A few questions on the content of the previous lecture

slido

Reproducibility refers to:

ⓘ Start presenting to display the poll results on this slide.

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HARKing refers to:

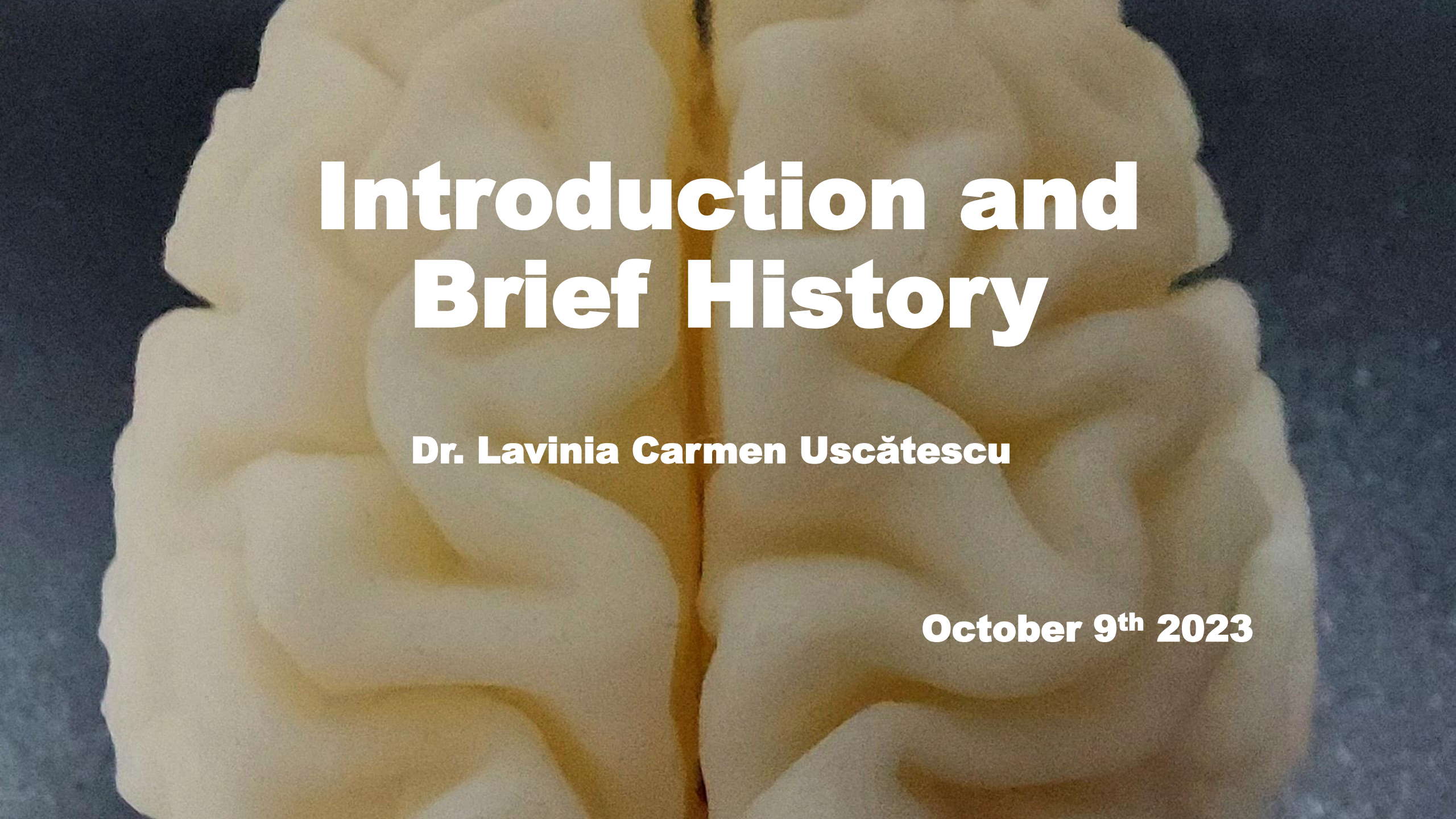
ⓘ Start presenting to display the poll results on this slide.

slido

Some ways to improve the replicability of scientific results are (multiple choice possible):

ⓘ Start presenting to display the poll results on this slide.

Any questions/remarks before we begin today’s lecture?



Introduction and Brief History

Dr. Lavinia Carmen Uscătescu

October 9th 2023

What you can gain from this course

- Knowledge of the first neurological observations based on brain injury;
- Knowledge about the first experiments targeting brain function;
- Insight into the major paradigm shifts as our knowledge of brain function evolved;
- Appreciation of the complexity of brain function and structure.

Outline

1. The brain, from prehistory through antiquity
2. First steps towards modern neuroscience
3. From structure to function: Phrenology
4. Modern neuroscience: a work in progress
5. Women in the history of neuroscience

The brain, from prehistory through antiquity

The first knowledge of **brain function** arose from observing the effects of **brain injury**.

Edwin Smith Surgical Papyrus ~ 1000 BC (based on an older treatise ~ 3000 BC)

Eur Spine J. 2010 Nov; 19(11): 1815–1823.
Published online 2010 Aug 10. doi: 10.1007/s00586-010-1523-6
PMCID: PMC2989268
PMID: 20697750

The Edwin Smith papyrus: a clinical reappraisal of the oldest known document on spinal injuries

Joost J. van Middendorp,[1] Gonzalo M. Sanchez,[2,3] and Alwyn L. Burridge[4]

Table 1 The diagnostic descriptions and therapeutic verdicts of the six spinal injury cases as reported in the Edwin Smith papyrus, based on the Sanchez and Burridge translation [9]

Case	Region	Injury type	Diagnosis of the spinal column	Significant symptoms	Injury of the spinal cord	Significant symptoms	Other documented signs and symptoms	Treatment verdict: "A medical condition…"
29	Cervical	Open	Fracture as a result of a penetrating injury	Stiffness of neck. Inability to rotate and bend the neck	No	–		"…I intend to fight with."
30	Cervical	Closed	Wrenching/sprain with disc injury[a]	Ability to rotate and bend the neck. Painful rotation and flexion of the neck	No	–		"…I can heal."
31	Cervical	Closed	Dislocation[a]	None reported	Yes	Motor and sensory loss of the upper and lower extremities, priapism, urinary incontinence, abdominal distention, priapism[b] and spermatorrhea[b]	Bloodshot eyes[c]	"…that cannot be healed."
32	Cervical	Closed	Compression fracture[a]	Inability to rotate and bend the neck ("face fixed")	No	–		"…I can heal."
33	Cervical	Closed	Burst fracture[a]	None reported	Yes	Motor and sensory loss of the upper and lower extremities	Stupor[c] and aphasia[c]	"…that cannot be healed."
48	Lumbar	Closed	Wrenching /sprain with disc injury	Immediate contraction of the leg after extending it because of vertebral pain	No	–		"…I can heal."

[a] This term is clarified in the case's additional subheading "Explanation", see Appendix
[b] This symptom was documented to be present in an injury located at "the middle vertebra of the back of neck"
[c] This symptoms is considered to be most likely the result of an inaccurately described closed head injury

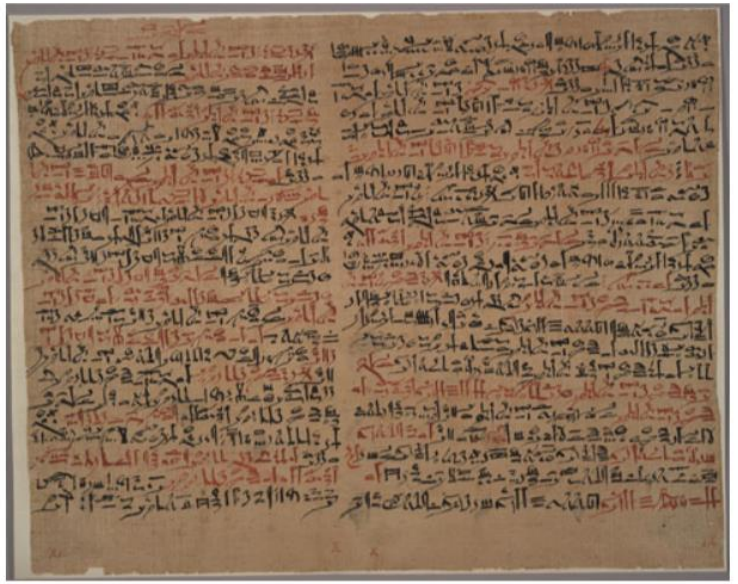


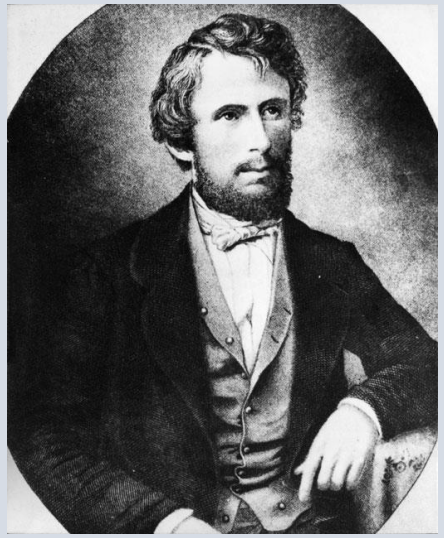
Fig. 1 Plate X and XI of the Edwin Smith papyrus including the five cervical spinal injury cases in hieratic script [7]

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2989268/

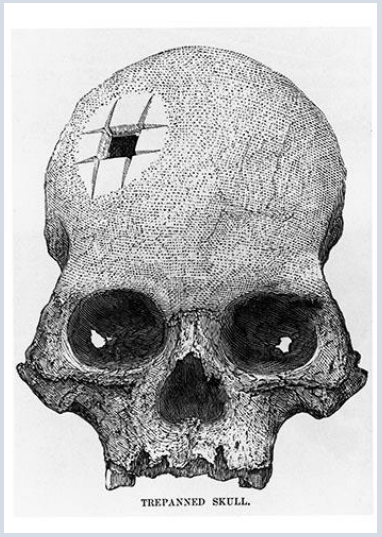
Oldest known neurosurgery (trepanation/trephination) on a living person ~ 1400–1530

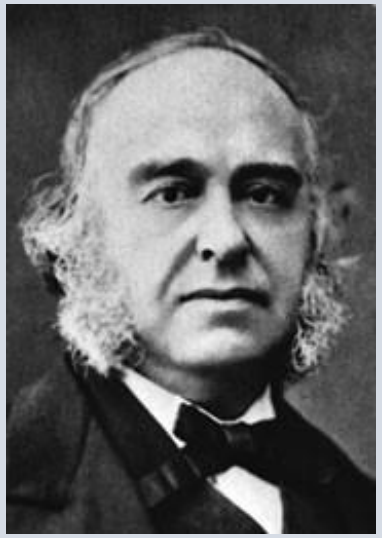
In 1865, this Inca skull was gifted to **Ephraim George Squier**, an American archaeologist in Cuzco, Peru, who then also showed it to **Paul Broca**. In 1876, Broca relayed this finding to the Anthropological Society of Paris, but his conclusion, that **the owner of the trephined skull healed and survived the surgery** was met with scepticism.

The skull is now at the American Museum of Natural History, in NY.



Ephraim George Squier





Paul Broca

https://thereader.mitpress.mit.edu/hole-in-the-head-trepanation/

> Neurosurgery. 2001 Dec;49(6):1417-25; discussion 1425-6.
doi: 10.1097/00006123-200112000-00021.

Discovering trepanation: the contribution of Paul Broca

W T Clower [1], S Finger

Affiliations + expand

PMID: 11846942 DOI: 10.1097/00006123-200112000-00021

Abstract

PAUL BROCA WAS an icon of neuroscience and neurosurgery who also happened to be intrigued by trepanned skulls. His anthropological work established that, thousands of years ago, individuals not only trepanned skulls but also successfully performed these operations on living persons. After first commenting on a pre-Columbian Peruvian skull in 1867 (the first case of trepanning on a living person widely recognized as such), he turned to even older trepanned skulls found on French soil. In the 1870s, he theorized that the procedure originated as a means to treat convulsions in infants. As he saw it, Neolithic man attributed such convulsions to evil spirits, for which trepanation provided a ready means of escape. Because simple infantile convulsions resolve on their own, the practice would have seemed successful, and therefore it would have been propagated and expanded by later generations. Broca's theory skillfully integrated his anthropological and medical knowledge and helped to create the exciting environment in which scientists pondered what Neolithic and primitive people really knew regarding the brain and surgery.

https://pubmed.ncbi.nlm.nih.gov/11846942/

The antiquity of cranial surgery in Europe and in the Mediterranean basin

Ancienneté de la chirurgie crânienne en Europe et dans le Bassin méditerranéen

Éric Crubézy [a], Jaroslav Bruzek [b], Jean Guilaine [c], Eugenia Cunha [d], Daniel Rougé [a], Jan Jelinek [e]

https://tinyurl.com/43aj5sfr

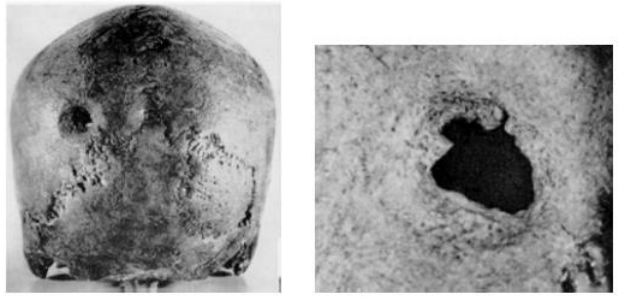


Figure 2. Taforalt Ia. Aperture of oval form (10.5 × 8.5 mm) on the left parietal, at 45 mm from the lambda with a chamfered edge at the expense of the external table with healing. The radiograph confirms the absence of lesion of the internal table. These observations confirm the trephination and the surviving of the subject. **1.** General view. **2.** Detailed view. Photograph from Dastugue [11].

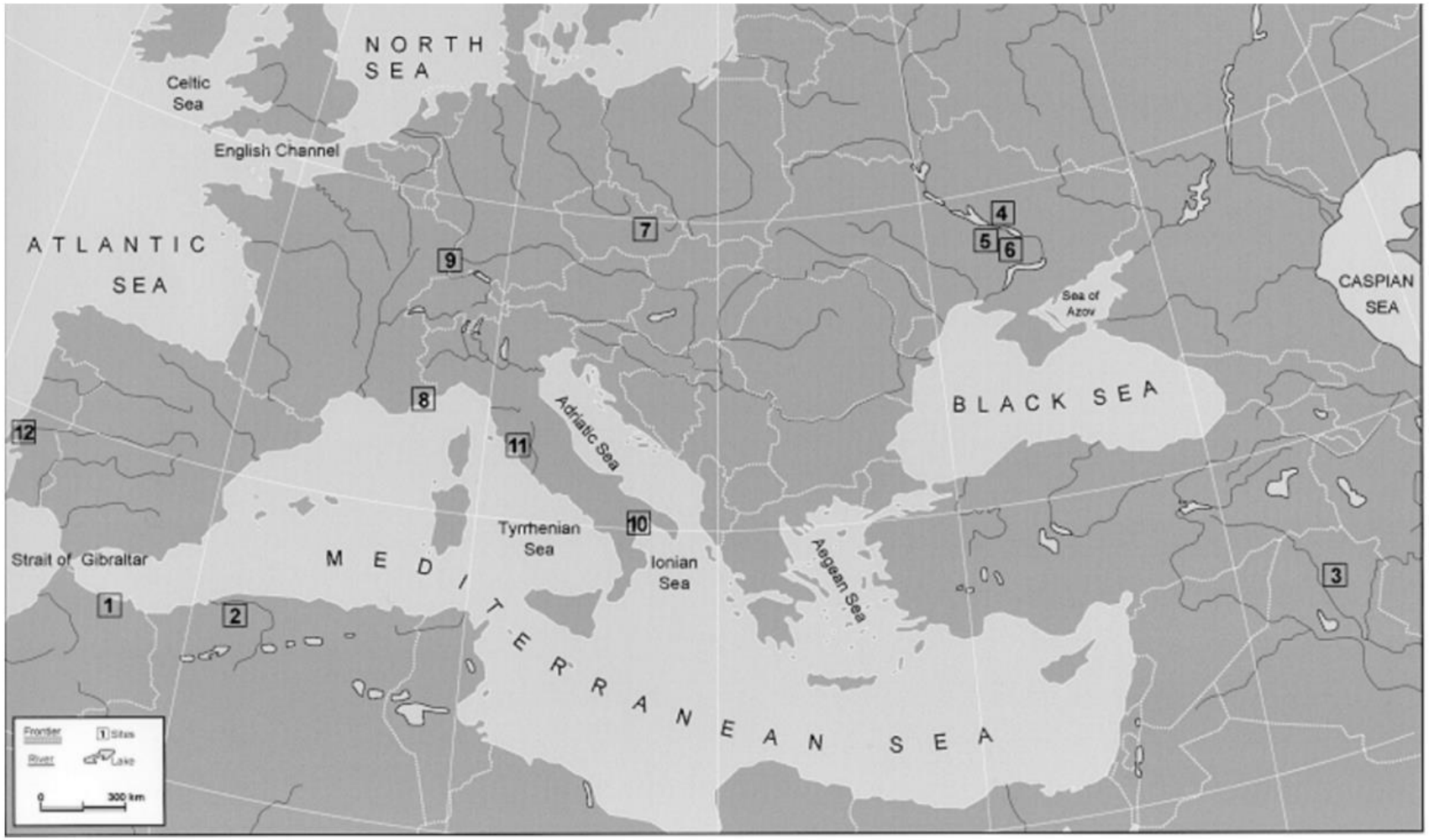
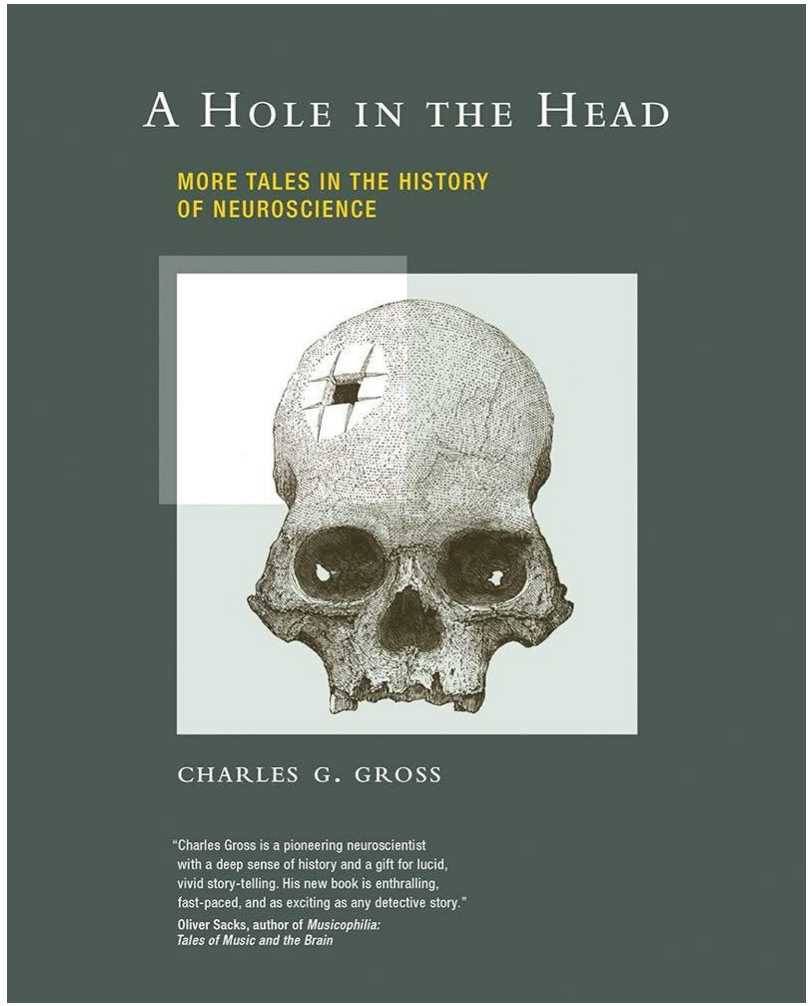


Figure 1. Geographical distribution of the trephination sites: **1**, Taforalt, Morocco [11]; **2**, Afalou-bou-Rhummel, Algeria [13]; **3**, Zawi Chemi, Irak [14]; **4**, Vasilyevka III, Ukraine [17]; **5**, Vasilyevka II, Ukraine [17]; **6**, Vovnigi Iin, Ukraine [18]; **7**, Vedrovice, Czech Republic [10]; **8**, Pendimoun, France [6]; **9**, Ensisheim, France [1]; **10**, Trasano, Italy [16]; **11**, Grotta Patrizi, Italy [16]; **12**, Concheiro da Moita do Sebastião, Muge, Portugal. Cultural attributions and datations: **1**, Taforalt, Epipaleolithic, 11 900 ± 240 BP [37, 38]; **2**, Afalou-bou-Rhumel, Epipaleolithic [13]; **3**, Zawi-Chemi, 10 870 ± 300 BP [14]; **4**, Vasilyevka III, Epipaleolithic, 10 000 BP [23, 24]; **5**, Vasilyevka II, Late Mesolithic, 8020–7620 BP [30]; **6**, Vovnigi II, Dnieper–Donec Neolithic culture, 5470–4783 BC [30]; **7**, Vedrovice, ancient Danubian, LnK [26, 36]; **8**, Pendimoun, ancient Mediterranean Neolithic, 5570–5270 BC [6]; **9**, Ensisheim, LnK, 6155 ± 39 BP [1]; **10**, Trasano, Neolithic culture from Passo di Corvo-Catignano; ten datations from 6330 ± 70 to 5910 ± 65 BP, around 5000 BC [16]; **11**, Grotta Patrizi, Neolithic culture from Sasso, transition VIth–Vth millenium BC [16]; **12**, Concheiro da Moita do Sebastião, Muge, Portugal, Mesolithic around 6000 BC [22].



ELSEVIER

World Neurosurgery
Volume 114, June 2018, Pages 245-251

Historical Vignette

Trepanation Procedures/Outcomes: Comparison of Prehistoric Peru with Other Ancient, Medieval, and American Civil War Cranial Surgery

Some preliminary data given in this article were presented as a poster at the American Academy of Neurology 69th Annual Meeting, April 24, 2017, in Boston, Massachusetts.

David S. Kushner [1], John W. Verano [2], Anne R. Titelbaum [3]

https://www.sciencedirect.com/science/article/abs/pii/S1878875018306259

The first chapter, *"A Hole in the Head: A History of Trepanation"*, is freely available:

https://thereader.mitpress.mit.edu/hole-in-the-head-trepanation/

First medical accounts of **aphasia** and **epilepsy**

J Med Biogr. 2003 May;11(2):114-7. doi: 10.1177/096777200301100214.

The Edwin Smith surgical papyrus: description and analysis of the earliest case of aphasia

Alireza Minagar [1], John Ragheb, Roger E Kelley

Affiliations + expand

PMID: 12717541 DOI: 10.1177/096777200301100214

The **Edwin Smith Surgical Papyrus** describes the first reported case of aphasia: *"Instructions for a gaping wound in the temporal bone" => "a wound in his temple, penetrating to the bone, (and) perforating his temporal bone" => "speechless"*

https://tinyurl.com/3rtw6bu9

On the Sacred Disease

By Hippocrates

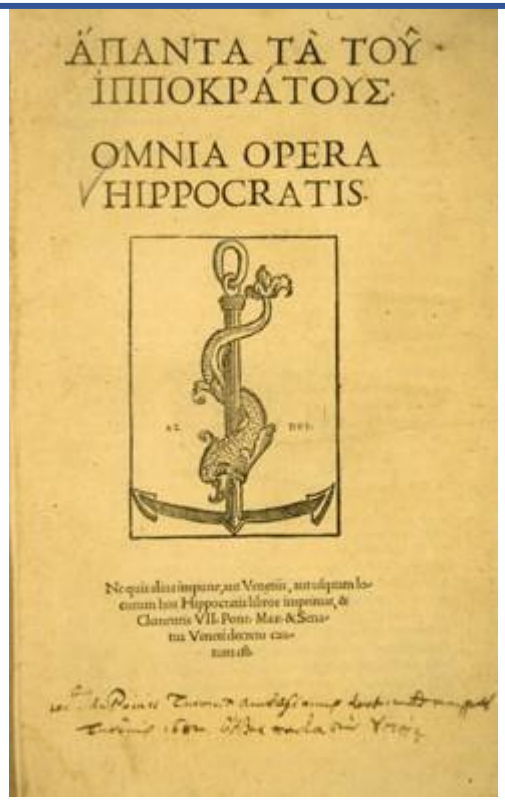
Written 400 B.C.E

Translated by Francis Adams

https://classics.mit.edu/Hippocrates/sacred.html

Corpus Hippocraticum, by **Hippocrates** (460 BC – 370 BC), first placed the origins of epilepsy in the brain.

Until then, it was believed that the seizures were a sign of possession due to divine punishment.



This first edition of Hippocrates' collected works was carefully edited by Aldo Manuzio's publishing house. (Venice, 1526).

https://tinyurl.com/4htscrat

The **heart** v. **brain** dispute

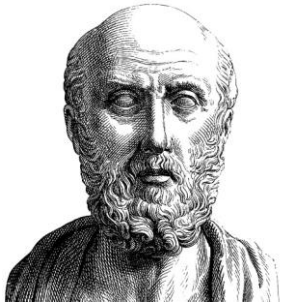
It ought to be generally known that the source of our pleasure, merriment, laughter and amusement, as of our grief, pain, anxiety, and tears, is none other than the brain.

Hippocrates

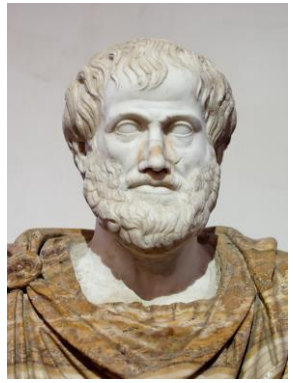
And of course, the brain is not responsible for any of the sensations at all. The correct view is that the seat and source of sensation is the region of the heart.

Aristotle

(Andrew Wickens, 2015, pg. 1)



Hippocrates
(460 BC – 370 BC)



Aristotle
(384 BC – 322 BC)

Aristotle, by observing **chicken embryos** inside the egg, noticed that their **heart** was the first to show noticeable activity. He surmised that the **heavy vasculature around the brain had the purpose of cooling down the body**, a hypothesis which he extended to the human brain, given its size. He further noted that touching the brain of a living animal did not trigger a noticeable sensation, and that some animals capable of feeling sensations did not have a brain (e.g., worms).

The first **experiments**

Galen of Pergamon
(129 – ~ 213)

Galen and the Squealing Pig

Charles G. Gross View all authors and affiliations

Volume 4, Issue 3 | https://doi.org/10.1177/107385849800400317

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Abstract

Galen, who lived in the Roman Empire in the 2nd century, was the greatest experimental physiologist and anatomist of classical antiquity. His ideas about biology and medicine were dominant in Europe for more than 1500 years. In one of his most famous experi ments, he demonstrated loss of vocalization after section of the recurrent laryngeal nerves in the pig. This may have been the first experimental evidence that the brain controls behavior and thought. NEUROSCIENTIST 4:216-221, 1998

https://tinyurl.com/28x9jxpt

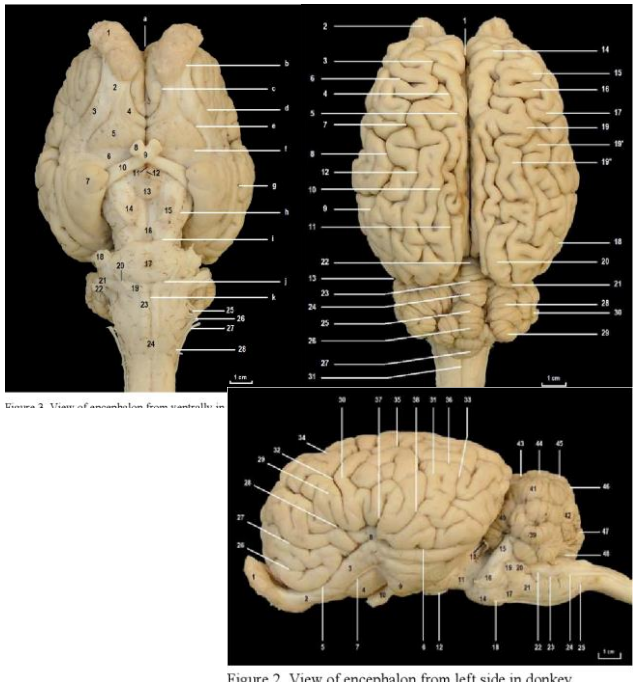
- described many of the **cranial nerves** and their function;
- inferred that the **spinal cord is an extension of the brain** and performed **systematic lesion studies** => sensory and motor function is compromised below the region of he injury;
- records two instances of infants losing the ability to vocalize after accidental injury to their **recurrent laryngeal nerves**;

The **cortex**

Erasistratus (304 BC – 250 BC) hypothesized that intelligence was correlated to the number of cortical convolutions.

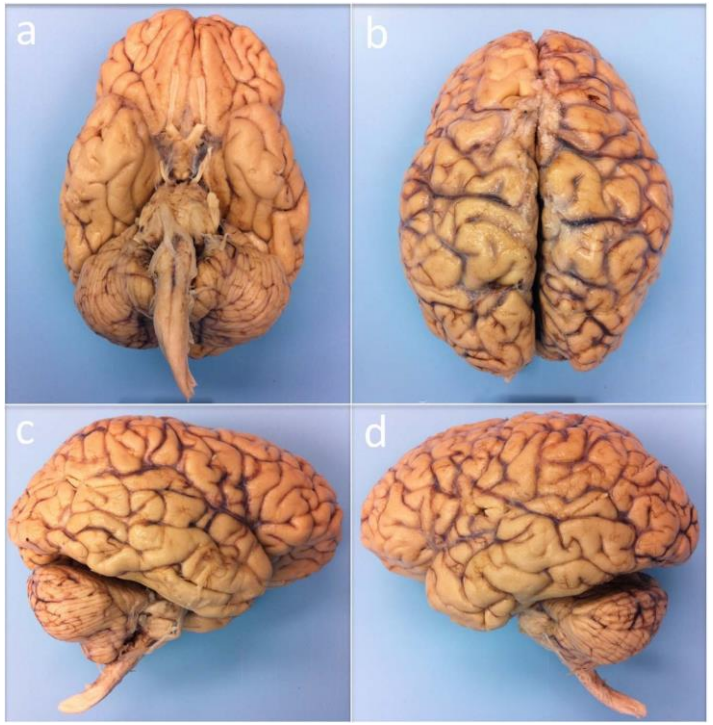
He inferred that **the cerebellum must be relevant for movement**, based on his observation that fast-running animals have a more convoluted one compared to slow-moving animals.

The cerebral cortex remained however underestimated for a long time. **Galen** is reported to have said: *"Even donkeys have a complex encephalon, whereas judging by their stupidity, [it] ought to be simple and uncomplicated"* (Gross, 1998).



Donkey brain specimen: (upper left) inferior, (upper right) superior, (bottom) left lateral perspectives.

https://tinyurl.com/29v3yb26



Human brain specimen: (a) inferior, (b) superior, (b) (c) right lateral , and (d) left lateral perspectives.

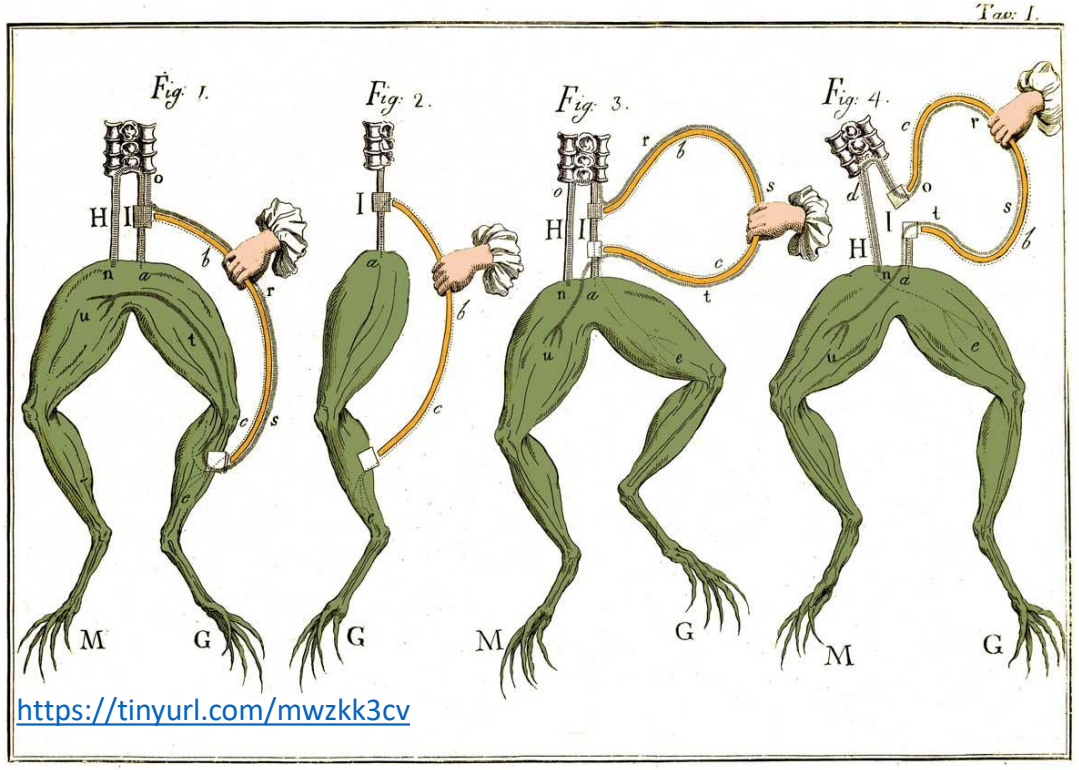
https://www.nature.com/articles/s41597-019-0254-8

First steps towards modern neuroscience

The discovery of ***"animal electricity"***

Carlo Matteucci
(1811 – 1868)

Luigi Galvani
(1737 – 1798)



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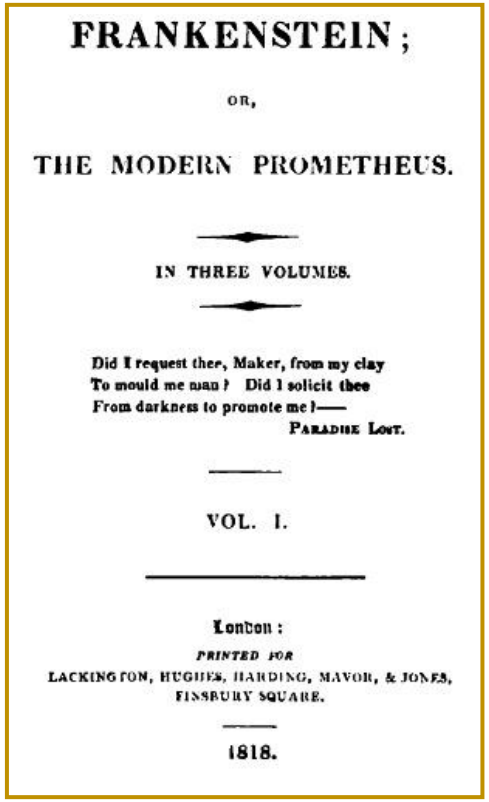
Mary Shelley
(1797 – 1851)



FRANKENSTEIN;

OR,

THE MODERN PROMETHEUS.

IN THREE VOLUMES.

Did I request thee, Maker, from my clay
To mould me man? Did I solicit thee
From darkness to promote me?—
PARADISE LOST.

VOL. I.

London:
PRINTED FOR
LACKINGTON, HUGHES, HARDING, MAVOR, & JONES,
FINSBURY SQUARE.

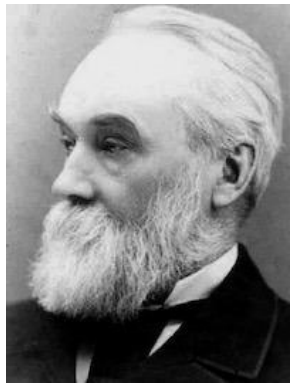
1818.

https://tinyurl.com/yckrkzyw

- **Luigi Galvani** discovered, on September 20th 1786, that **the sciatic nerve** of a dead frog could conduct an **electrical signal** and contract the frog's leg;

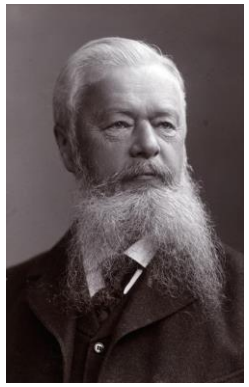
- the invention of the ***galvanometer***, in the 1820s, allowed **Carlo Matteucci** to show that nerves and muscles do indeed contain some electrical signals, as Galvani had surmised.

The discovery of the **motor cortex**



John Hughlings Jackson
(1835 – 1911)

- was studying **epilepsy**, when he noted that epileptic seizures gradually propagated from the hands towards the face (*"Jacksonian march"*);
- hypothesized that different parts of the body were controlled by different parts of the cortex;
- surmised that **aberrant electrical activity** in the brain gave rise to epileptic seizures.

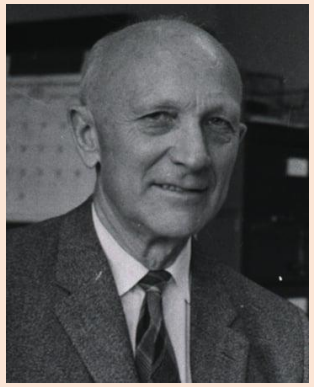


Gustav Fritsch
(1838 – 1927)

Eduard Hitzig
(1838 – 1907)

- in 1870, they identified the motor cortex **experimentally**, by electrically stimulating the motor cortex of a dog;
- they showed the **contralateral** correspondence between stimulation site and the elicited movement;
- further supported their conclusion with **targeted lesion** studies of the motor cortex, in dogs.

The cortical **homunculus**



Wilder Penfield
(1891 – 1976)

Throughout my career, I was driven by the central question that has obsessed both scientists and philosophers for hundreds of years. Are mind and body one? Can the mind - thinking, reasoning, imagination — be explained by the functions of the brain? As a doctor, my first concern was always for my patients — to relieve the terrible suffering caused by diseases such as epilepsy.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3221191/

- together with **Herbert Jasper**, he invented the *"Montréal Procedure"*, which identifies and destroys the neurons where an epileptic seizure originates;

- in preparation for the procedure, he would map out cortical function **by electrically stimulating** the patient's brain;

- he thus mapped out motor and sensory function on the cortex => the **cortical homunculus** was born.

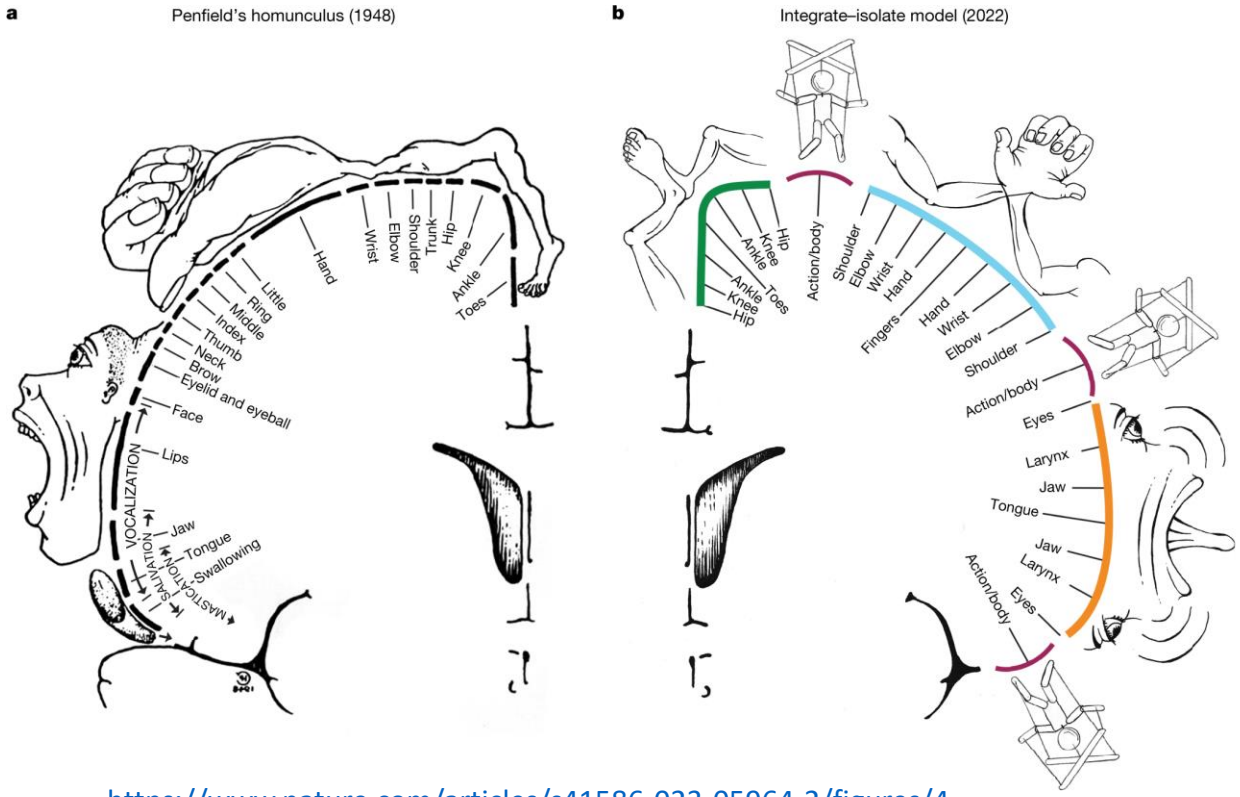
Article | Open access | Published: 19 April 2023

A somato-cognitive action network alternates with effector regions in motor cortex

Evan M. Gordon, Roselyne J. Chauvin, Andrew N. Van, Aishwarya Rajesh, Ashley Nielsen, Dillan J. Newbold, Charles J. Lynch, Nicole A. Seider, Samuel R. Krimmel, Kristen M. Scheidter, Julia Monk, Ryland L. Miller, Athanasia Metoki, David F. Montez, Annie Zheng, Immanuel Elbau, Thomas Madison, Tomoyuki Nishino, Michael J. Myers, Sydney Kaplan, Carolina Badke D'Andrea, Damion V. Demeter, Matthew Feigelis, Julian S. B. Ramirez, ... Nico U. F. Dosenbach + Show authors

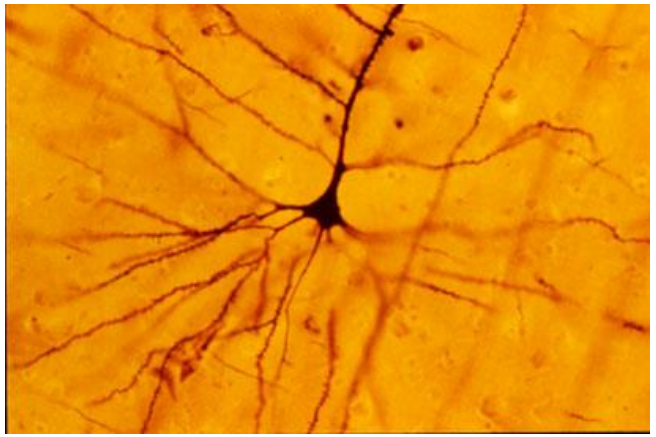
Nature **617**, 351–359 (2023) | Cite this article

141k Accesses | **16** Citations | **1738** Altmetric | Metrics



https://www.nature.com/articles/s41586-023-05964-2/figures/4

The **neuron doctrine**



A human neocortical pyramidal neuron stained via Golgi technique
https://tinyurl.com/258ece5e

neuron = a single, **independent**

unit of the nervous system

The Nobel Prize in Physiology or Medicine 1906

"in recognition of their work on the structure of the nervous system"

Camillo Golgi

1/2 of the prize

Italy

Pavia University
Pavia, Italy

b. 1843
d. 1926

Santiago Ramón y Cajal

1/2 of the prize

Spain

Madrid University
Madrid, Spain

b. 1852
d. 1934

www.nobelprize.org

Drawing of a Purkinje cell in the cerebellum cortex done by Cajal, using the Golgi stain
https://tinyurl.com/258ece5e

Brain Res Rev. 2007 Oct;55(2):490-8. doi: 10.1016/j.brainresrev.2006.11.004. Epub 2007 Jan 9.

How the 1906 Nobel Prize in Physiology or Medicine was shared between Golgi and Cajal

Gunnar Grant [1]

Affiliations + expand

PMID: 17306375 DOI: 10.1016/j.brainresrev.2006.11.004

https://tinyurl.com/2xwunam6

Camillo Golgi
Biographical

https://www.nobelprize.org/prizes/medicine/1906/golgi/biographical/

Santiago Ramón y Cajal
Biographical

https://www.nobelprize.org/prizes/medicine/1906/cajal/biographical/

From structure to function: Phrenology

As the skull takes its shape from the brain, the surface of the skull can be read as an accurate index of psychological aptitudes and tendencies.

Franz Joseph Gall

Franz Joseph Gall
(1758 – 1828)

Faculties shared by humans and animals	***Directly human***
1 Reproductive instinct	20 Wisdom
2 Love of one's offspring	21 Sense of metaphysics
3 Affection or friendship	22 Satire and wit
4 Instinct of self-defence or courage	23 Poetic talent
5 Destructiveness or tendency to murder	24 Kindness
6 Cunning	25 Mimicry
7 Desire to possess things	26 Religious sentiment
8 Pride	27 Firmness of purpose
9 Vanity or ambition	
10 Circumspection	
11 Memory for facts and things	
12 Sense of place	
13 Memory for people	
14 Memory for words	
15 Sense of language	
16 Sense of colour	
17 Gift of music	
18 Sense of numbers	
19 Mechanical or architectural sense	

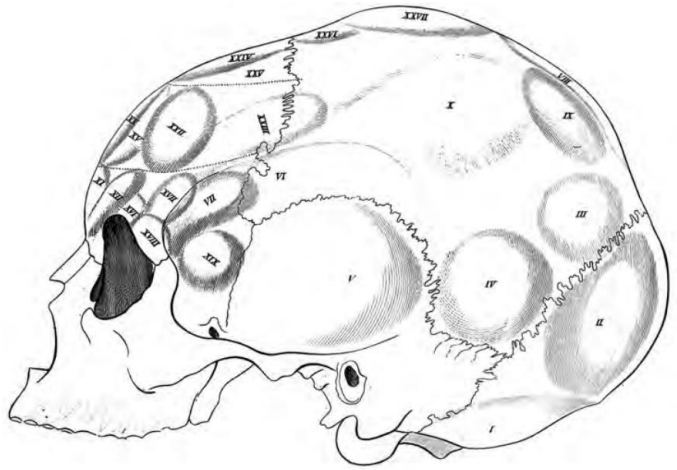


FIGURE 6.2 A plate taken from Gall's *Anatomie et physiologie du système nerveux*, followed by a table listing his faculties as proposed in 1812.

Source: the plate is from the Wellcome Library, London.

(Andrew Wickens, 2015, pg. 142)

Even in Gall's day, phrenology was ridiculed by many investigators. Yet, phrenology was to prove an important step forward in the history of neuroscience, especially the biological study of the mind. For one thing, phrenology's rise in popularity, despite the protestations of the Church, quickly led to a change in the academic climate where the soul was exorcised from brain functioning, thereby making it more amenable to objective and scientific investigation. Phrenology also helped establish psychology as a biological science, encouraging a more naturalistic approach to the study of behaviour, and paving the way for evolutionist theories that saw man as part of the animal kingdom. However, perhaps most important of all, was phrenology's insistence that mental faculties could be localised to discrete areas of the brain. While this idea was rejected for much of the nineteenth century by brain researchers, including Pierre Flourens who was widely regarded as the greatest authority of them all, Gall was eventually proven correct – at least in some respects. Despite its many failings, phrenology represents a point in the historical development of neuroscience where a significant break with the dogma and assumptions of the past was made. Consequently, it was crucially important in formulating a more modern way of understanding the brain.

(Andrew Wickens, 2015, pg. 135)

Modern neuroscience: a work in progress

A variety of neuroscientific **branches**

Systems neuroscience

how neurons connect to form networks that support different brain functions

Cellular and **molecular** neuroscience

neurons, glia, neurotransmitters, receptors

Cognitive and **behavioral** neuroscience

how brain function relates to observable/measurable cognition and behavior

Translational and **clinical** neuroscience

tries to expand/translate basic or experimental research findings into clinical tools to improve patient outcome

Computational neuroscience

tries to explain, using mathematical models, the laws that relate brain function, at different levels of detail, to observable behavior and cognition

A variety of neuroscientific **methods**

https://tinyurl.com/52dwd9w4

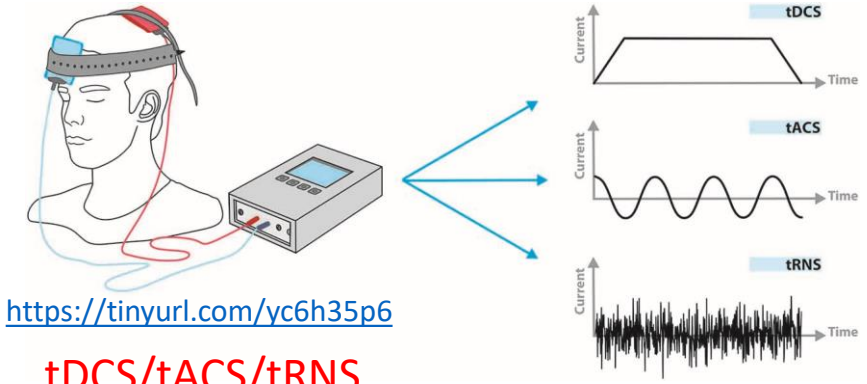
Optogenetics

(Karl Deisseroth, but see also Zhuo-Hua Pan)

"Optogenetics makes living neurons sensitive to light by introducing special genes, carried by a virus, which produce photoreceptive proteins. By shining light on those cells — generally with a fiber-optic wire — scientists can either activate or suppress particular groups of neurons, exploring how different parts of the brain work and how they communicate with the rest of the brain." (https://tinyurl.com/4u5426nt)

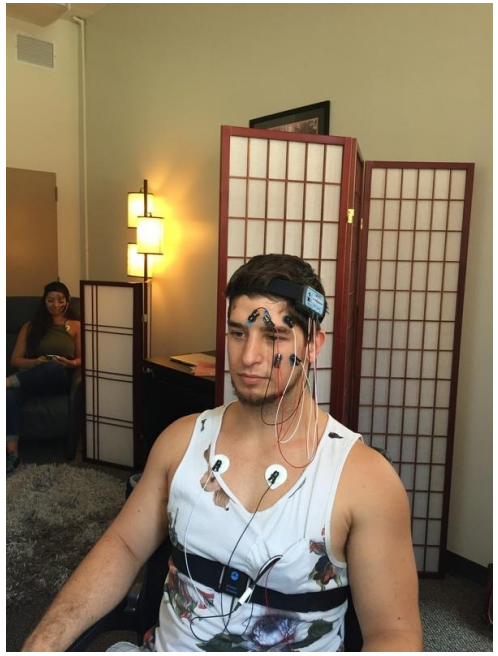
MRI https://tinyurl.com/3bwnurs2

MEG https://tinyurl.com/26bedn9j



https://tinyurl.com/yc6h35p6

tDCS/tACS/tRNS



Psychophysiology

https://tinyurl.com/mvnmt3s5

TMS https://tinyurl.com/3hnz3b3f

EEG

https://tinyurl.com/5yzs59x6

and more…

Women in the history of neuroscience

> J Hist Neurosci. 2002 Mar;11(1):80-6. doi: 10.1076/jhin.11.1.80.9098.

Women and the history of the neurosciences

Stanley Finger [1]

Affiliations + expand

PMID: 12012582 DOI: 10.1076/jhin.11.1.80.9098

https://pubmed.ncbi.nlm.nih.gov/12012582/

womensneuronet.com/team/lavinia-uscatescu

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Lavinia Uscatescu

postdoc

> J Neurosci. 2022 Jun 15;42(24):4769-4773. doi: 10.1523/JNEUROSCI.0536-22.2022.

Lessons from the Stories of Women in Neuroscience

Leslie J Sibener [1], Megan A Kirchgessner [2], Sheila Steiner [3], Chiaki Santiago [3], Daniela Cassataro [3 4], Marley Rossa [3 4], Caterina P Profaci [5], Nancy Padilla-Coreano [6]

Affiliations + expand

PMID: 35705494 PMCID: PMC9188381 DOI: 10.1523/JNEUROSCI.0536-22.2022

Free PMC article

https://pubmed.ncbi.nlm.nih.gov/35705494/

Front Integr Neurosci. 2021; 15: 810331.

Published online 2022 Jan 26. doi: 10.3389/fnint.2021.810331

PMCID: PMC8825414

PMID: 35153689

Women in Neuroscience: Four Women's Contributions to Science and Society

Priscilla E. Yevoo [1, 2, *] and Arianna Maffei [1, 2]

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8825414/

Rita Levi-Montalcini
(1909 – 2012)

https://www.nobelprize.org/womenwhochangedscience/stories/rita-levi-montalcini

https://www.nobelprize.org/prizes/medicine/1986/levi-montalcini/biographical/

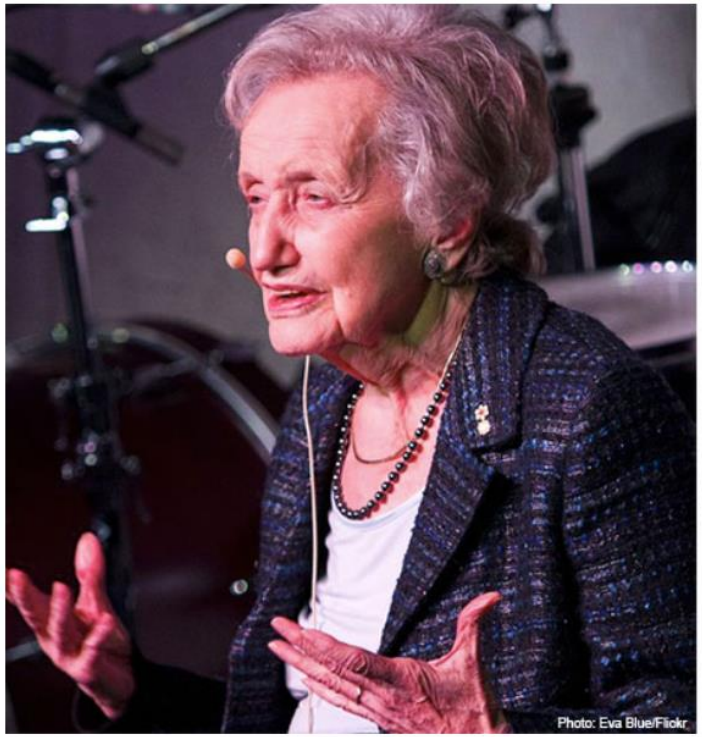
The discovery of the **Nerve Growth Factor (NGF)**, crucial for the development and survival of sympathetic, sensory and forebrain cholinergic neurons

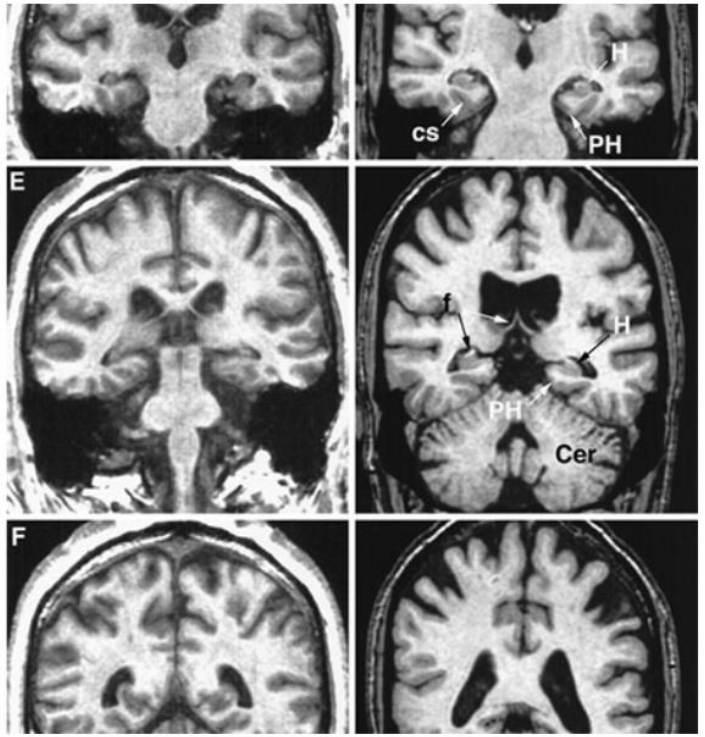
(https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4812798/)

Interview: https://www.youtube.com/watch?v=WgkAR-vrJpM&t=790s

At 105 Years Old, Neuroscientist Brenda Milner Is Still Unlocking The Mysteries of the Brain

Posted on July 14, 2023 by Katherine





https://www.amightygirl.com/blog?p=25635

Brenda Milner
(born: 1918)

Considered one of the founders of **neuropsychology** (the field studying the impact of brain lesions) and for her extensive work on the case of **anterograde amnesia** of **patient H.M**. He died in 2008.

(https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2649674/)

https://tinyurl.com/ypsnkzkr

Anne Treisman
(1935 – 2018)

National Medal of Science, in 2013

In Memoriam | Published: 22 June 2018

Anne Marie Treisman (1935–2018)

Karla K. Evans

Attention, Perception, & Psychophysics **80**, 1027–1029 (2018) | Cite this article

In the late 1970s, Treisman moved to a new faculty position at the University of British Columbia, Canada, where she conducted a slew of new experiments—now primarily in vision once again—forming the empirical basis of the seminal theory of visual object perception and attention, the feature integration theory (FIT). FIT is a two-stage model that describes the early stages of object perception as the parallel encoding of basic features—such as color, form, and orientation—as separate entities, instantly detectable. However, conscious perception of the object as a whole requires focused attention: Only with focused attention can one combine the distinct features into an "object file" that allows identification and localization. This theory was first mapped out in the 1980 article by Treisman and Gelade, with subsequent refinements in later work (most notably in Treisman, 1988, and Kahneman, Treisman, & Gibbs, 1992).

https://link.springer.com/article/10.3758/s13414-018-1563-2

Leslie Ungerleider
(1946 – 2020)

Important research which led to distinguishing the **dorsal/"where"** from the **ventral/"what"** visual pathways

RETROSPECTIVE

Leslie Ungerleider, 1946–2020: Who, what, and where

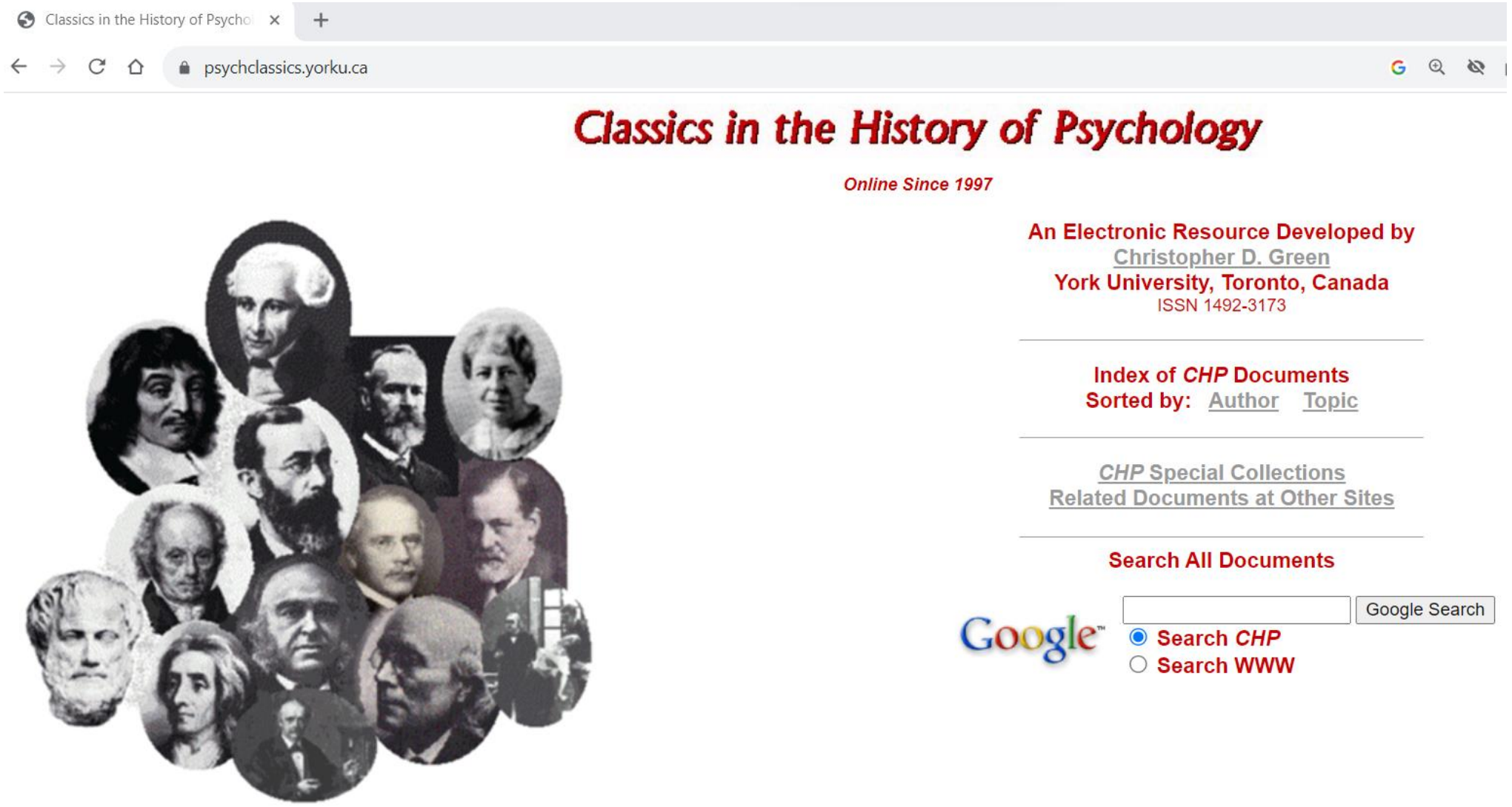
David C. Van Essen, Sabine Kastner, and Peter Bandettini Authors Info & Affiliations

March 15, 2021 | 118 (13) e2102784118 | https://doi.org/10.1073/pnas.2102784118

In collaboration with Mishkin, Leslie carried out a seminal set of experiments showing that lesions to the inferior temporal cortex impaired perception of object identity ("what it is"), whereas lesions to the posterior parietal cortex impaired perception of spatial relationships ("where it is"). They also showed that spatial localization and object identification both required an intact striate cortex (V1, or primary visual cortex), but were preserved after superior colliculus lesions in monkeys (3, 4). This pointed to a dramatic difference in visual system functional organization in primates vs. rodents, given that previous studies in the hamster by Gerald Schneider had implicated the superior colliculus in the analysis of spatial relationships. Leslie's "what" vs. "where" model provided an elegant and intuitively attractive division of labor for thinking about higher visual functions, because the information needed to ascertain object identity (e.g., stimulus features within the part of the visual field occupied by an attended object) is very different from that needed to assess object location and spatial relationships across a broad expanse of the visual field. Additionally, information about object identity vs. location is used in very different ways to mediate behavior.

https://www.pnas.org/doi/10.1073/pnas.2102784118

Further reading



Journal of the History of the Neurosciences

Journal of the History of the Neurosciences, Volume 32, Issue 4 (2023)

Volume 32, 2023 | Vol 31, 2022 | Vol 30, 2021 | Vol 29, 2020 | See all volume

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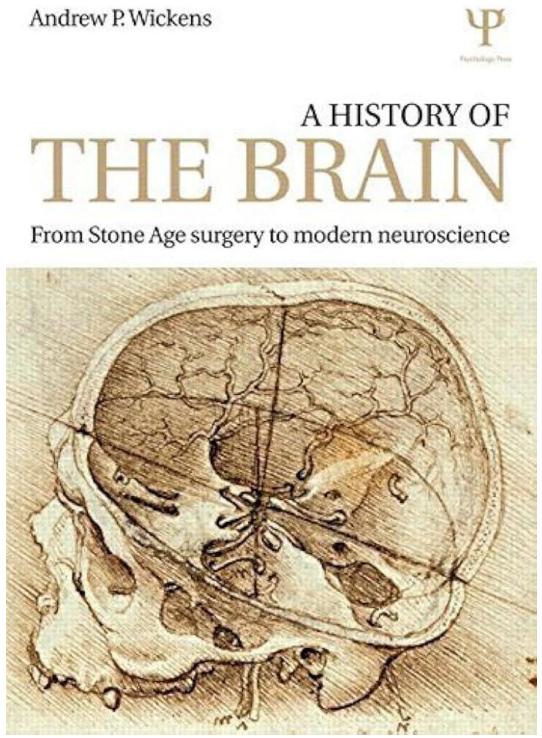
Andrew P. Wickens
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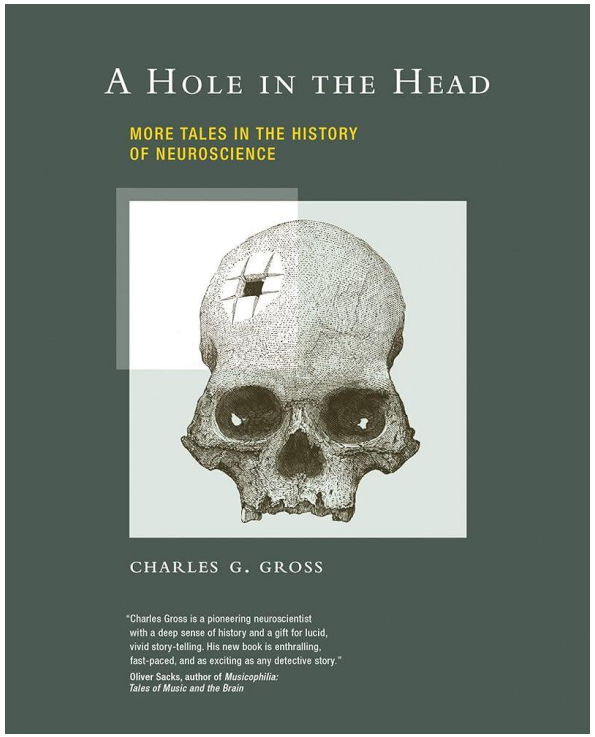
THE BRAIN
From Stone Age surgery to modern neuroscience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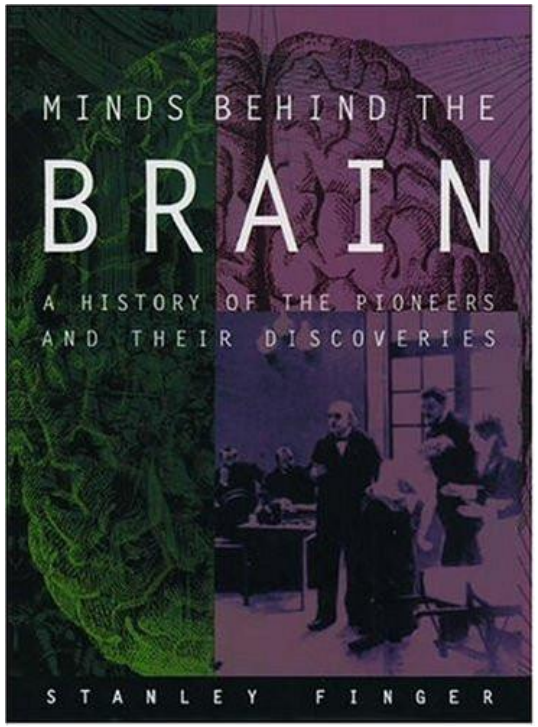
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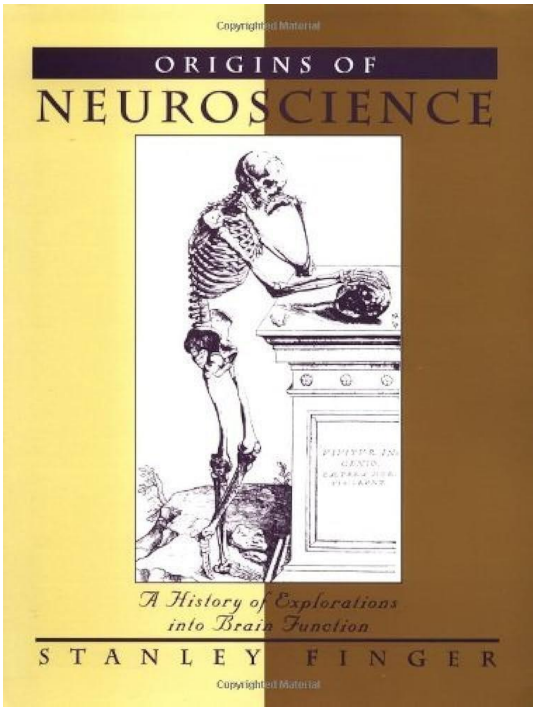
A HISTORY OF THE PIONEERS
AND THEIR DISCOVERIES
STANLEY FINGER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A History of Explorations into Brain Function
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