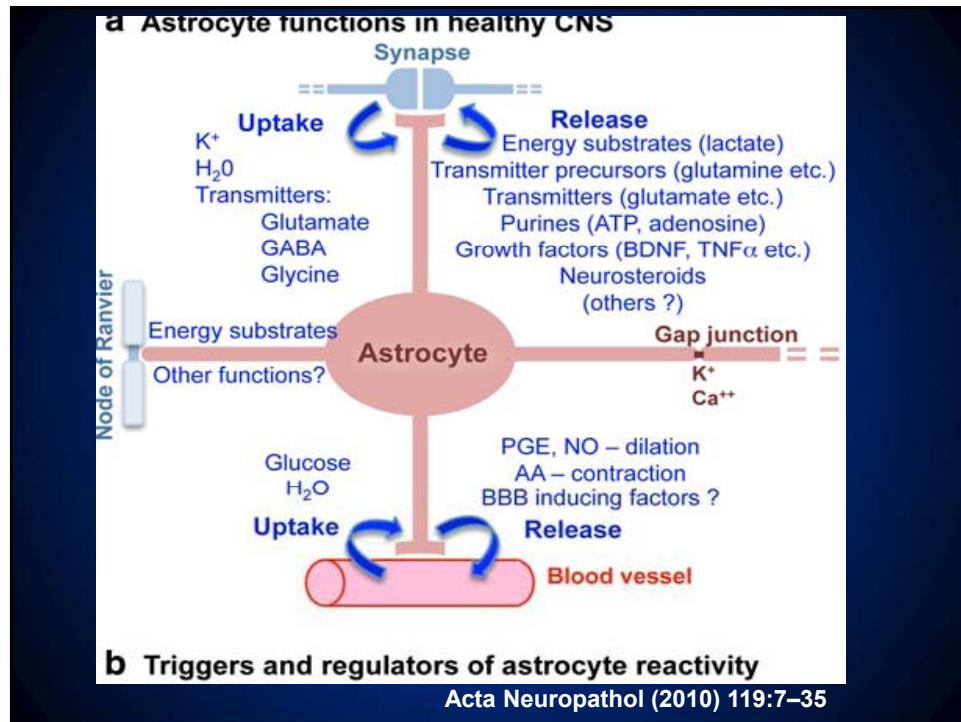
Brain tissue is largely divided between domains of astrocytes. Mouse astrocytes, whose gap junctions were closed, were filled with two different dyes to visualize their respective domains. In a human brain, a single astrocyte domain can encompass over million neuronal synapses. Reprinted from Pekny and Wilhelmsson (2006).



<http://www.antanitus.com/hypothesis/>

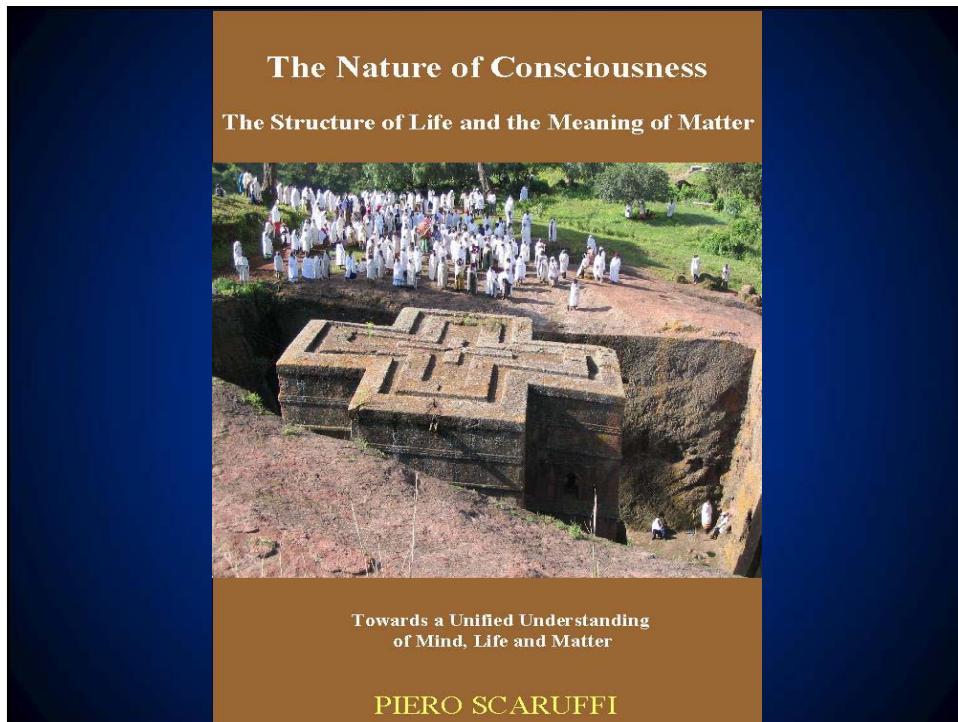
Amzica, 2000

Expression of neurotransmitter receptors in astrocytes in different brain regions is highly heterogeneous and is likely to be regulated by local neurotransmitter environment and often the assortment of receptors expressed by astroglia matches that present in the their neuronal neighbors (Verkhratsky et al. 1998; Verkhratsky 2011).



The structure of quantum mechanics is such that, although the effect upon the observed system of the agent's choice about how to act is mathematically specified, the manner in which this choice itself is determined is not specified. This means that, in the treatment of experimental data, the choices made by human agents must be treated as freely chosen input variables, rather than as mechanical consequences of any known laws of nature.

Model of mind-brain interaction Phil. Trans. R. Soc. B (2005)



*A breakthrough in neuroscience needs a
“Nebulous Cartesian System”
Oscillations, quantum dynamics and chaos in
the brain and vegetative system. International
Journal of Psychophysiology 64 (2007) 108-122*

*Endogenous Brain Oscillations and Related
Networks Detected by Surface EEG-Combined
fMRI. Human Brain Mapping 29:762-769 (2008)*

*Spontaneous and driven cortical activity:
implications for computation. Current Opinion in
Neurobiology 2009, 19:439-444*