

**AZ ELEKTROFIZIOLÓGIA
RÖVID TÖRTÉNETE
A KEZDETEKTŐL**

MÁR A GÖRÖGÖK...

- Egyiptomi hieroglifák (i.e. 4000): Elektromos hal ütése



- Terápiás alkalmazás (i.u. 46): Scribonius Largus sikerrel alkalmazott torpedo halat fejfájás és arthritis gyógyítására.
- Claudius Galenus (129 – 199/217) görög származású római orvos „animal spirit” áramlik az agykamrából az idegeken keresztül az izmokba.
- A "physiologia" szót írott szövegben először Jean Fernel francia orvos (†1558) használta: "Medicina Universa" (1552).
- Th. Zwinger: "Physiologia medica" (1610) az első könyv, amely címében is tartalmazza e szót.

René Descartes (1596-1650) Principia Philosophie (1644)

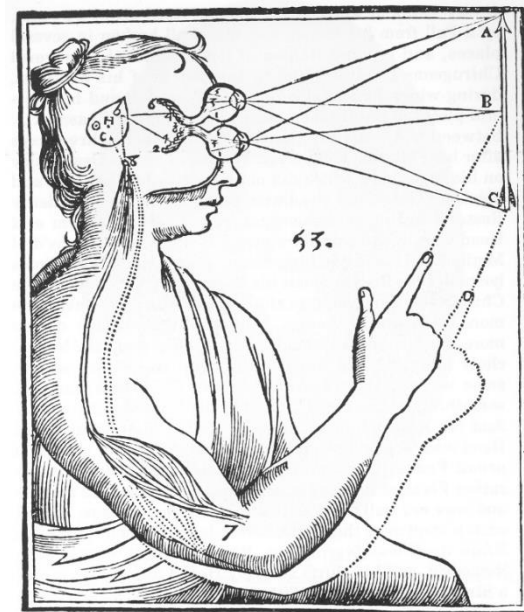


Figure 2.16. A drawing from *De homine* (1662) by René Descartes showing how light enters the eye and forms images on the retina. Hollow nerves from the retina project to the ventricles. The pineal gland (H) then releases the animal spirits into the motor nerves to produce motion.

„... megmagyaráztam még, milyen alkatúaknak kell lenniük a test idegeinek s izmainak, hogy az életszelleme, melyek bennük vannak, megmozgathassák a test tagjait...”

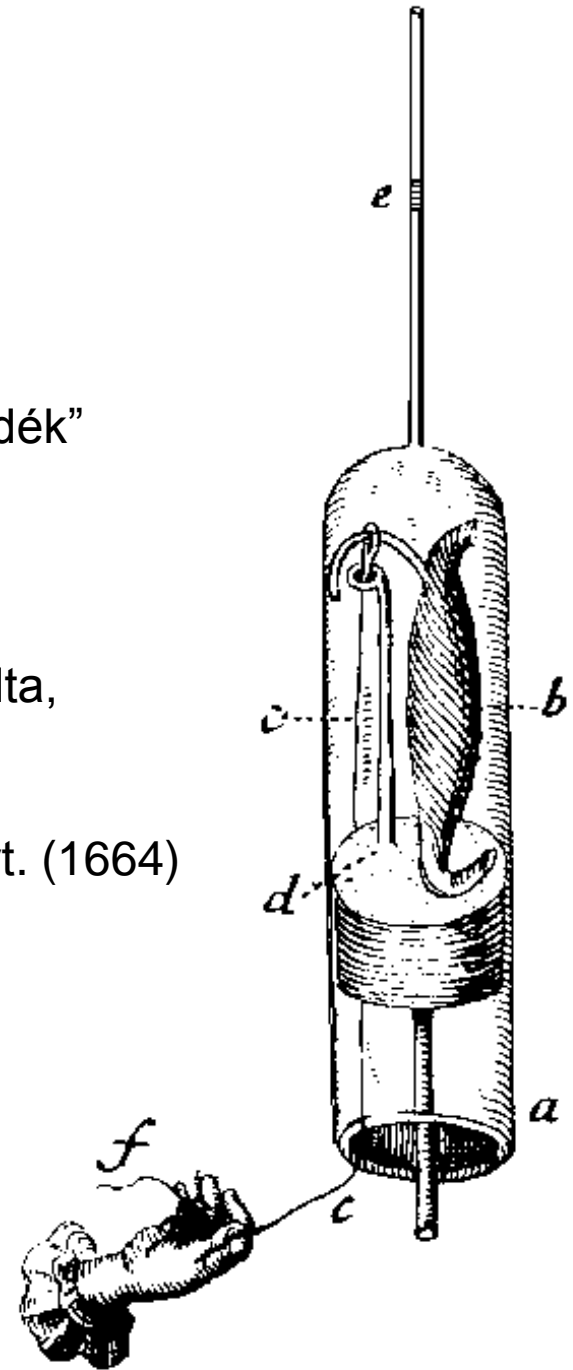
"... a kísérletekre annál inkább szükség van, minél előbbre haladtunk a megismerésben."

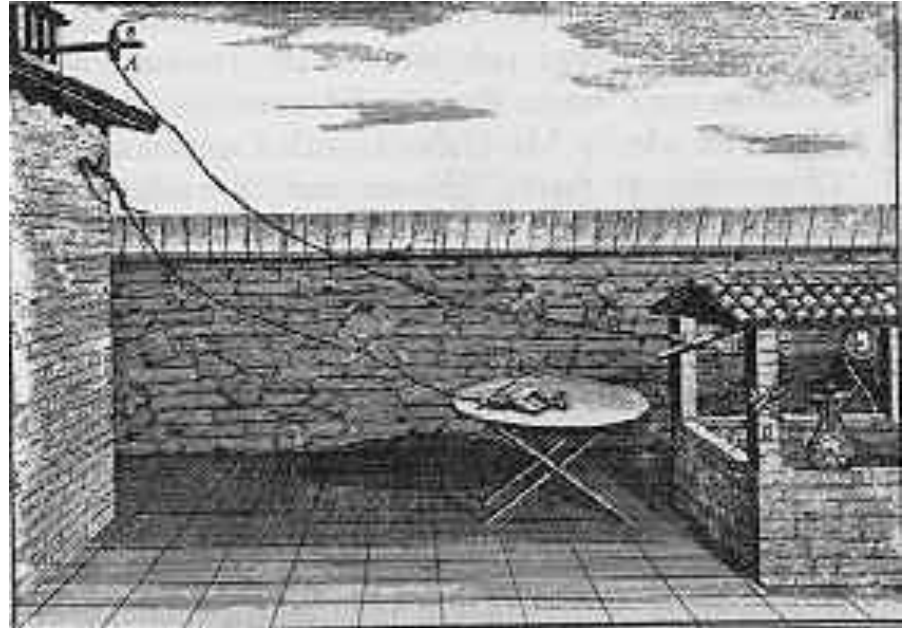
Jan Swammerdam (1637-1680)

holland biológus

Ha az idegben áramló „animal spirit” vagy „idegi folyadék” okozza az izom összehúzódását, akkor az izom térfogatának összehúzódáskor meg kell nőni.

Ezt akarta kimutatni Swammerdam és ekkor tapasztalta, hogy az ideg mozgására szolgáló ezüst drót és a réz hurok érintkezése ingerli az ideg-izom készítményt. (1664)





Luigi Galvani

1737 Bologna - 1798 Bologna

1762 Bolognai Egyetemen előadó

1773 Megkezdzi béka kísérleteit

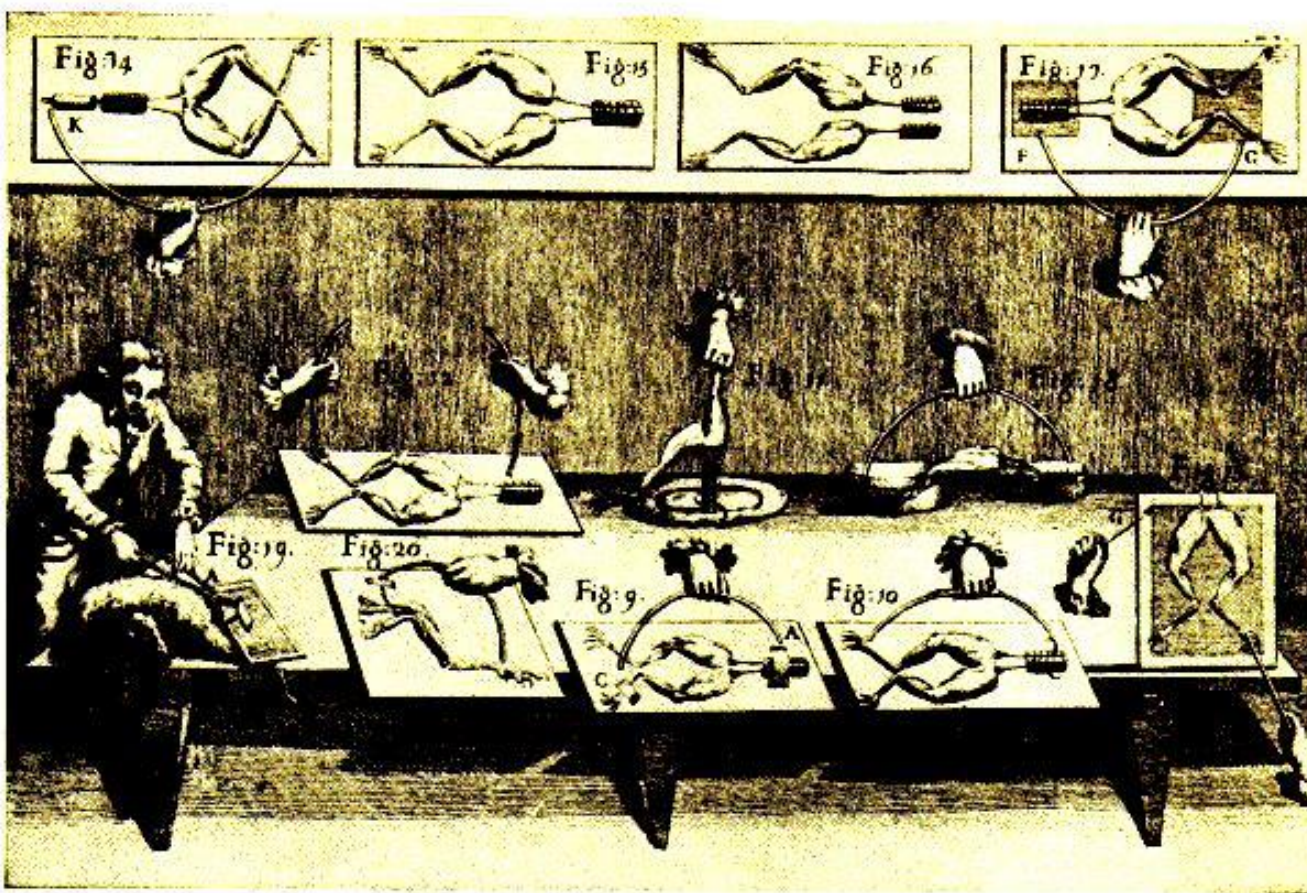
1775 Anatómia és Szülészet professzora

1780 béka ideg-izom preparátum elektromos ingerlése

1791 De Viribus Electricitatis in Motu Musculari

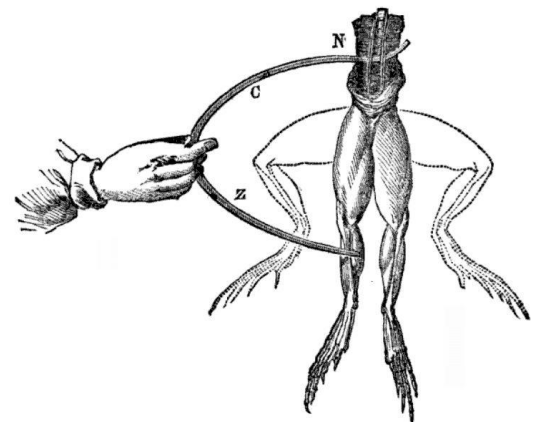
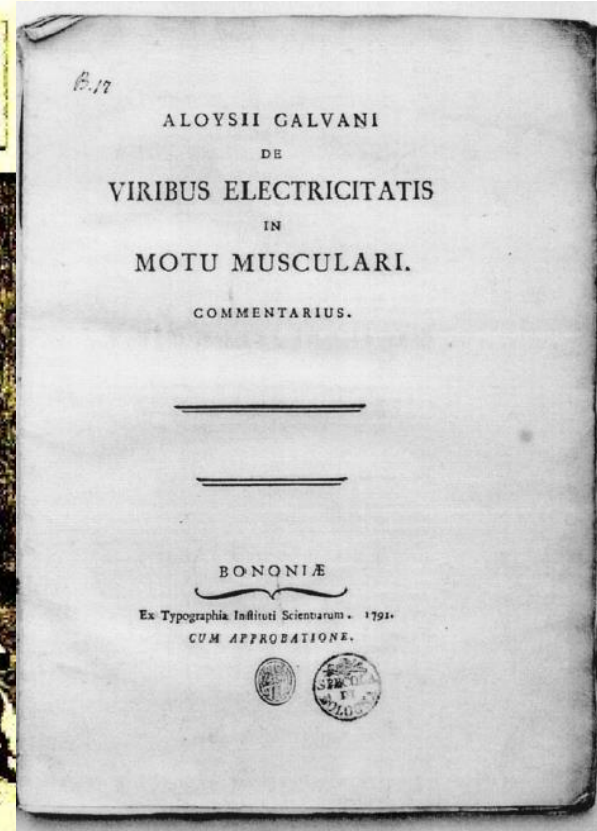
Commentarius

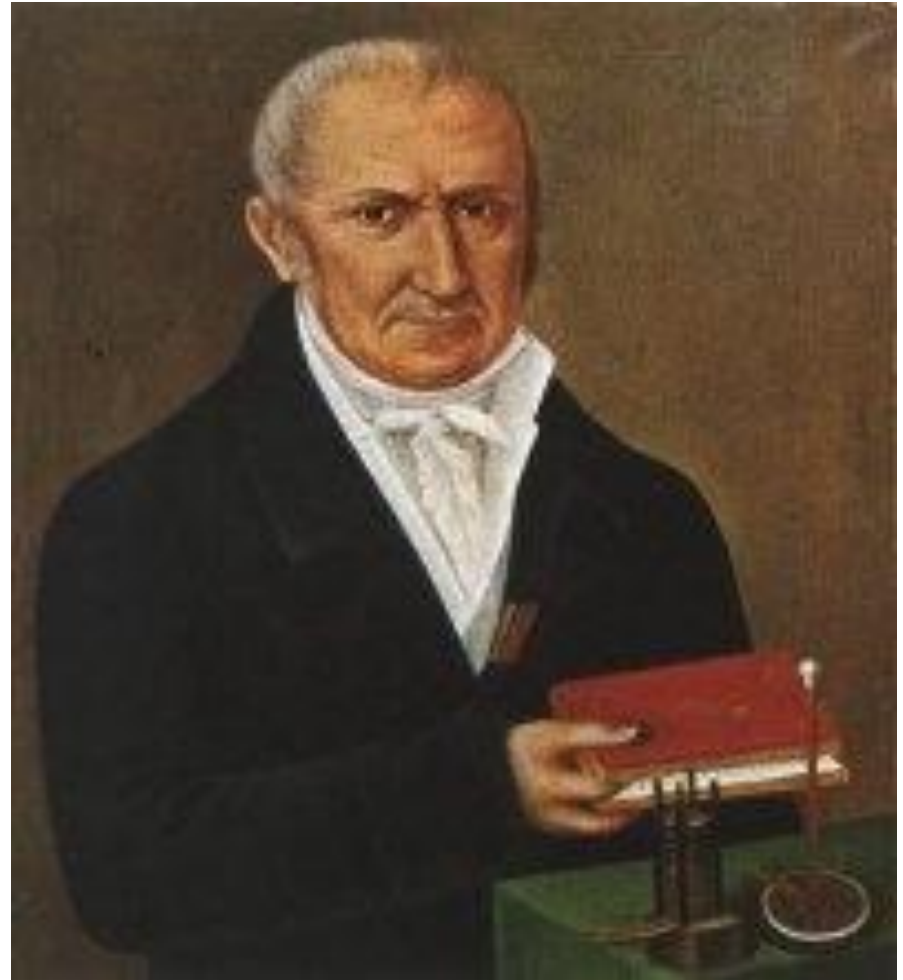
1796 megfosztják egyetemi címeitől



Galvani's Experiments on "Animal Electricity"

„And still we could never suppose that fortune were to be so friend to us, such as to allow us to be perhaps the first in handling, as it were, the electricity concealed in nerves, in extracting it from nerves, and, in some way, in putting it under everyone's eyes.”





Alessandro Volta

1745 Como

+ 1827 Como

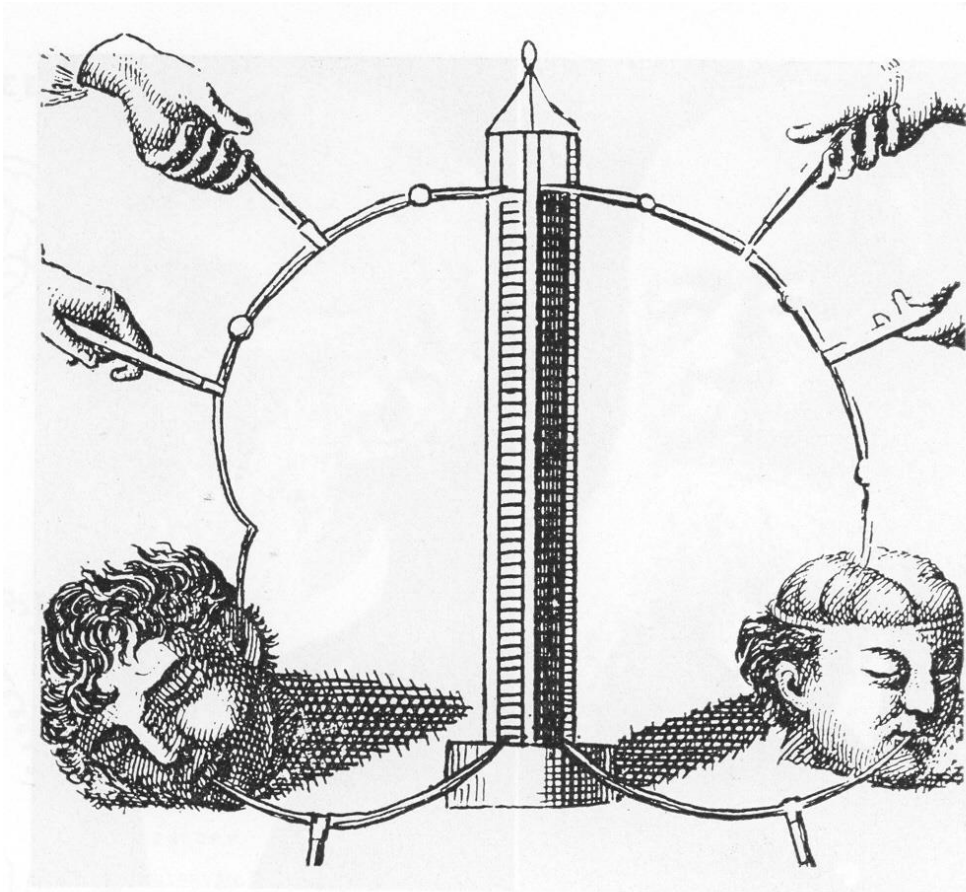


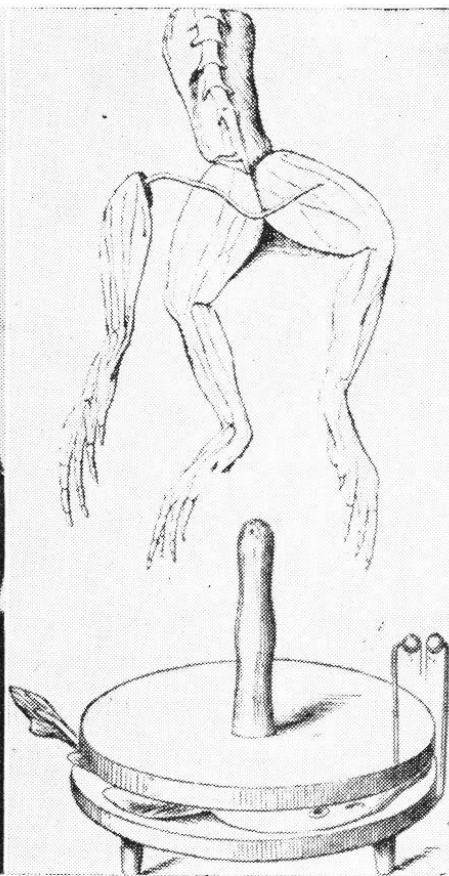
FIG. 32. One of the bizarre experiments of Aldini on two freshly-decapitated criminals. In the center is a voltaic pile, the circuit through the heads being completed by conducting arcs. Aldini, Galvani's impetuous nephew, lacked the sagacity and scientific acumen of his famous uncle. (From Aldini, *G. Essai Théorique et Expérimental sur le Galvanisme*. Paris: Fournier, 1804. 2 vol.)



Giovanni Aldini

1762-1834

Galvani unokaöccse
lefejezett bűnözők agyát
ingerelte

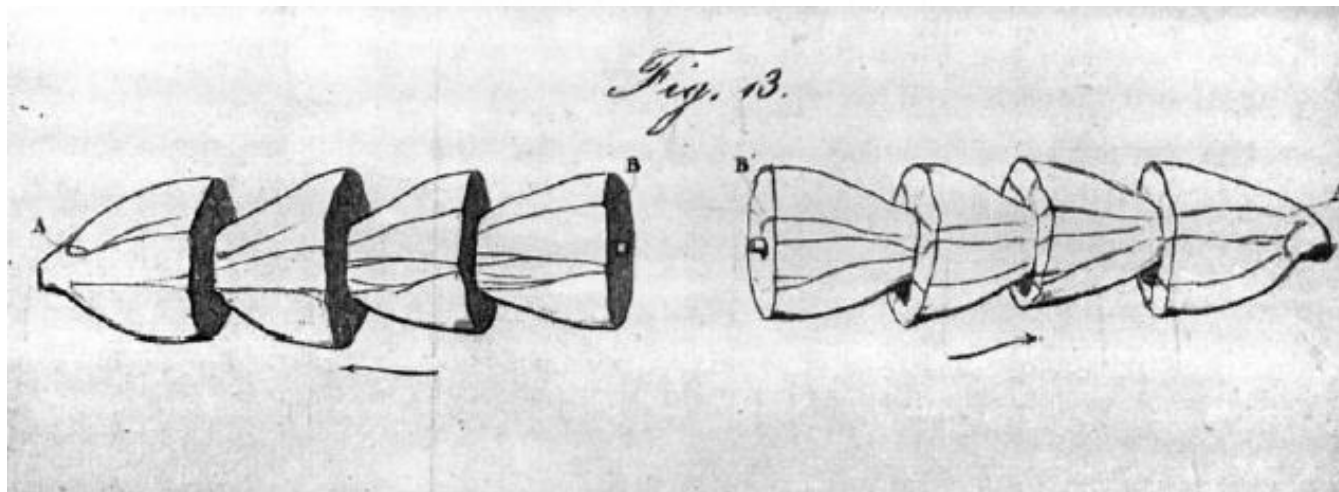


Carlo Matteucci

1811-1865

1840 Pisa fizika professzor

Sorba kapcsolt „izom oszlop”



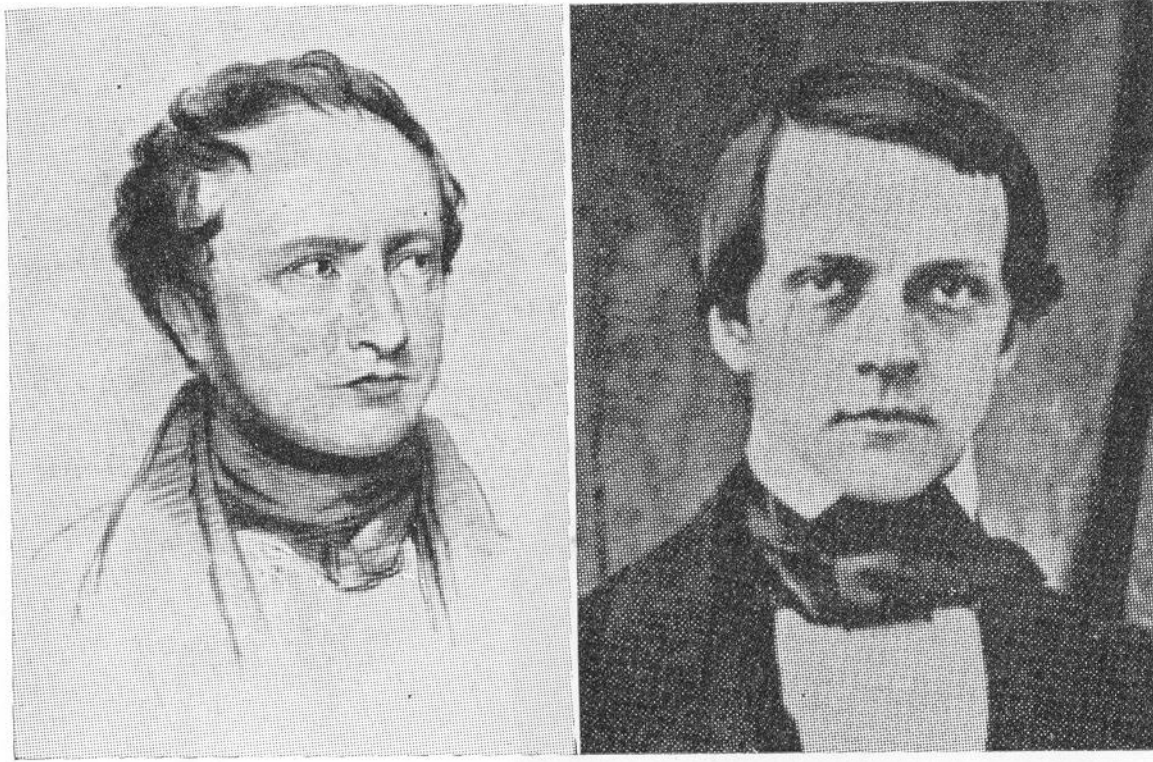


FIG. 15. Johannes Müller and his famous pupil von Helmholtz. The delicate chalk drawing of Müller was at one time in the Surgeon General's Library (now the National Library of Medicine). The picture of von Helmholtz shows him as a young man in the period when he made his major contributions to the physiology of peripheral nerve.

Johannes Müller

1801-1858

1844:

„Probably we will never have the means to measure the speed of the nervous action, since we lack, in order to establish comparisons, these immense distances whereby we can calculate the speed of light, which, under this respect, has some relation with it.”

Hermann L. F. von Helmholtz

1820-1894

1850:

megméri a béka ideg vezetési sebességét: ~ 30 m/s

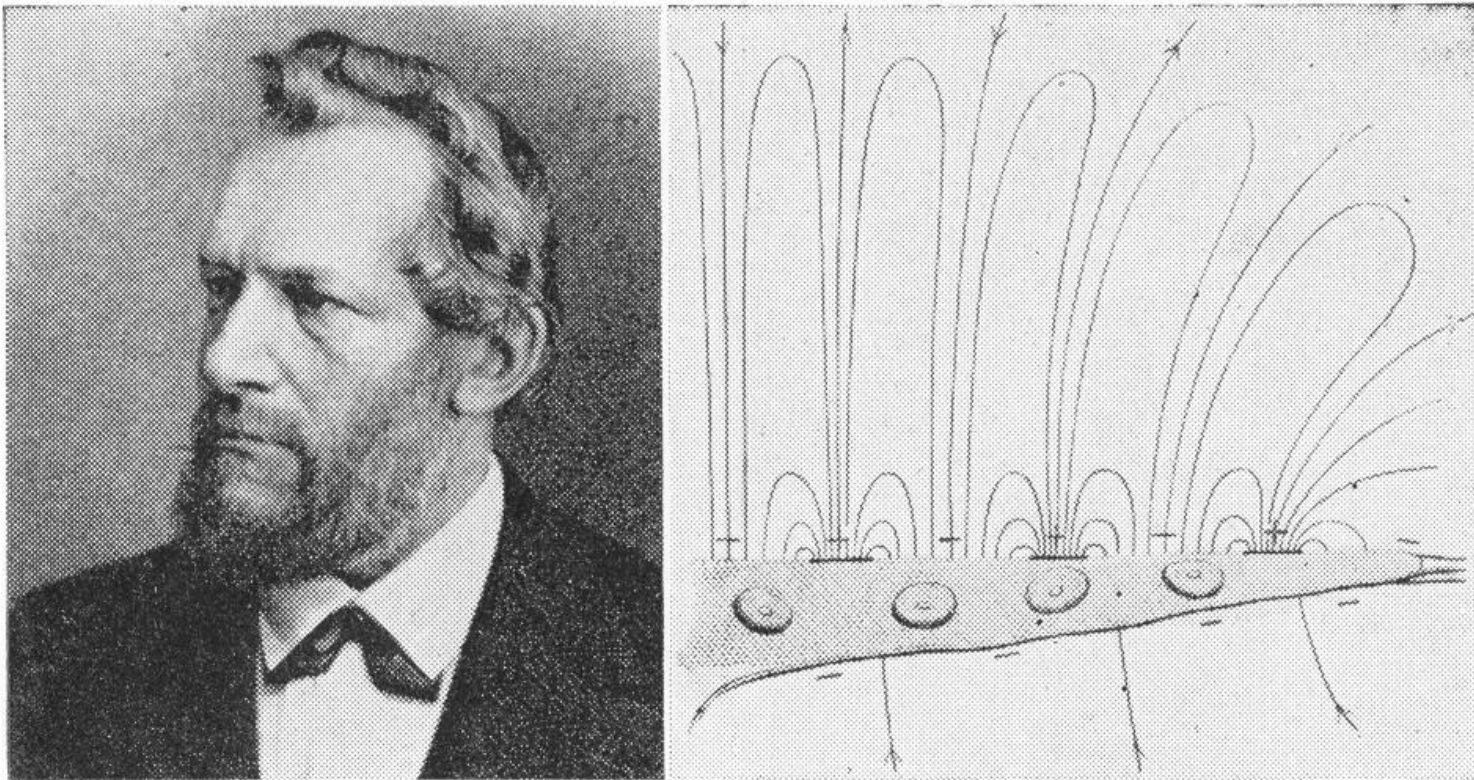


FIG. 17. du Bois-Reymond and one of the schemata he postulated for transmission at the end plate.

Emil Du Bois-Reymond 1818-1896 „Negative Schwankung”
„the negative variation” a békaizom sértett felülete negatív a sértetlenhez képest.



Gustav Theodor Fritsch

német anatómus és fiziológus

1838-1891

Eduard Hitzig

német neurológus és pszichiáter

1838-1907

Az agykéreg feltérképezése
elektromos
ingerléssel állatokon



Richard Caton

angol orvos, 1842-1926

Elsőként vezetett el
bioelektromos jeleket
nyúl és majom
agykérgéről.
1875.

Vasili Danilevsky 1877

Adolf Beck 1880

Ernst von Marxow 1883

Hans Berger

1873-1941

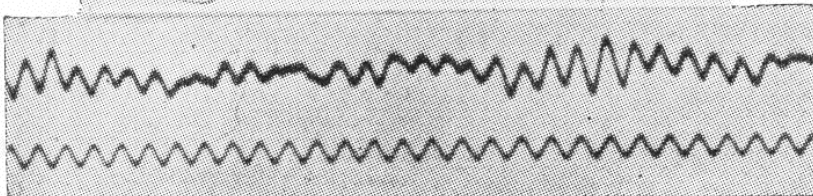
Elsőként vezetett el agyi
bioelektromos jeleket emberről.

1924. július 6.

Über das Elektroenkephalogramm des Menschen
(1929)



Hans Berger



A BIOELEKTROMAGNETIKUS JELENSÉGEK KAPCSOLATOS NOBEL DÍJAK I.

Year	Name of recipient	Nationality	Subject of research
1901	Jacobus van't Hoff *)	The Netherlands	laws of chemical dynamics and osmotic pressure
1903	Svante Arrhenius *)	Sweden	theory of electrolytic dissociation
1906	Camillo Golgi Santiago Ramón y Cajal	Italy Spain	work on the structure of nervous system
1920	Walther Nernst *)	Germany	work in thermochemistry
1924	Willem Einthoven	The Netherlands	discovery of electro-cardiogram mechanism
1932	Edgar Douglas Adrian Sir Charles Sherrington	Britain Britain	discoveries regarding function of neurons
1936	Sir Henry Hallet Dale Otto Loewi	Britain Germany	work on chemical transmission of nerve impulses
1944	Joseph Erlanger Herbert Spencer Gasser	U.S. U.S.	researches on differentiated functions of nerve fibers
1949	Walter Rudolf Hess	Switzerland	discovery of function of middle brain

* Kémiai Nobel díj

A BIOELEKTROMAGNETIKUS JELENSÉGEK KAPCSOLATOS NOBEL DÍJAK II.

1961	Georg von Békésy	U.S.	discoveries of the physical mechanism of the inner ear
1963	Sir John Eccles Alan Lloyd Hodgkin Andrew Fielding Huxley	Australia Britain Britain	study of the transmission of nerve impulses along a nerve fibre
1967	Ragnar Arthur Granit Haldan Keffer Hartline George Wald	Finland U.S. U.S.	discoveries about chemical and physiological visual processes in the eye
1968	Lars Onsager *)	U.S.	work on theory of thermodynamics of irreversible processes
1970	Julius Axelrod Sir Bernard Katz Ulf von Euler	U.S. Britain Sweden	discoveries concerning the chemistry of nerve transmission
1981	David Hunter Hubel Torsten Nils Wiesel	U.S. Sweden	discoveries concerning information processing in the visual system
1991	Erwin Neher Bert Sakmann	Germany Germany	discoveries concerning the function of single ion channels in cells
2000	Arvid Carlsson Paul Greengard Eric Kandel	U.S. U.S. US.	discoveries concerning channels in cell membranes

* Kémiai Nobel díj

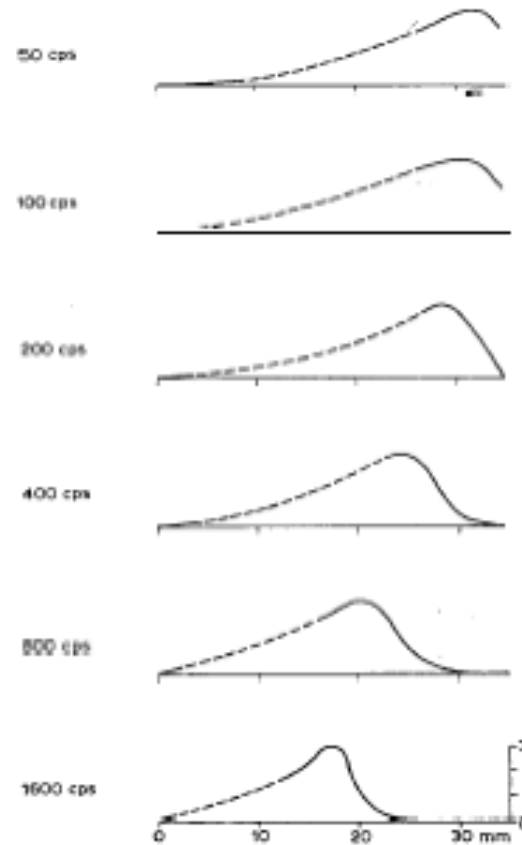
A BIOELEKTROMAGNETIKUS JELENSÉGEK KAPCSOLATOS NOBEL DÍJAK III.

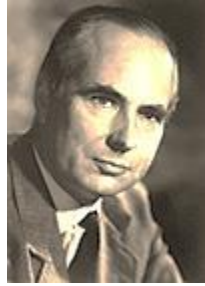
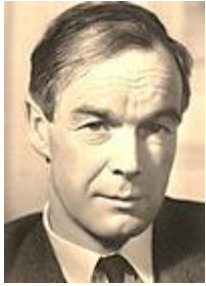
2003	<u>Lauterbur, Paul C.</u> <u>Mansfield, Sir Peter</u>	American British	Discoveries concerning magnetic resonance imaging
	<u>MacKinnon, Roderick</u>	American	Structural and mechanistic studies of ion channels
2004	<u>Buck, Linda B</u> <u>Axel, Richard</u>	American American	Discovery of odorant receptors and the organization of the olfactory system
2013	<u>Rothman, James E.</u> <u>Schekman, Randy W</u> <u>Sudhof, Thomas C.</u>	American American German- American	Discovery of the machinery regulating vesicle traffic, a major transport system in our cells
2014	John O'Keefe May-Britt Moser Edward I. Moser	US- British Norwegian Norwegian	Discovery of cells that constitute a positioning system in the brain



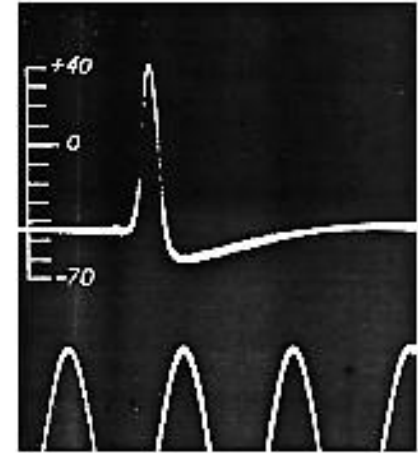
Georg von Békésy
Physiology or Medicine 1961

Discoveries of the physical mechanism
of stimulation within the cochlea

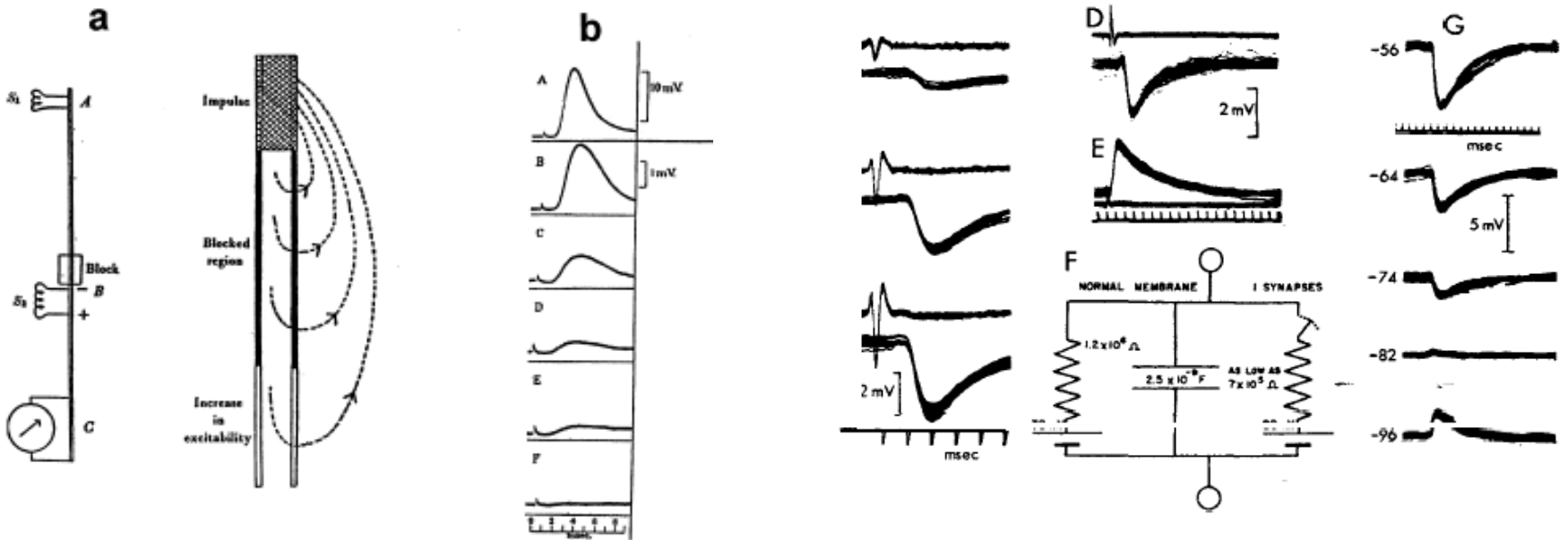


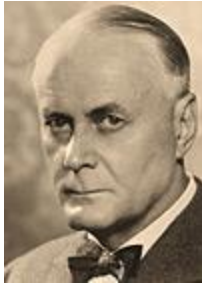


Alan Hodgkin, Andrew Huxley, John Eccles
Physiology or Medicine 1963



Discoveries concerning the ionic mechanisms involved in excitation and inhibition in the peripheral and central portions of the nerve cell membrane





Ragnar Granit



Haldan Keffer Hartline
Physiology or Medicine 1967



George Wald

Discoveries concerning the primary physiological and chemical visual processes in the eye

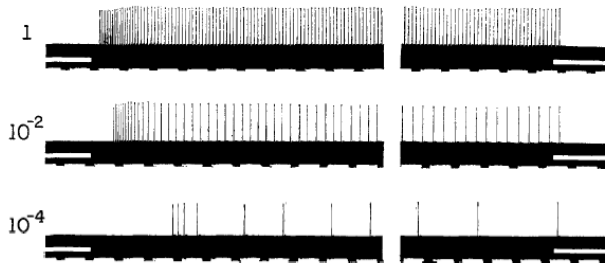
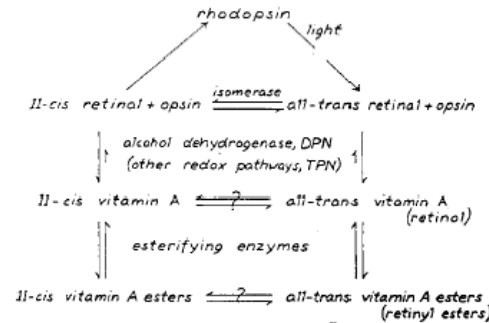


Fig. 1. Oscillograms of the electrical activity (discharge of nerve impulses) in a single optic nerve, from the lateral eye of *Limulus*, stimulated by illumination of the facet associated with its receptor. Relative values of light intensity given at left. Time marked in 1/5 sec in trace at bottom of each record; signal marking period of steady illumination blackens out the white band just above time marks. (After Hartline¹⁾)

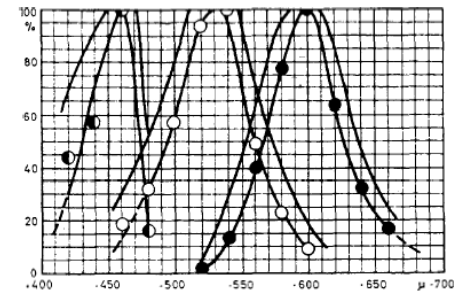


Fig. 3. Averages of individual modulators from cat eye after selective adaptation with blue, green or red filter. Outer contours indicate dispersion. (*J. Neurophysiol.*, 8 (1945))



Sir Bernard Katz



Ulf von Euler



Julius Axelrod

Physiology or Medicine 1970

Discoveries concerning the humoral transmitters in the nerve terminals and the mechanism for their storage, release and inactivation

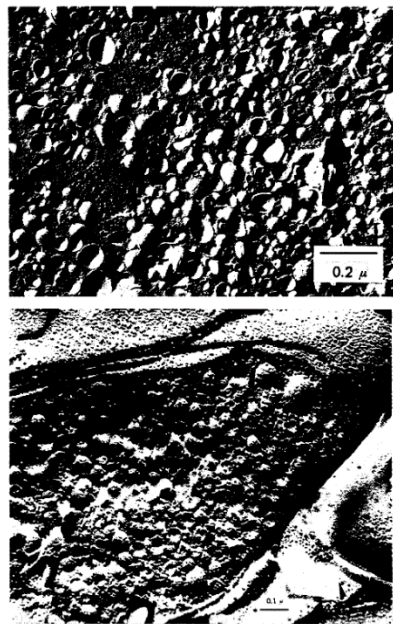
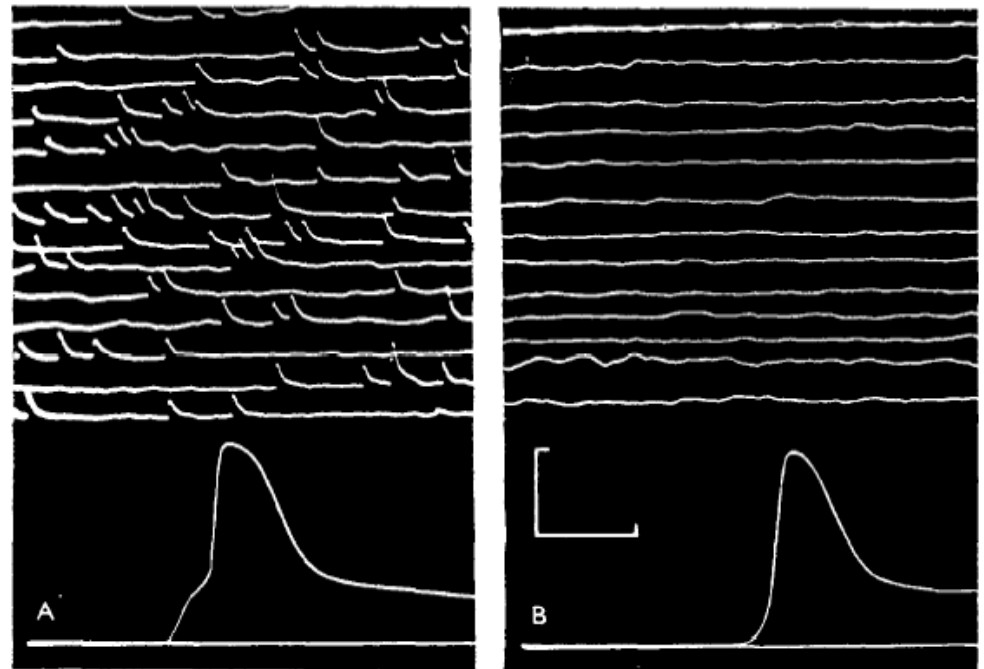
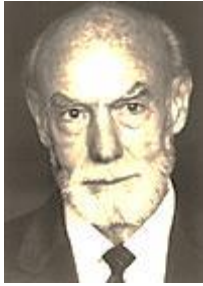


Fig. 2. Freeze-etch preparations. Upper figure: Sedimented bovine splenic nerve granules. Lower figure: Adrenergic nerve terminal swelling in guinea-pig vas deferens. (Von Euler, Gemne and Lishajko)





Roger W. Sperry



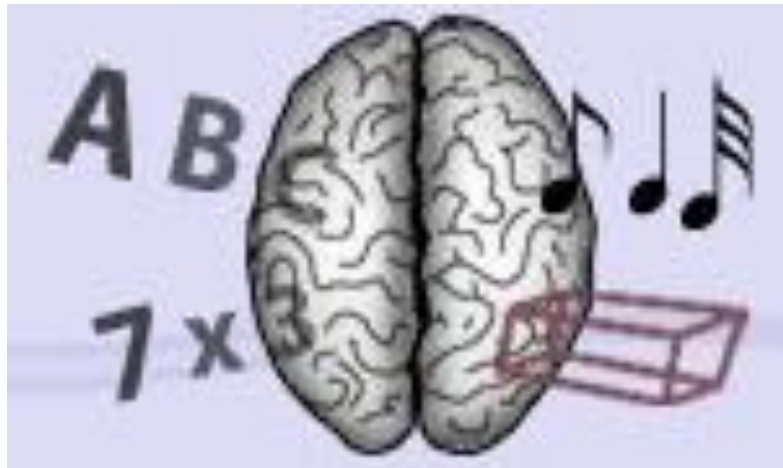
David H. Hubel



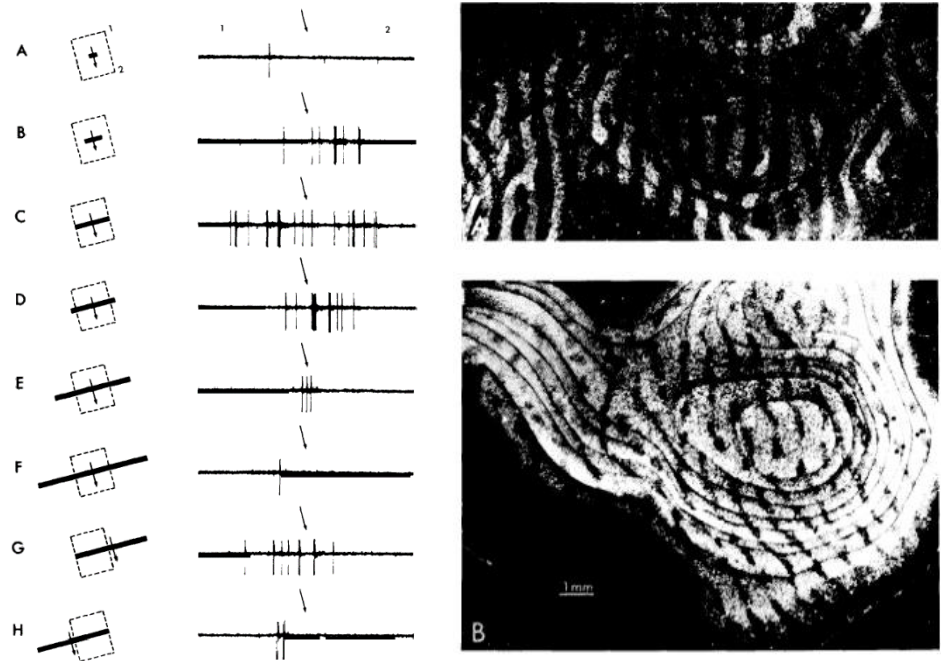
Torsten N. Wiesel

Physiology or Medicine 1981

Discoveries concerning the functional specialization of the cerebral hemispheres



Discoveries concerning information processing in the visual system





Erwin Neher Bert Sakmann
Physiology or Medicine 1991

Discoveries concerning the function of single ion channels in cells

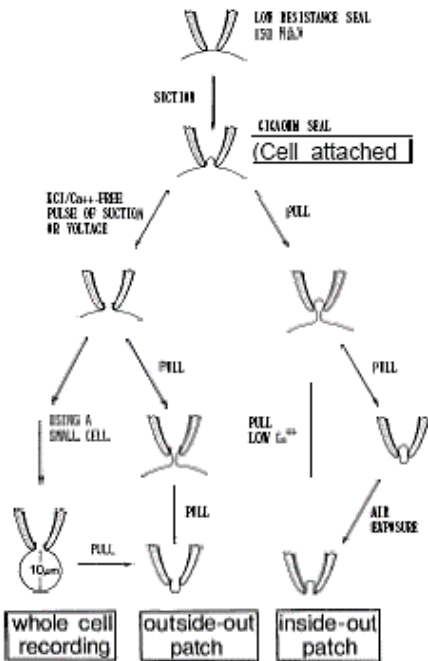
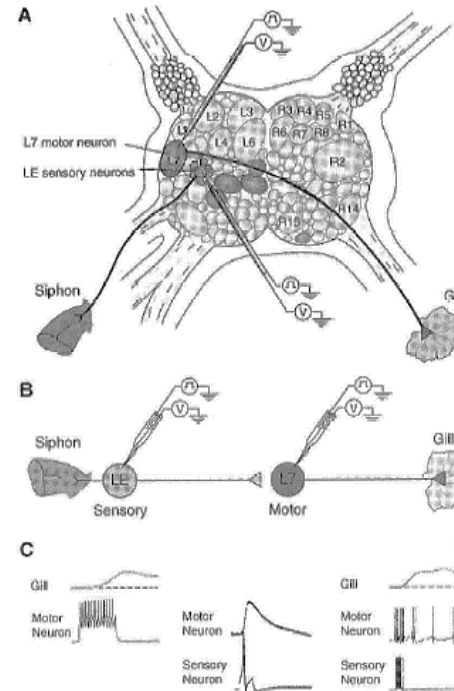


Figure 4. Schematic representation of the procedures that lead to the different patch clamp configurations. From Hille et al. 1981.



Arvid Carlsson Paul Greengard Eric Kandel
Physiology or Medicine 2000

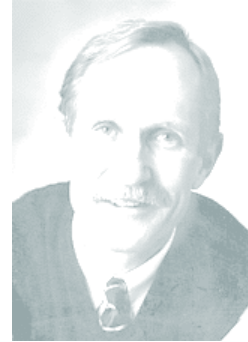
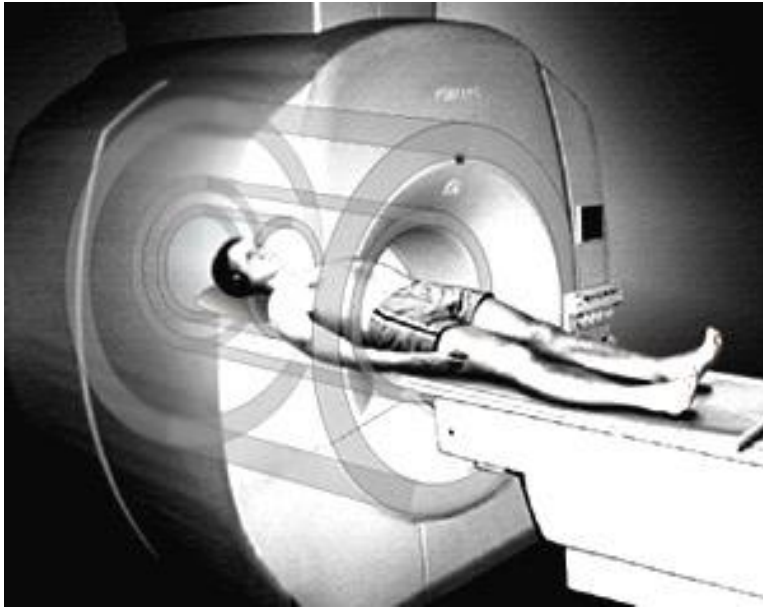
Discoveries concerning signal transduction in the nervous system





**Paul C. Lauterbur Sir Peter Mansfield
Physiology or Medicine 2003**

Discoveries concerning magnetic
resonance imaging

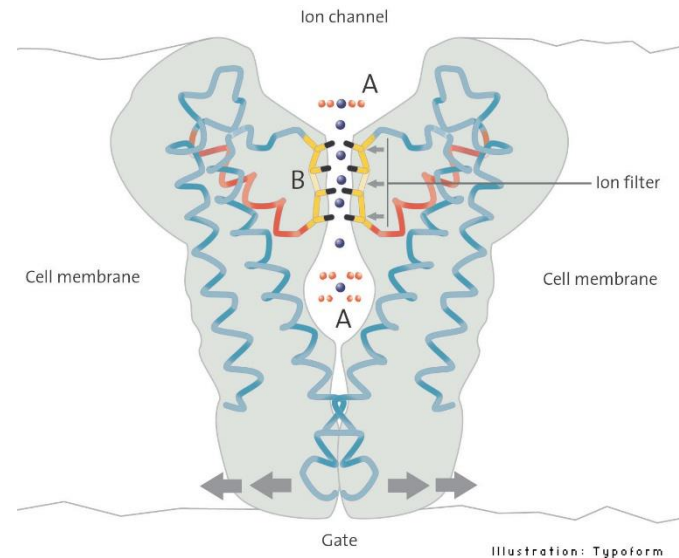


Peter Agre

Roderick MacKinnon

Chemistry 2003

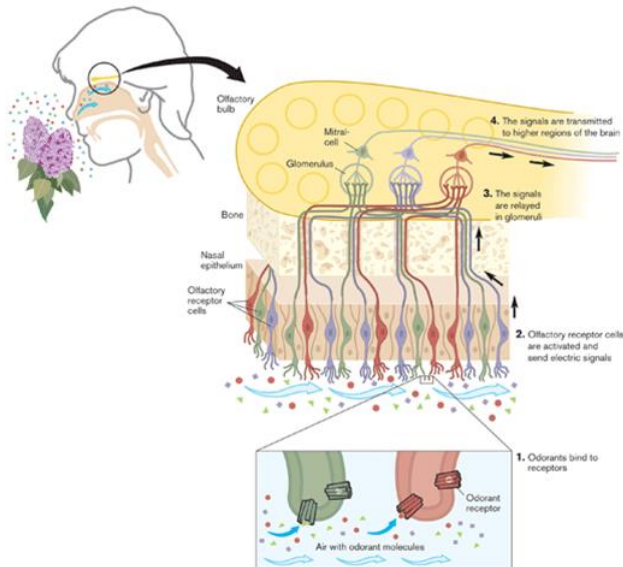
Discoveries concerning structural and
mechanistic studies of ion channels





Richard Axel **Linda B. Buck**
Physiology or Medicine 2004

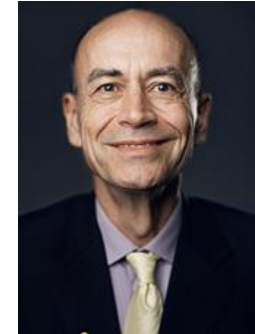
Discoveries of odorant receptors and the organization of the olfactory system



James E. Rothman



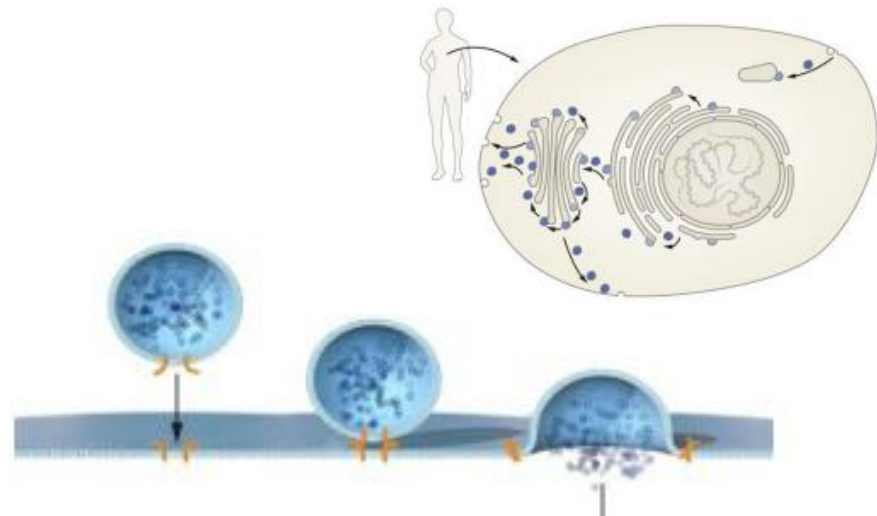
Randy W. Schekman

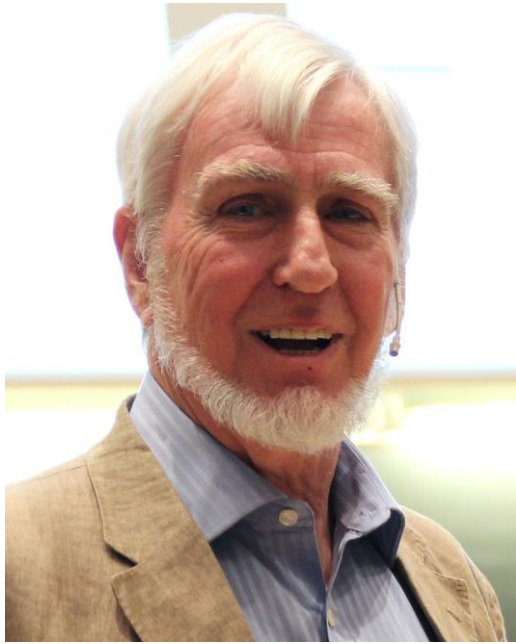


Thomas C. Südhof

Physiology or Medicine 2013

Discoveries of machinery regulating vesicle traffic, a major transport system in our cells





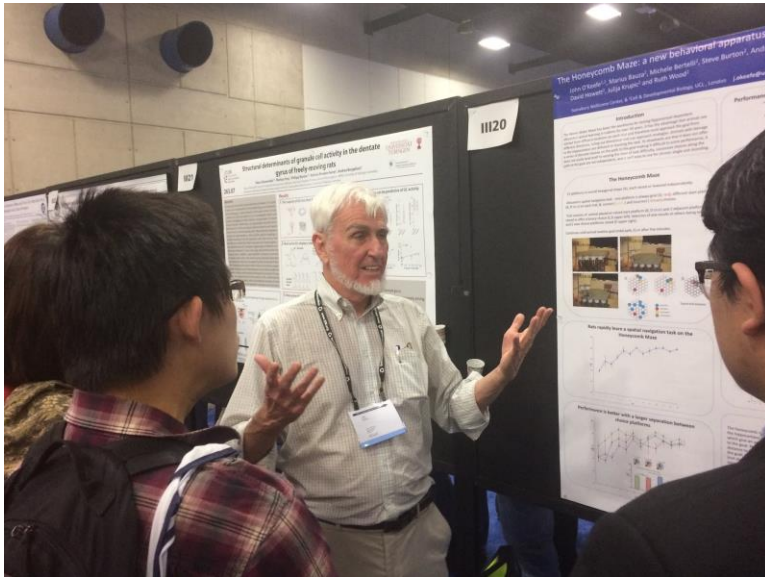
John O'Keefe



May-Britt Moser



Edward I. Moser



Annual Meeting of the Society for Neuroscience, 2016

Physiology and Medicine 2014

"for their discoveries of cells that constitute a positioning system in the brain".

AZ ELEKTROFIZIOLÓGIA TÖRTÉNETE

ÖSSZEFOGLALÁS

