

The Enchanted Loom:
A History of Research on the Brain
with
a Select Who's Who in Neurology, Neuroscience
and Neuropsychology

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January 27, 2016

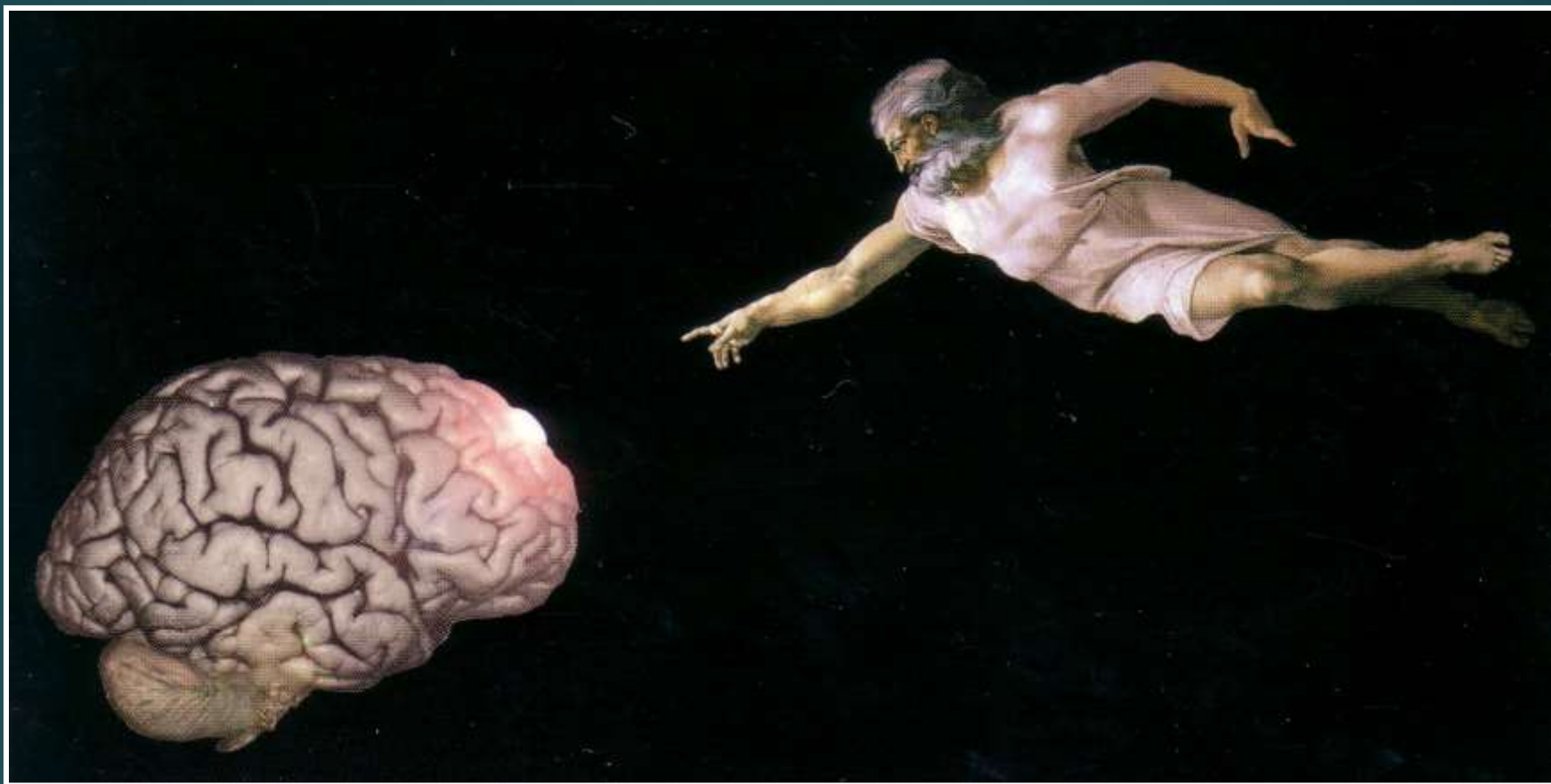
www.charlesjvellaphd.com

- ▶ All of my lectures in PDF files
- ▶ In Ollie Brain Class section of my website: www.charlesjvellaphd.com
- ▶ Or in the OLLIE Google Drive:
<https://drive.google.com/folderview?id=0B-99S2HCCnmMVDZkdDJxT3htdkk&usp=sharing>
- ▶ Email: charlesvella@comcast.net

Enchanted Loom: The Brain



And God...



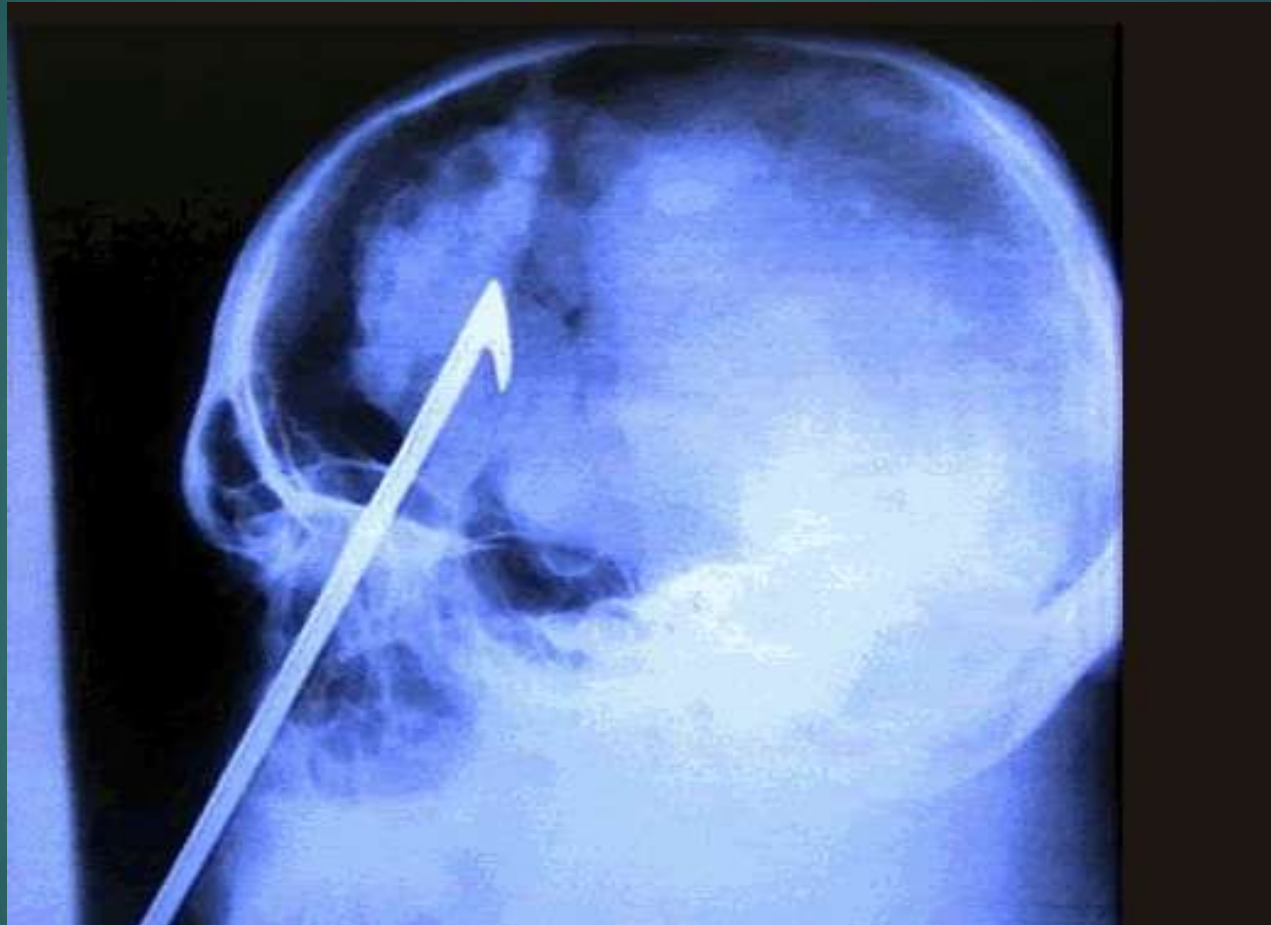
4000, BC: First written mention of the Brain

- ▶ The first known writing about brain function is found in ancient Sumerian records dated around 4000, BC.
- ▶ The anonymous writer describes euphoric mind-altering effect of ingesting the common poppy.

2500 BC: Egyptians

- ▶ Egyptians believed that the heart was the most important body organ.
- ▶ The Book of the Dead, which instructs that a dead man's heart must be weighed against feathers to determine the balance of good to evil it contains. The brain, on the other hand, is considered a minor, unimportant organ.
- ▶ They discard it during the embalming process even as they ceremoniously preserve other organs for mummification.

Egyptian Mummification:
No Canopic Jar: Brain was worthless



Egyptian method used to remove brain in mummification

Edwin Smith Surgical Papyrus by Imhotep, 1700 B.C.

- ▶ First written record about brain anatomy:
- ▶ 27 head injury cases
- ▶ Brain mentioned 7 times
- ▶ Case 6: TBI, brain convolutions, meninges, CS fluid



“Brain” in Hieroglyphic



Spinal Cord Injury in Assyria, 600 BC

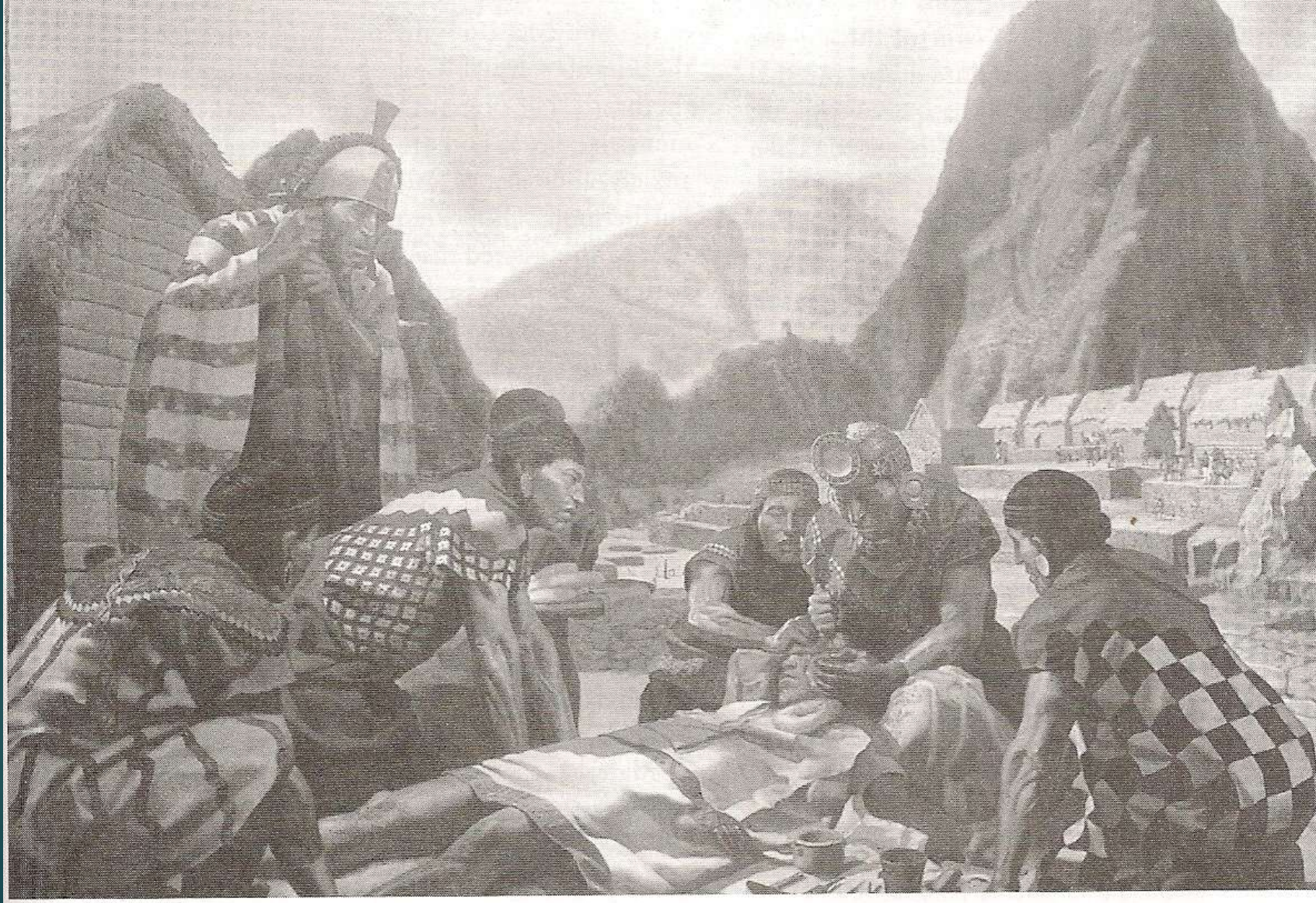


Figure 1.1

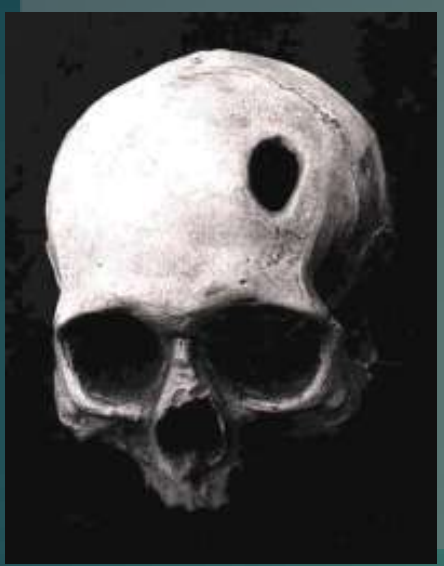
From the British Museum Assyrian collection ca. 600 BC. The figure is from a wall panel showing the effect of a spinal cord lesion. The lioness has been pierced by a spear, interrupting the spinal cord at a midthoracic level. Note the flaccid paralysis of the lower limbs and the normal posture in the upper limbs. ©The

Midthoracic spinal cord injury = flaccid paralysis

Machu Picchu: Neurological Procedure



Neolithic Neurology: *Trephination*



Trephination: as early as 13,000 years ago in Morocco; Egyptians used it around 4,000 years ago, as did pre-Inca groups living in South America 1,000 years ago.

Estimated 65% survival rate (from Stanley Finger, neurologist)

One archeological site in France with 120 skulls had 40 with holes

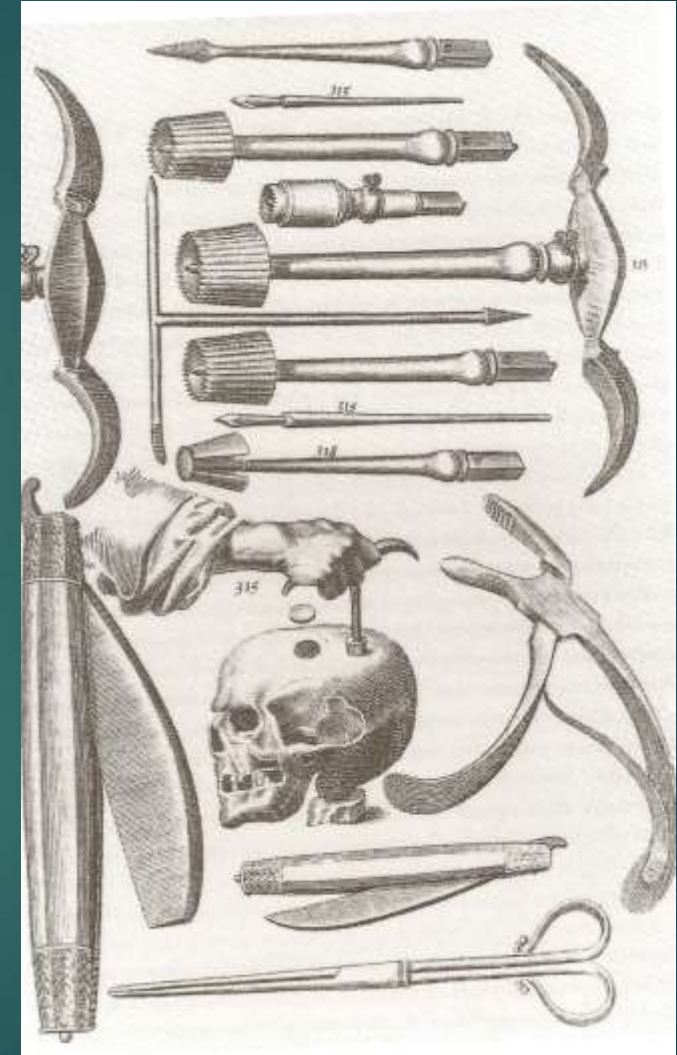
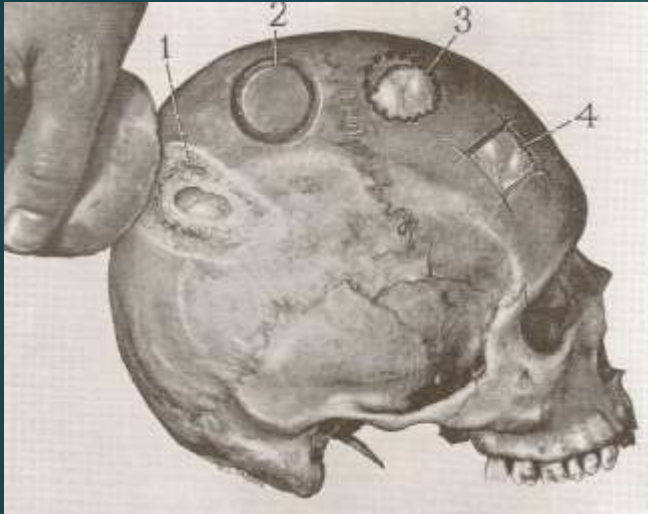
Peruvian Paleolithic to modern consciousness raising (see <http://www.trepan.com/>)

Medieval Application



Figure 28.14. Woodcut showing a craniotomy in progress. Two people assist the surgeon, while a man warms a cloth, a woman prays, and two others watch. (From Della Croce, 1573.)

Trephination Techniques & Tools



Modern Use: Relief of ICP in TBI injuries

Psalm 137

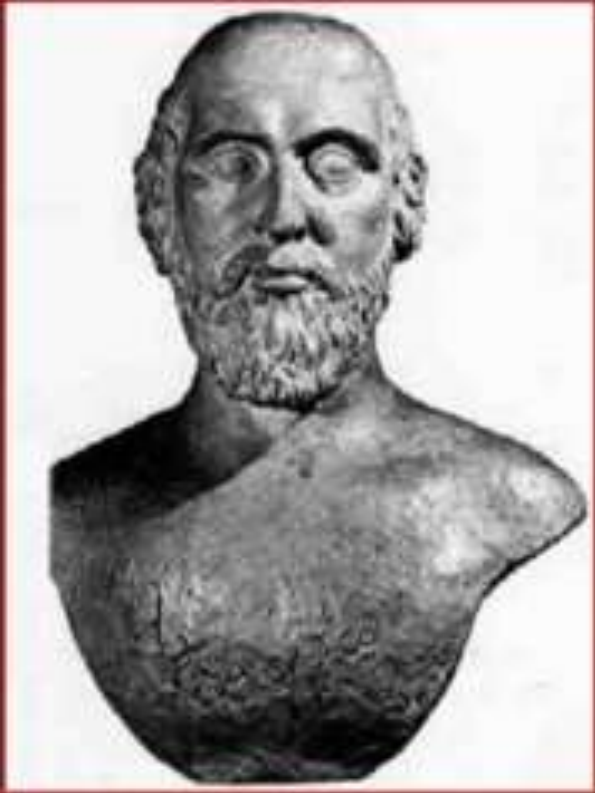
- ▶ If I forget you, Jerusalem, may my right hand wither.
- ▶ May my tongue stick to my palate if I do not remember you, If I do not exalt Jerusalem beyond all my delights.
- ▶ Name the neurological syndrome described above.

Left hemisphere stroke with right hemiplegia and aphasia

Brain vs Heart

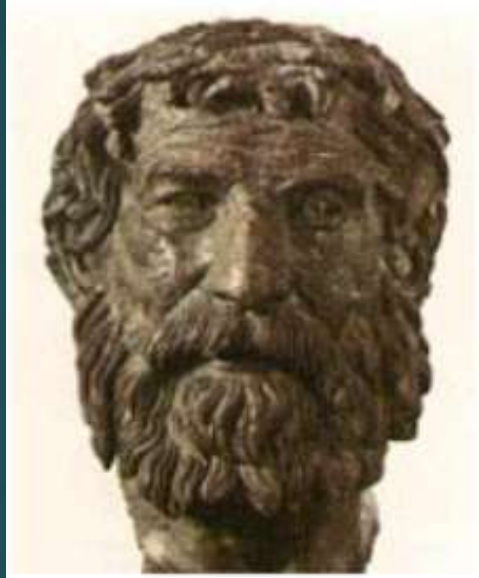
- ▶ Alcamaeon of Croton – located mental processes in the brain (**the brain hypothesis**)
- ▶ Empedocles of Acragas – located mental processes in the heart (**the cardiac hypothesis**)
- ▶ **The relative merits of these two hypotheses were debated from the next 2000 years.**

Alcmaeon of Croton, (510 BC-)



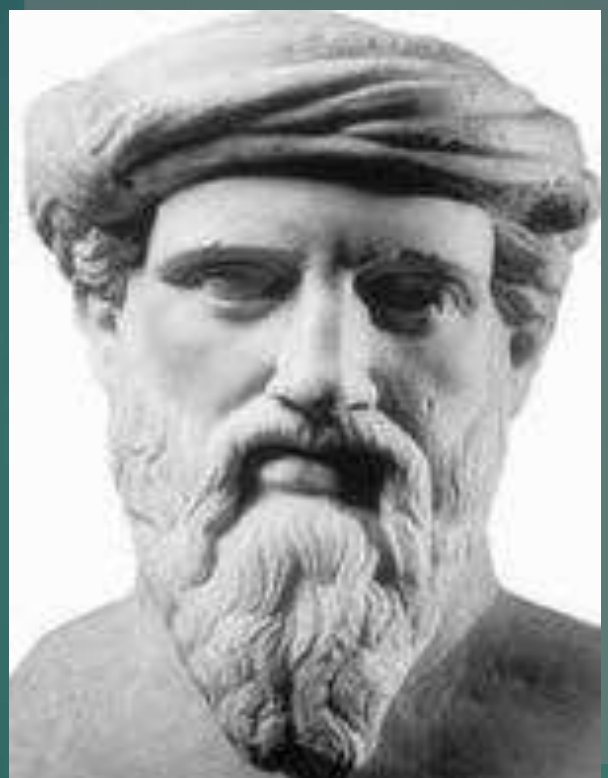
- ▶ The first to consider the brain, not the heart, to be the place where the mind was located, subscribing to what is now called the brain hypothesis
- ▶ First to use anatomic dissection of animals as basis of his theories
- ▶ Nerve Dissection: of sensory nerves; optic nerve leads to brain

Empedocles (495 BC): Cardiocentric View



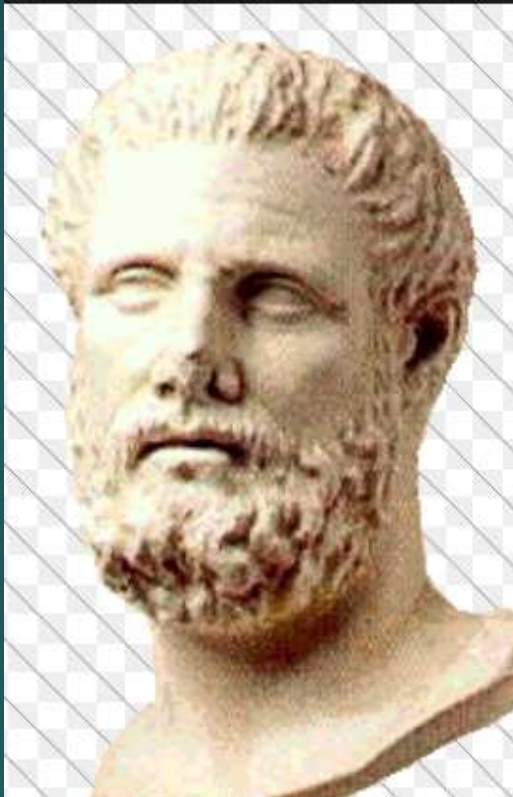
Located mental process in the heart, subscribing to what could be called the “cardiac hypothesis”: heart is site of mind

Pythagoras, 500 BC:



Brain as the primary locus of the soul

Hippocrates, 460 B.C. -370 B.C.



Father of Medicine

Hippocratic Oath

Epilepsy (Sacred Disease)
as disturbance of brain

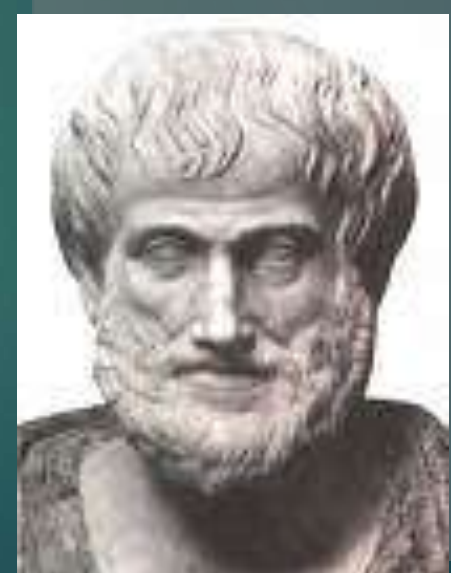
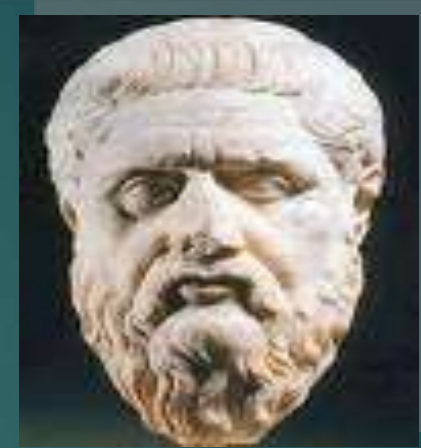
Brain as seat of intelligence

Motor lesion produced
contralateral effect

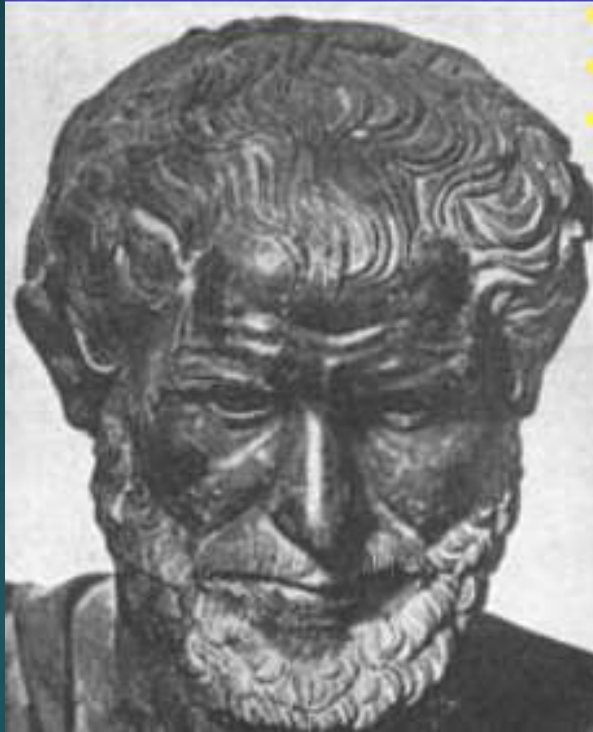
Plato, 387 B.C. vs. Aristotle, 335 B. C.

- ▶ **Right for wrong reason: Plato**
- ▶ Concept of the tripartite soul and placed its rational part in the brain because that was the part that was closest to the heavens: Brain as seat of intelligence

- ▶ **Wrong: Aristotle**
- ▶ Heart was warm and active, and the source of mental processes; the brain, because it was cool and inert, served as a radiator to cool the blood. Heart was seat of intelligence



Herophilus, 300 B.C.: Father of Anatomy



- ▶ Medical school at Alexandria
- ▶ Along with Erasistratus, first to dissect human body; held public dissections
- ▶ Localization: Brain was the source of intellect, the third ventricle the source of cognition, the fourth ventricle the seat of the soul, and posterior regions responsible for memory
- ▶ Only arteries pulse.
- ▶ Identified cerebellum, meninges, ventricles, and pathways of sensory motor nerves
- ▶ Nerves as hollow tubes

Erastriatus, 304 BC- 250 BC

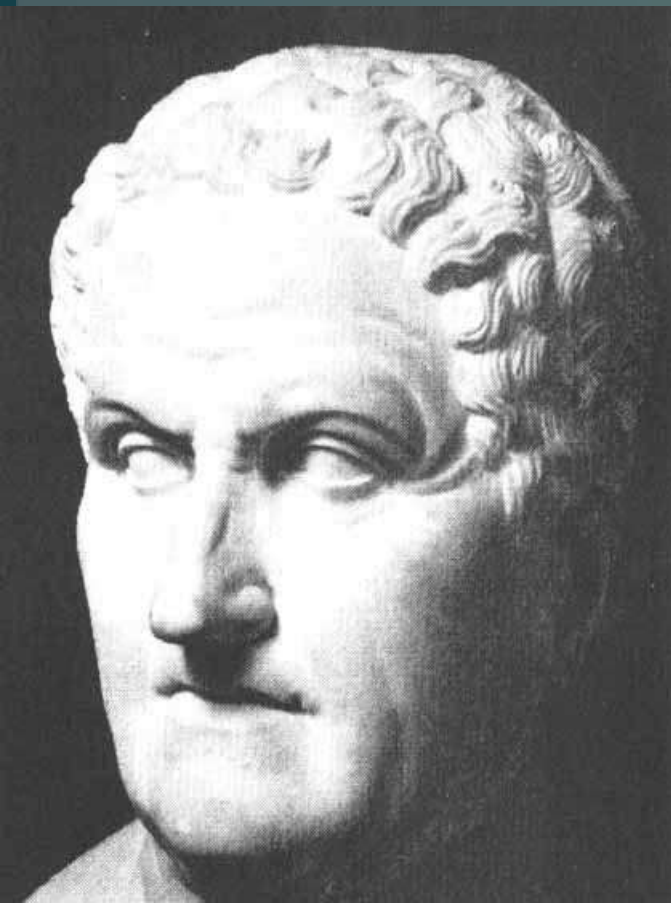
- ▶ Differentiated between the function of the sensory and motor nerves, and linked them to the brain.
- ▶ He is credited with one of the first in-depth descriptions of the cortex and cerebellum.



First Psychoanalytic cure:

Curing Antiochus: Noticed pulse increased when stepmother came into room; —that a passion for his inaccessible stepmother was at the root of the problem.

Galen 130-200 A.D.



Humors: blood, phlegm, cholera, bile

Surgeon to the Gladiators x 5 years: behavioral consequences of TBI; Physician to the Emperors

Refuted Aristotle by pointing out that nerves from sense organs go to the brain and not the heart

177 AD: On the Brain

Ventricular Theory: “Animal spirits”/bodily humors, were produced in the heart, flowed to the ventricles, where they were stored and were used for movement and sensation, via hollow nerve

Ventricles were the instrument of the soul, but the brain tissue was the seat of intellect (animal spirits flowed into the brain as well as the nerves)

1500 years of influence (but dissections based on animals not humans)

Humors



Blood (lust: lute)



Yellow Bile (Anger)

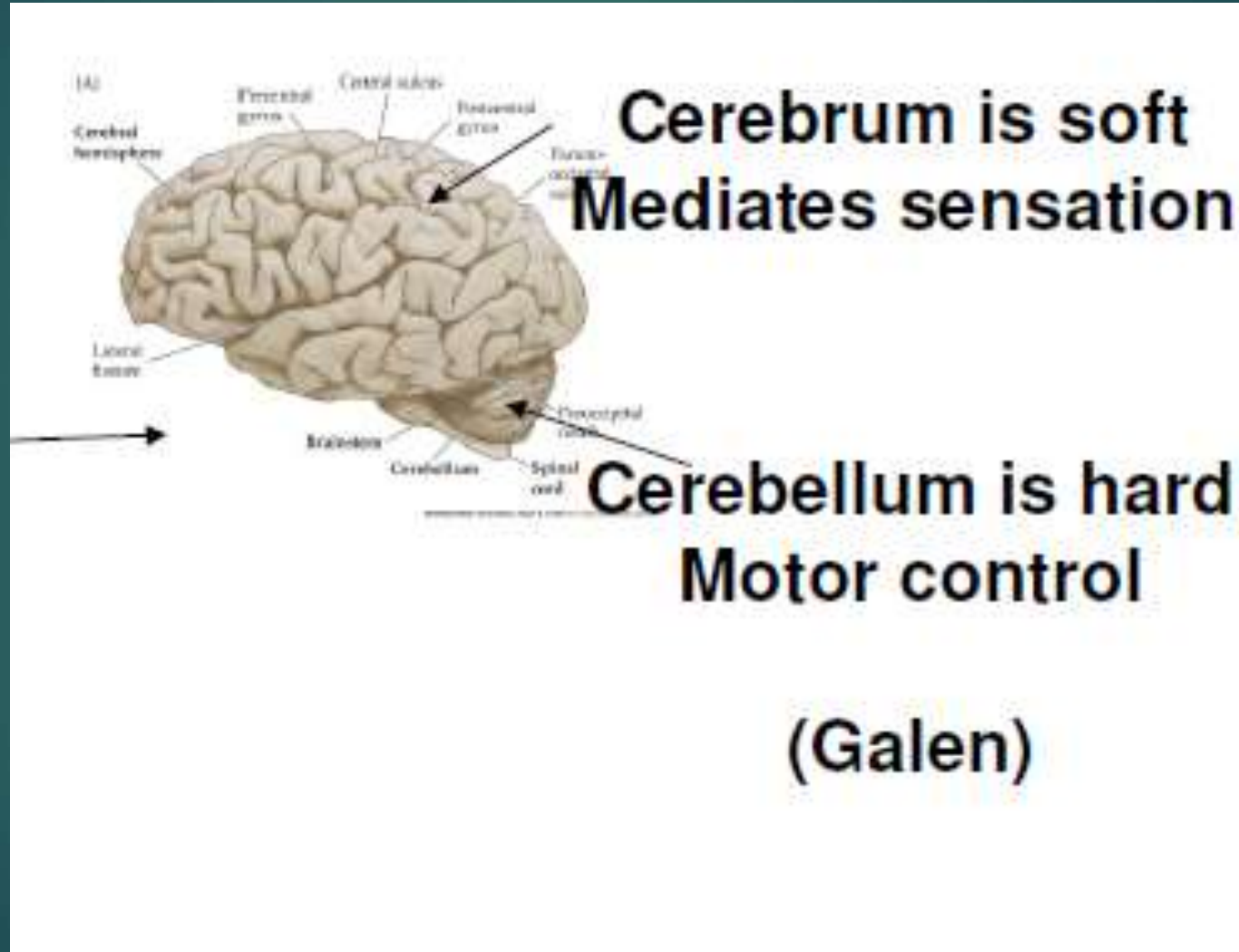


Mucus (slow response)



Black Bile (depress)

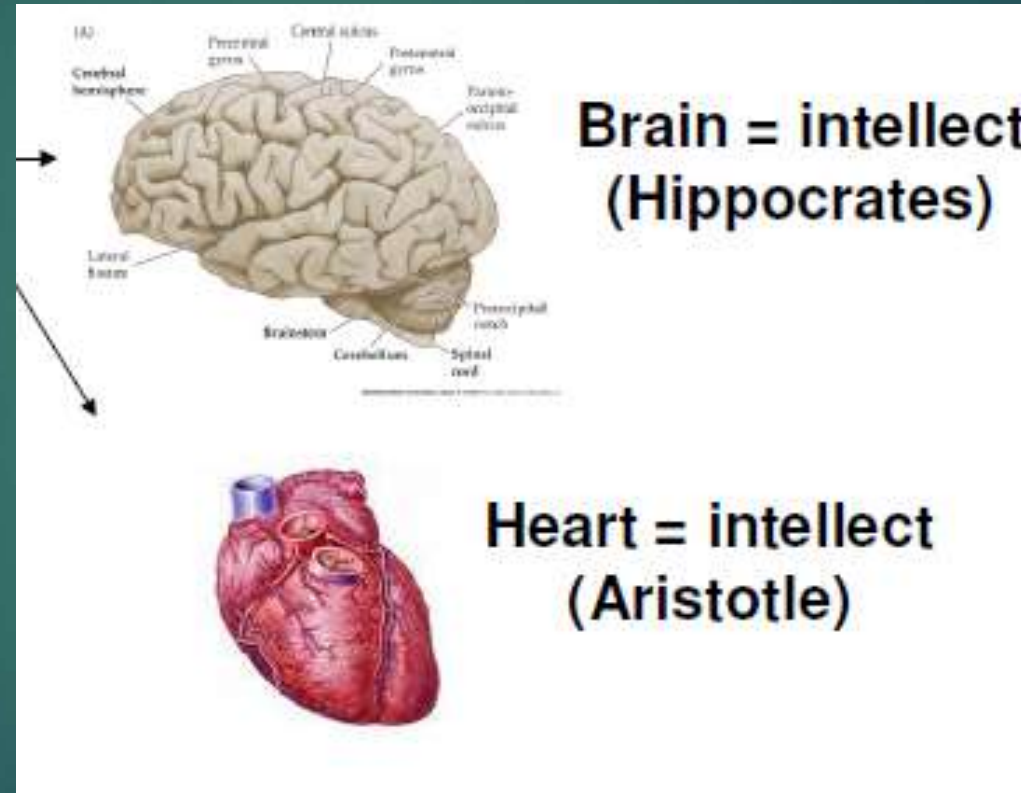
Galen 2



Ancient Debate on Location of Mind: Cardiocentric (heater) vs. Neurocentric (radiator) theories

Cold

Warm



Radiator

Heater

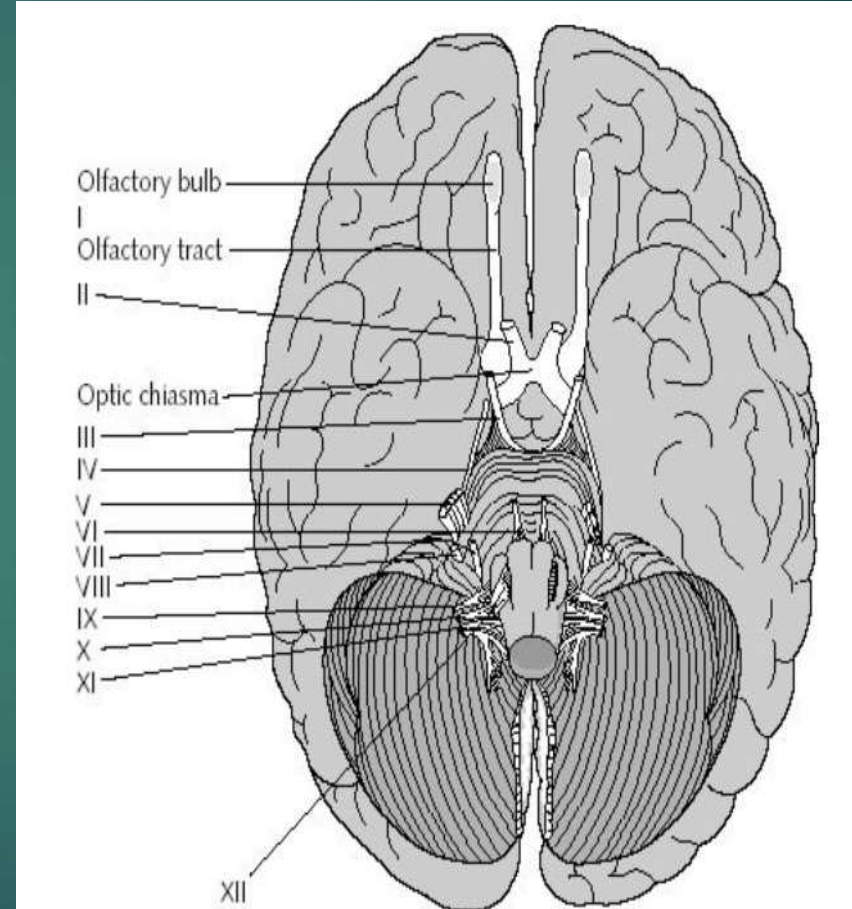
Chinese invented testing

- ▶ 2000 B.C.E.: Scattered evidence of civil service testing in China
- ▶ 206 B.C.E. to 220 C.E.: Han Dynasty in China develops test batteries: two or more tests used in conjunction: Test topics include civil law, military affairs, agriculture, revenue, geography
- ▶ 1368 C.E. to 1644 C.E.: Ming Dynasty in China develops multistage testing: Local tests lead to provincial capital tests; capital tests lead to national capital tests: Only those that passed the national tests were eligible for public office
 - ▶ Developed & administered competitive examinations for government service jobs.

Chinese: Merit testing

- ▶ 1832: English East India Company copies Chinese system to select employees for overseas duty.
- ▶ 1855: British Government adopts English East India Company selection examinations. French & German governments follow shortly.
- ▶ 1883: United States establishes the American Civil Service Commission

Abu Bakr Muhammad ibn Zakariya al-Razi, 865-925:
Kitab al-Hawi Fi Al Tibb
(The Comprehensive Book of Medicine)



7 cranial nerves and 31 spinal nerves

Middle Ages, 1100-1500: Catholic Church Ban

- ▶ Brain studies cease during the Middle Ages due to Catholic Church's ban on human dissection and study of anatomy
- ▶ Jewish physicians continued to do it secretly.
- ▶ Brain surgery continues to be performed by enterprising barbers who roam the countryside offering to remove the "stone of madness" or "pierre de follie" from skulls of mentally ill.

Middle Ages: Cell Doctrine (Rule of the Ventricles)

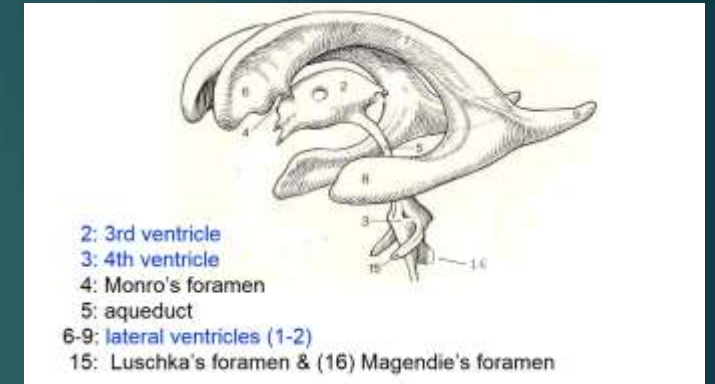
Cell Doctrine: Localization of function in the ventricles

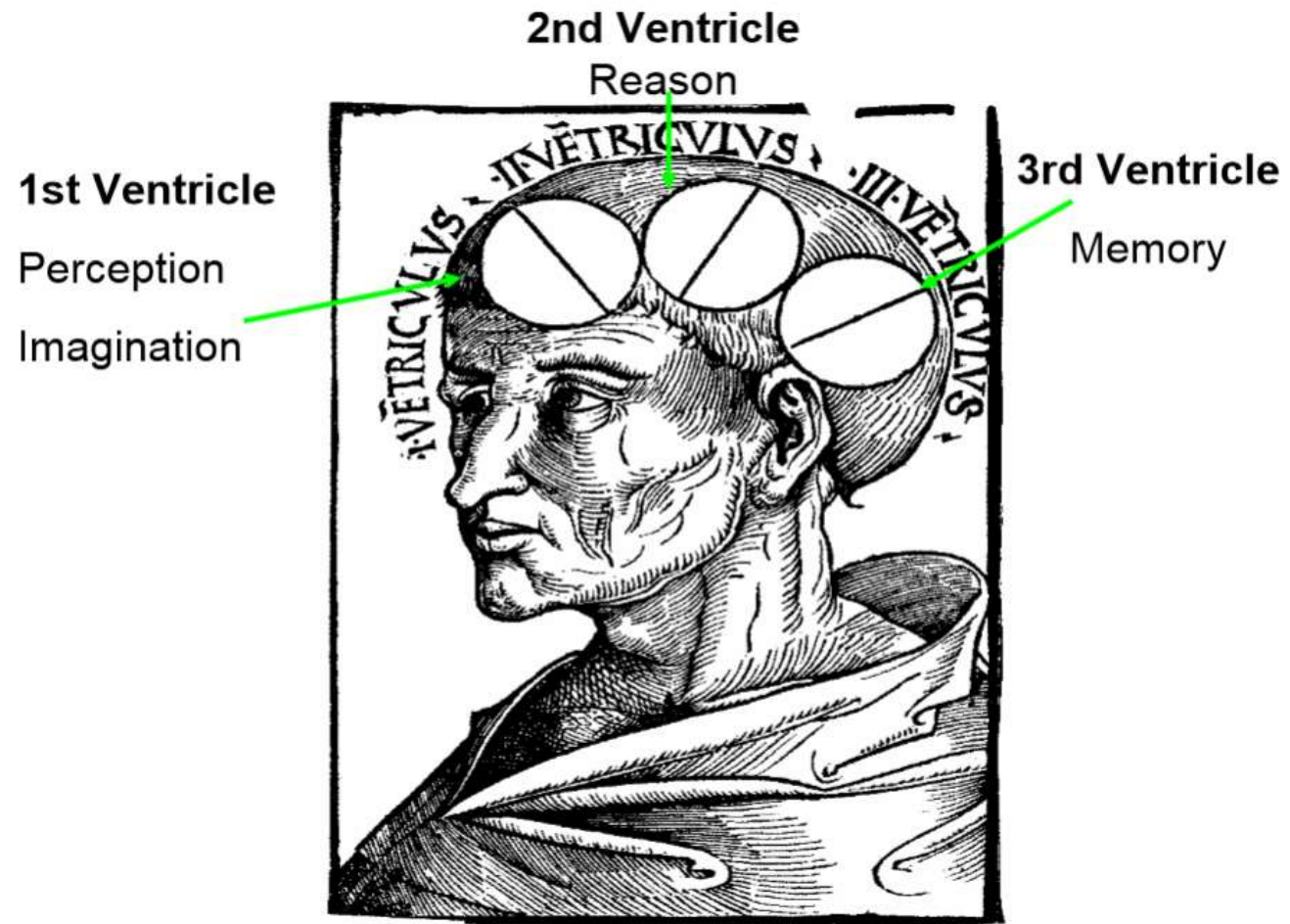
St. Augustine (354-430)

- Perception = anterior ventricles
- Memory = middle ventricle
- Motion = posterior ventricle

Nemesius, Bishop of Emesia (390)

- Perception = anterior ventricles (lateral)
- Cognition = middle ventricle (3rd)
- Memory = posterior ventricle (4th)





Albertus Magnus, *Philosophia naturalis*, 1506

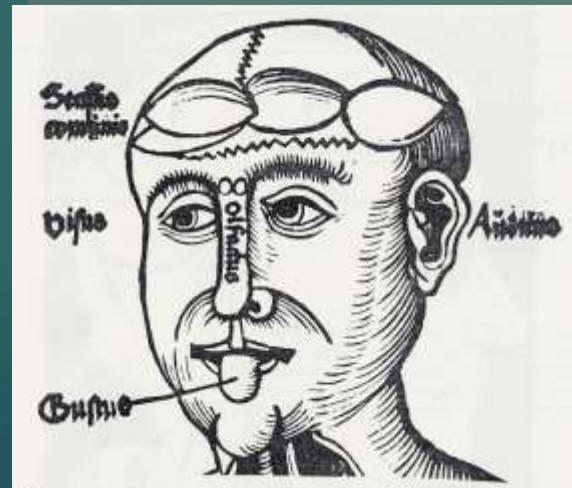
Magnus 1490



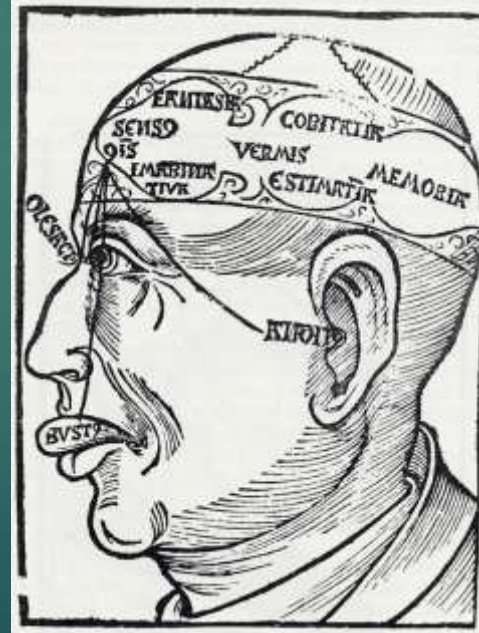
Magnus 1506



Peyligk 1516



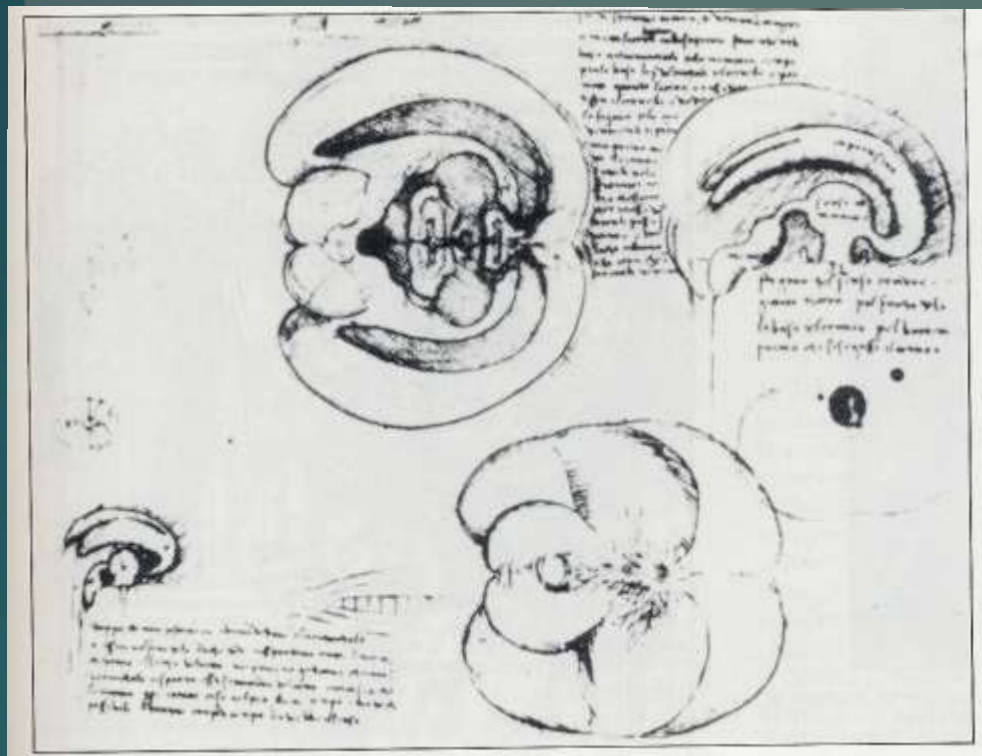
Brunschwig 1497



Leonardo Da Vinci, 1504:
Cast the Ventricle in wax



Leonardo Da Vinci, 1504

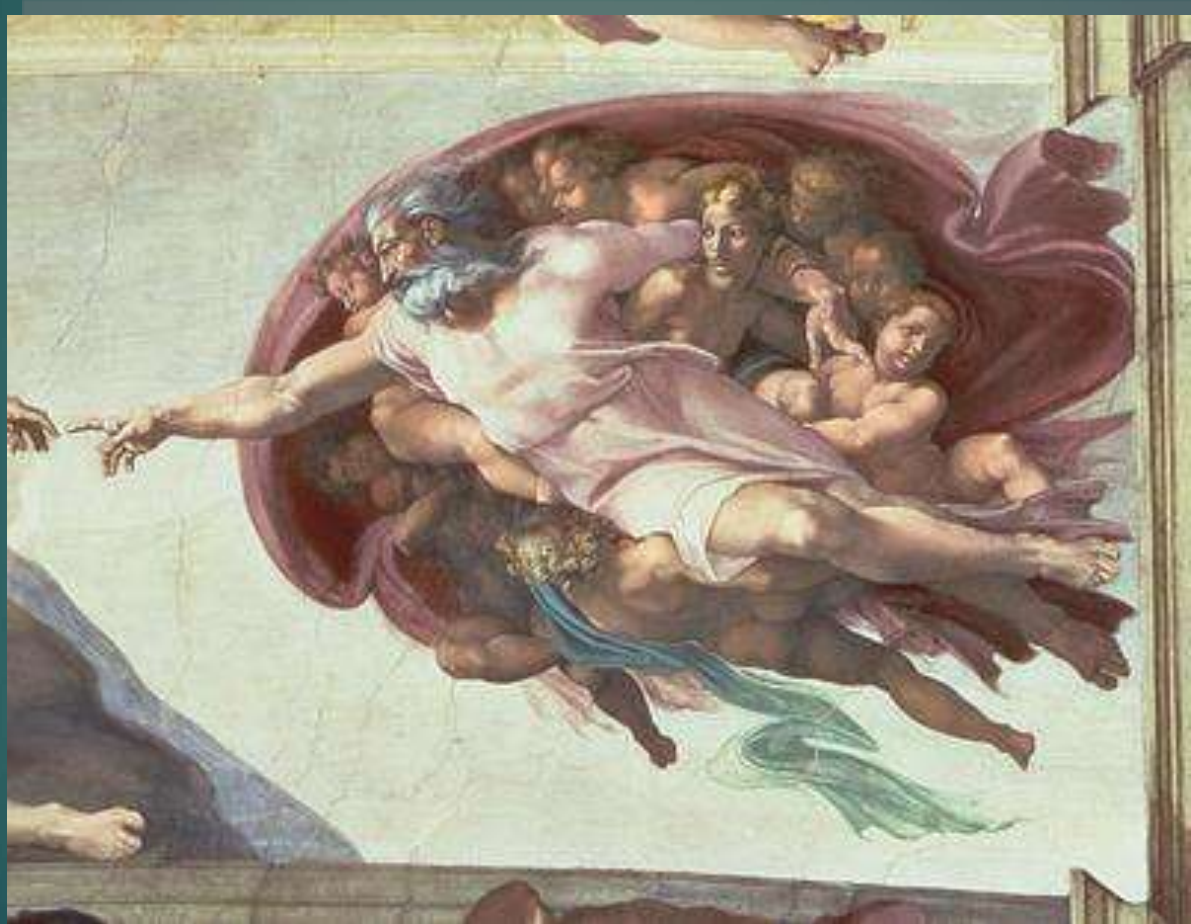


Wax cast in a cow brain



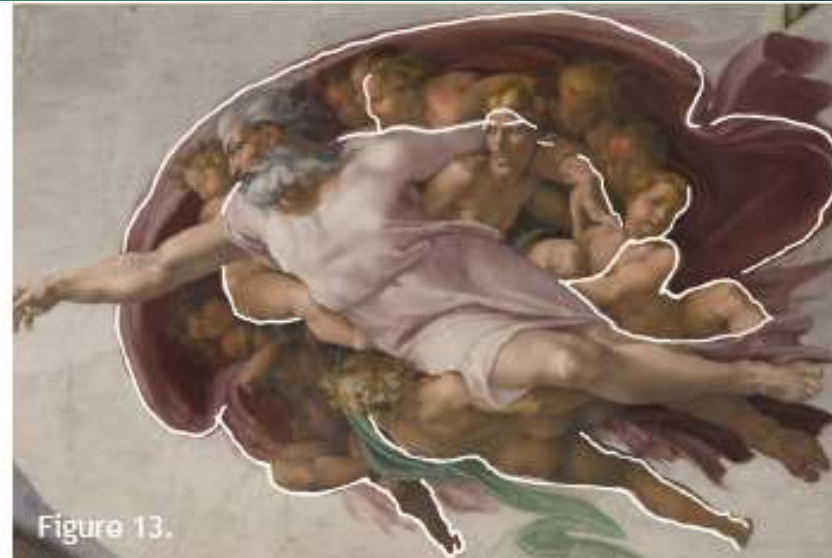
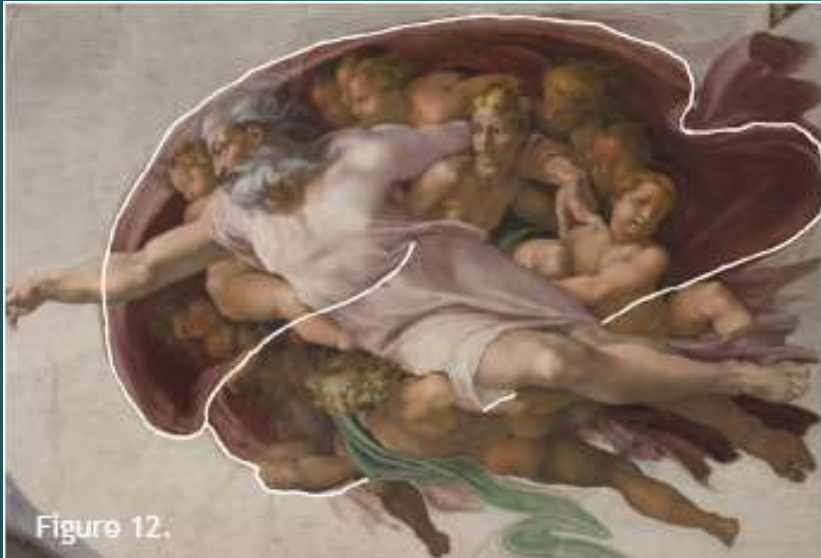
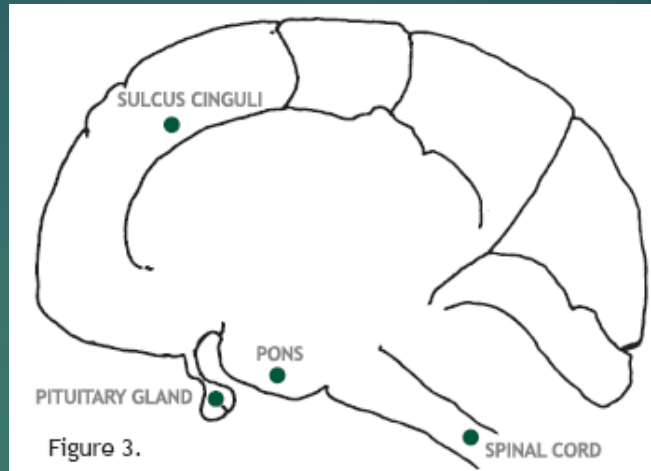
Creation of Adam, 1508: Michelangelo's theory of creative brain

Frank Meshberger: *Mid-sagittal cross-section of a human brain.*

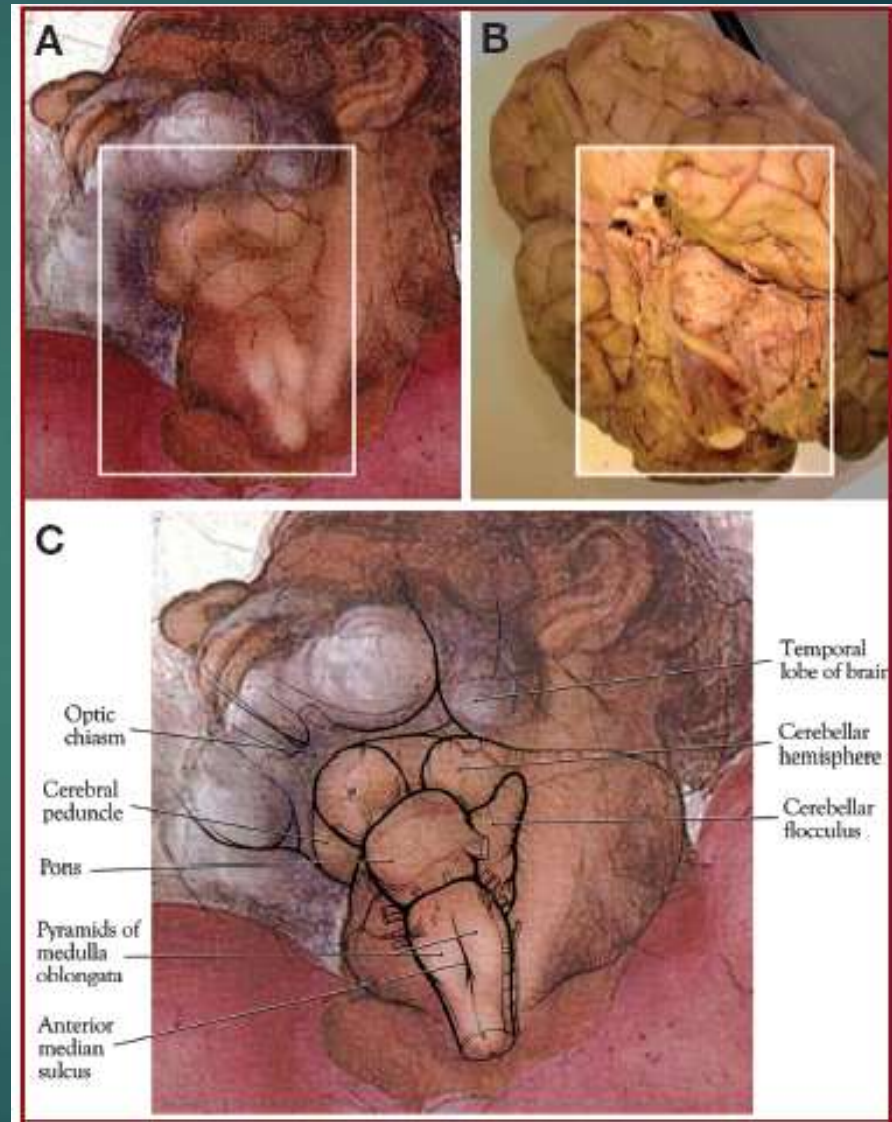
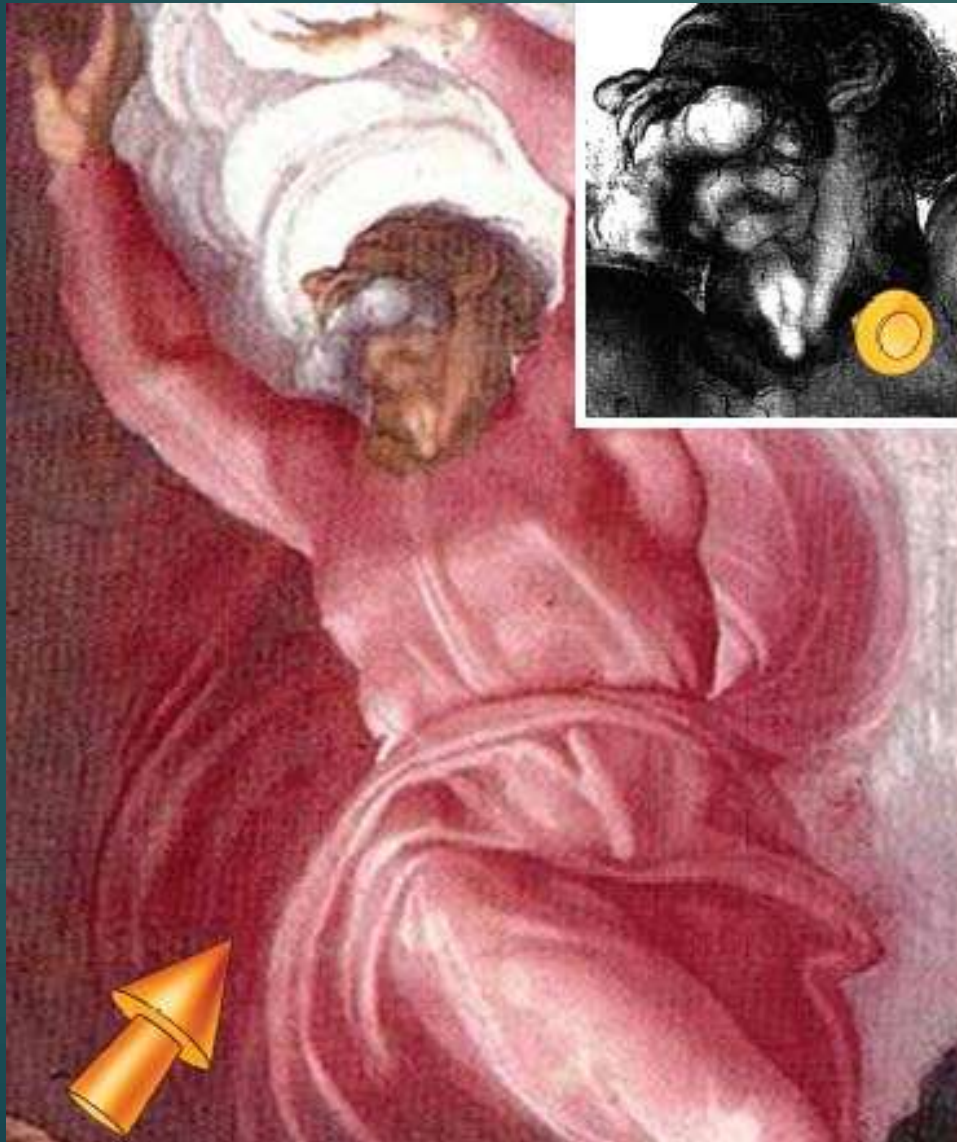


Concealed Neuroanatomy in Michelangelo's Separation of Light and Darkness in the Sistine Chapel, 2010, Ian Suk and Rafael J. Tamargo in Neurosurgery, Vol. 66, No. 5, pp. 851-861.

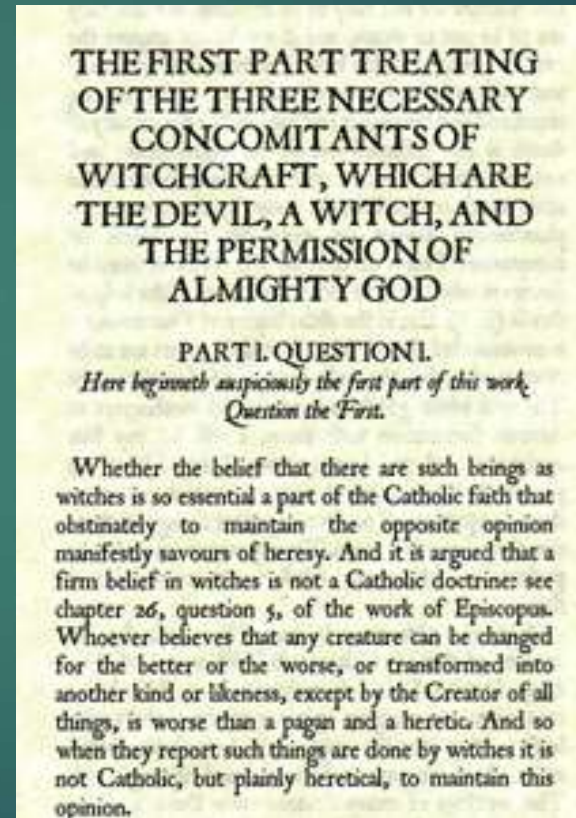
Michaelangelo 2



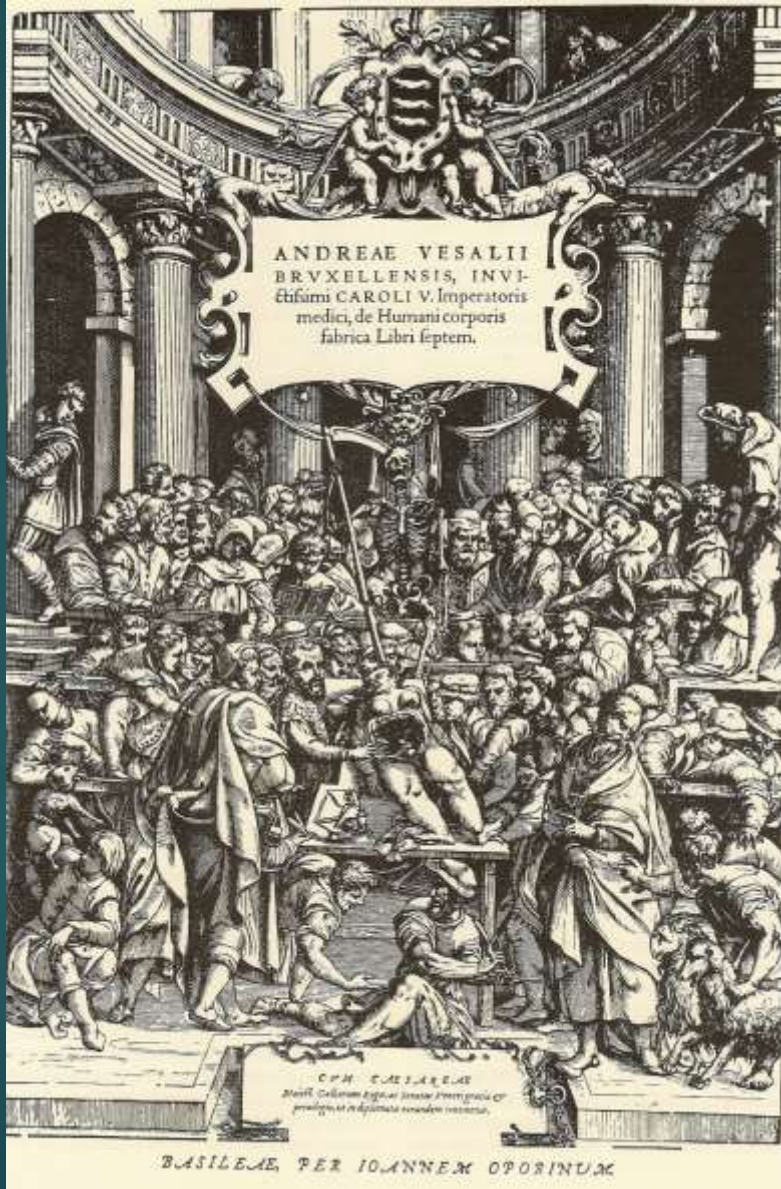
Michaelangelo & Sistine Chapel



Malleus Maleficarum (Hammer of Witches): First major anti-feminist tract; First “Psychiatry” Textbook & Horror film manual



1543: Vesalius's Anatomical Revolution



De Humani Corporis Fabrica
(The Fabric of The Human Body) -
Andreas Vesalius

First detailed anatomy of human body
based on human dissection

First known neuroscience textbook

Andreas Vesalius (1514-1564)

SECUNDA SEPTIMI LIBRI FIGVRA



SECUNDAE FIGVRAE, EIVSDEMQUE CHARACTERICUM INDEX.

PRÆSENS figura sectionis serie primam subsequens, seriatim durae membranae suam (quem prima figura C aliquot insignitum gerit) longa sectione secundum capitis longitudinem ducta ad apertum demonstrat. Insuper ad huius tertij sinus latera, per capitis quoque longitudinem duas de duci sectiones, utrinque mirā ad sinum singulas, quae duram membranam denotant penetrant, & durae membranae latera ab ea membrana separavit parte, quae dextram cerebri partem a sinistra dividit, atque in subsequēti figura tribus D insignitur. Praeter tres iam cōmemoratas sectiones utrinque alij quoque molitus sunt, quae ab aere ad uterūq; pertingūt, solam





Andreas Vesalius

Studied human anatomy solely for structure

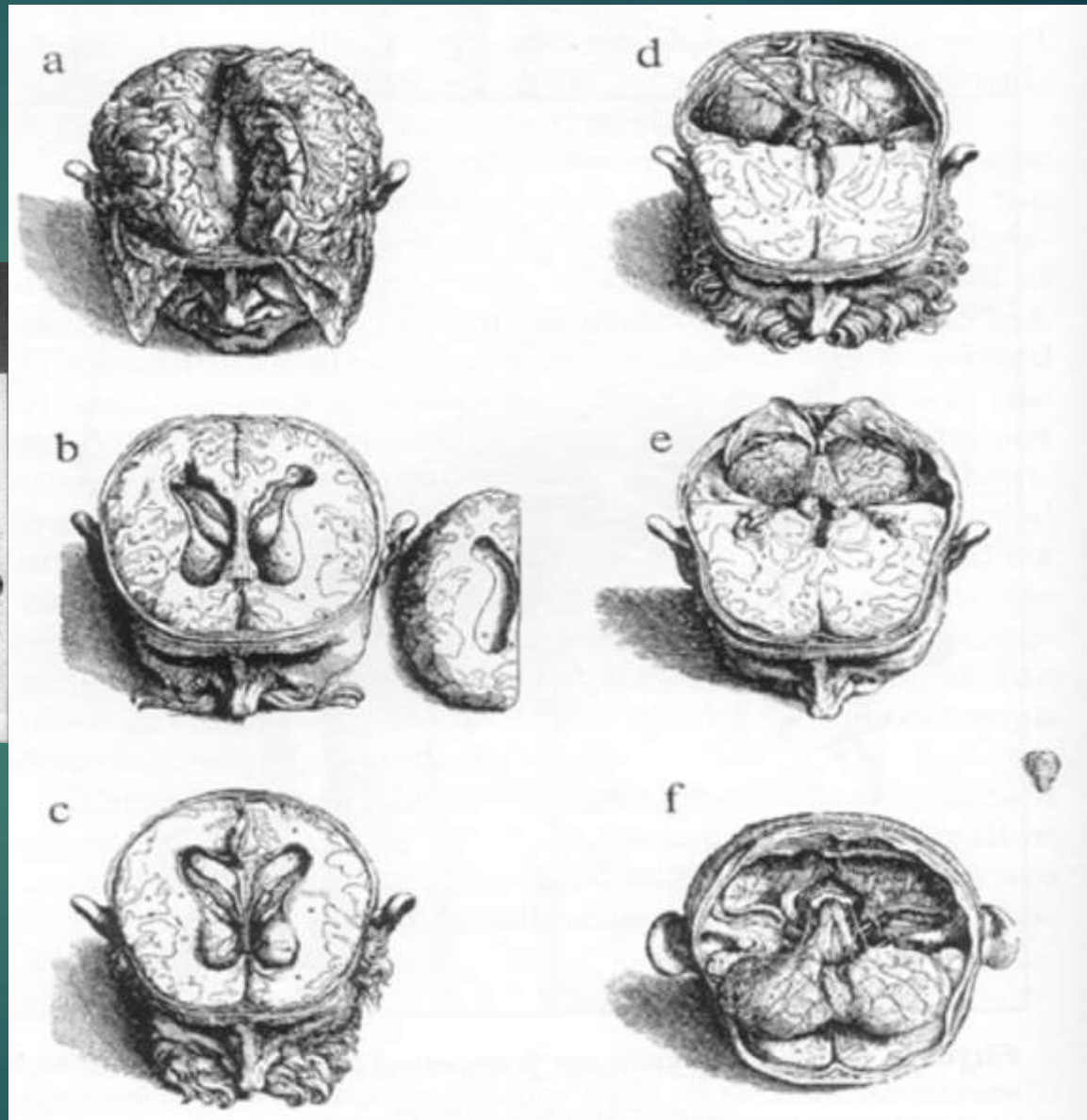
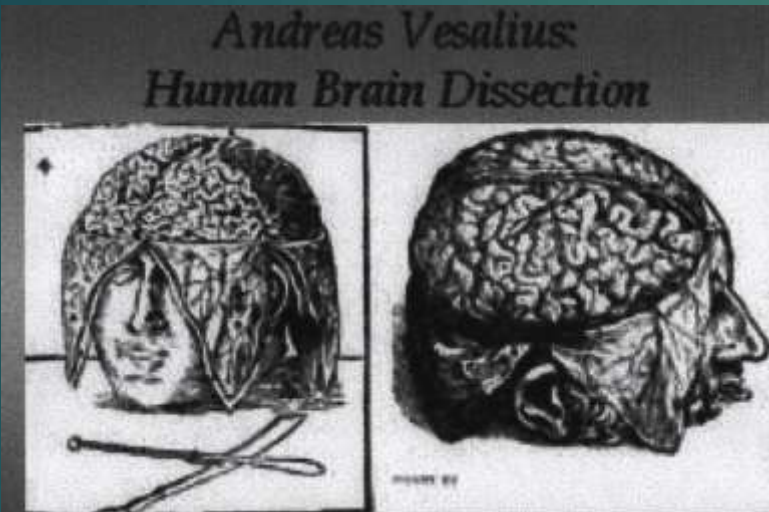
Did not get some of the convolutions of the brain right

Argued that Galen was wrong; opposed Ventricle Theory (animals have ventricles, but no soul; therefore theory is wrong)

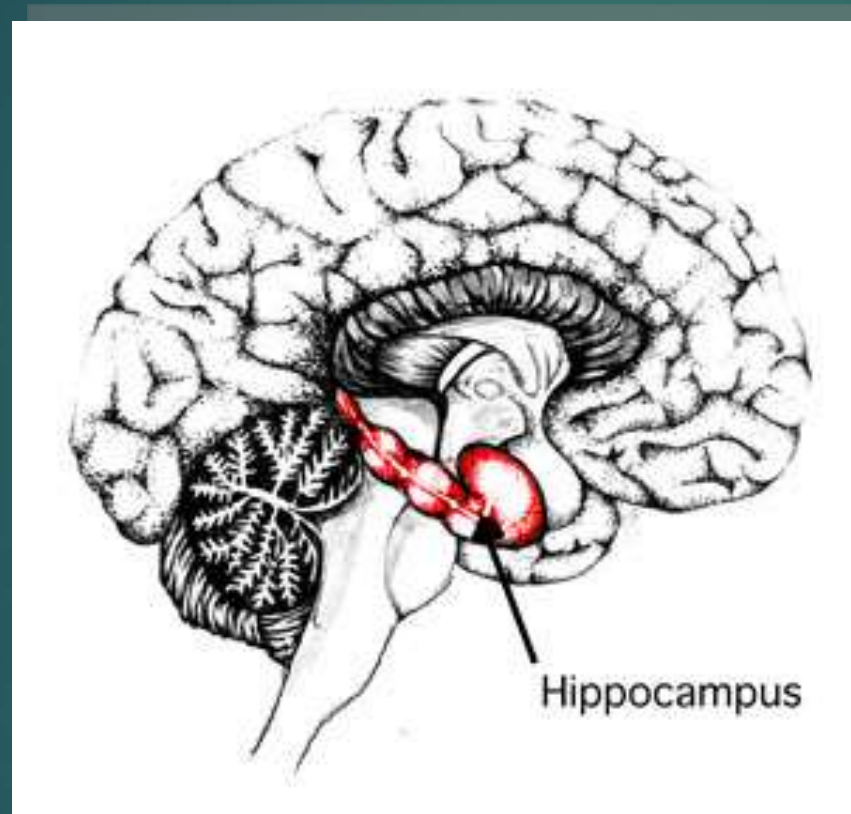
Described hydrocephalus

Was branded a heretic and fled.

Vesalius's Brain illustrations



Giulio Cesare Aranzi, 1564



Described **ventricles** and coined the term **hippocampus**

Rene Descartes, 1596-1650



De Homine – 1662

Brain as machine: mechanistic hydraulic view of brain;

Dualism - it is the mind, not the brain, which contains a person's thoughts and desires or "soul."

Mind Localization: Pineal gland – First to locate mental processes precisely within brain tissue

Ventricles controlled body via hollow tubes (nerves)

Reflexes: sensory stimulation --> valves in ventricles to release animal spirits into hollow nerves which caused movement



Multiple Historical Metaphors for Brain Functioning

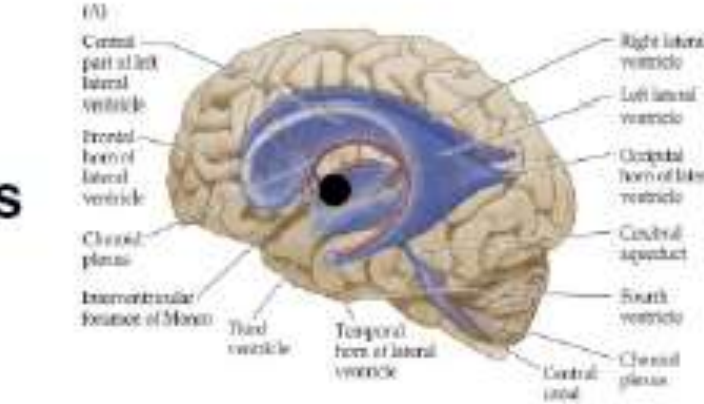
Brain models based on most recent invention/technology:

- Ancients: Stamp on wax
- 1600-1700: hydraulics
- 1800s: cartographic metaphor; mechanical centers; looms (brain as enchanted loom)
- 1990s: computer analogy (circuits and software programs, database)
- 2000: wet networks
- 2400: ???

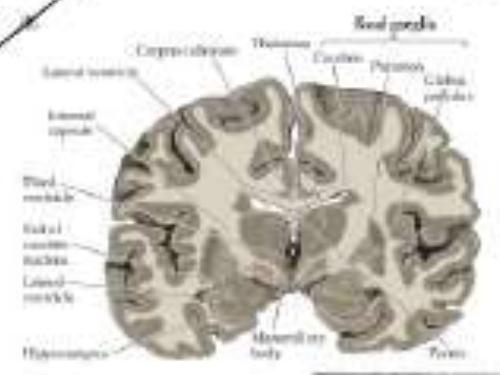


Vesalius vs. Descartes

Brain functions hydraulically (Vesalius)



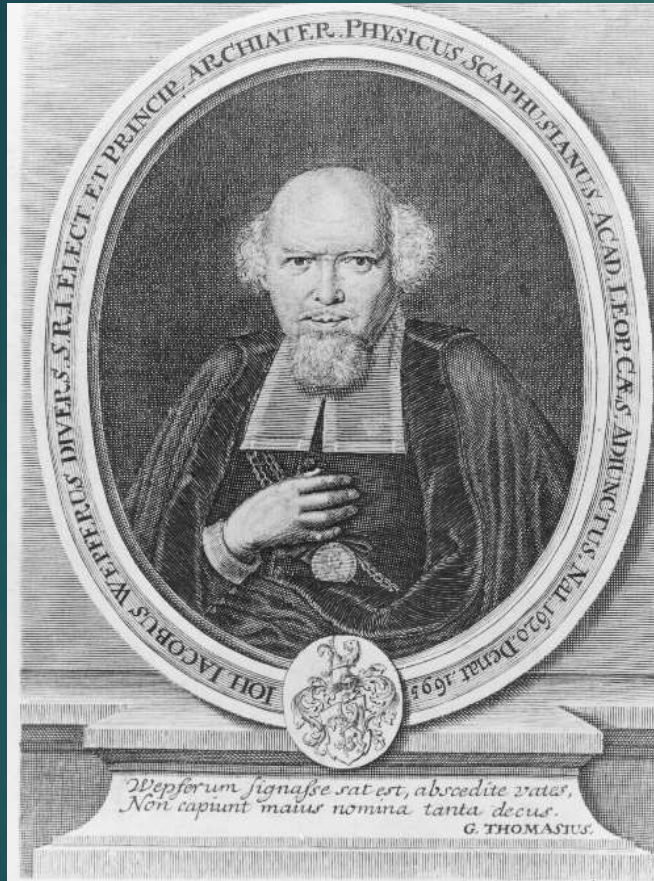
Mind distinct from brain – communicate via pineal (Descartes)



White Matter

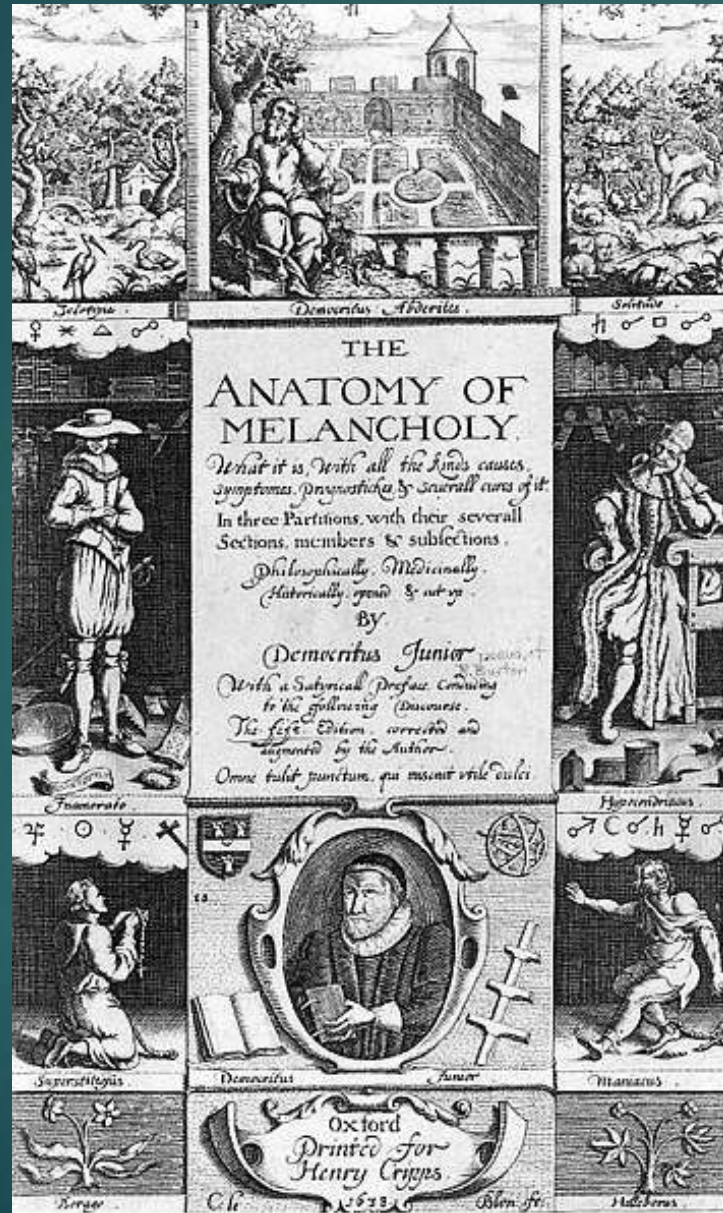
- ▶ After the **XVI century**, it was accepted that the encephalon (brain) was the **site of mental functions** but the **critical structure was held to be the white matter**, whereas the gray matter was considered as the external, protecting layer.
- ▶ • Schenck (XVI)
- ▶ • Wepfer (1727, book published posthumously)

Johann Jakob Wepfer, 1620-1695



- ▶ Swiss pathologist and pharmacologist
- ▶ Described vascular anatomy of the brain and the study of cerebrovascular disease.
- ▶ He was the first physician to hypothesize that the effects of a stroke were caused by bleeding in the brain.

Robert Burton: *The Anatomy of Melancholy*, 1621



First Major Description of Depression

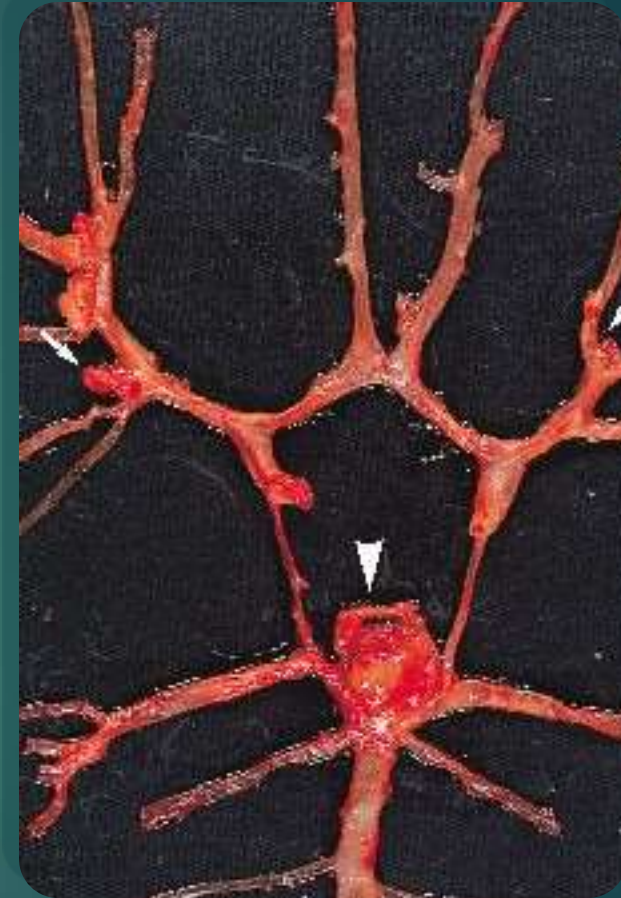
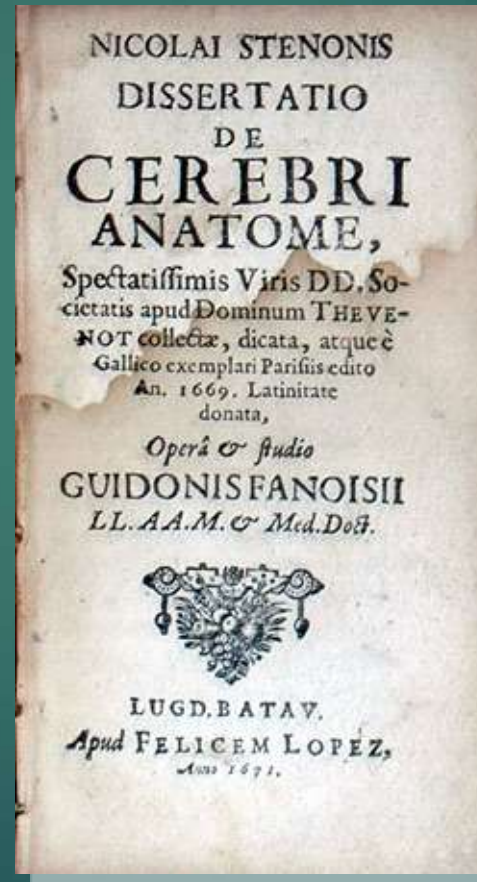
Thomas Willis, 1621 – 1675

Neurology as a discipline



Anatomy of the Brain
*With a Description of the
Nerves & Their Function*

1664 (Latin) & 1681 (English)



First monograph on brain
anatomy and physiology

Thomas Willis

- ▶ English Neurologist; Oxford anatomist
- ▶ Localizationist: Cerebral hemispheres determine thought and action and are completely separate from the part of the brain that controls basic motor functions like walking. He locates specific mental functions within the corpus callosum, corpus striatum and the cerebellum
- ▶ Introduces the words; 'neurology,' 'hemisphere,' 'lobe,' 'pyramid,' 'corpus striatum,' and 'penduncle' into the modern vocabulary.
- ▶ First description of:
 - ▶ circle of arteries at base of brain (1664),
 - ▶ the 11th cranial nerve,
 - ▶ and Myasthenia Gravis (1671)
- ▶ Willis' disease (1st eponym for diabetes mellitus)
- ▶ Biography: *Soul Made Flesh* by Carl Zimmer

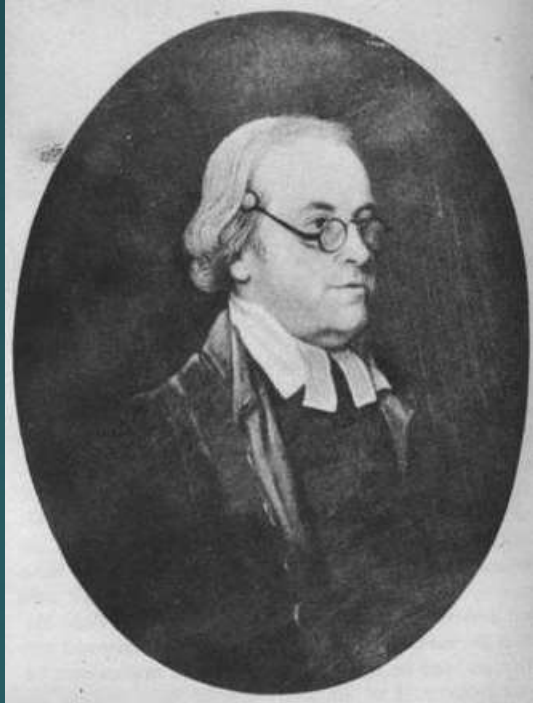
Emanuel Swedenborg, 1688-1772



- 1740 – 1st to state that cerebral cortex is functionally specialized
- Cortex is separated by fissures and gyri
- Voluntary motor areas were topographically mapped in the front of the brain
- Different motor regions controlled different parts of the body
- Intellectual functions were controlled by the frontal lobes

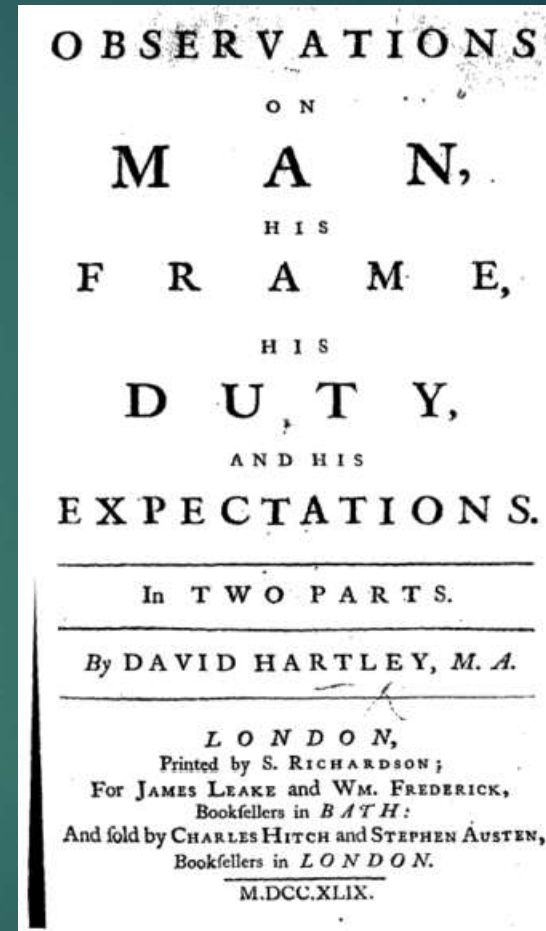
Never published, and “mystical visions” turned him away from neurology and into theology

David Hartley 1705-1757



English philosopher

First English work using the word
“psychology”



Thomas Reid (1710-1796):



Scottish Philosopher

Faculty Psychology:
separate intellectual abilities
or 'faculties' such as
memory, learning,
intelligence, perception,
and will.

Charles Bonnet, 1720-1793



1788: First to describe reduplicative paramnesia (belief that a place or location has been duplicated)

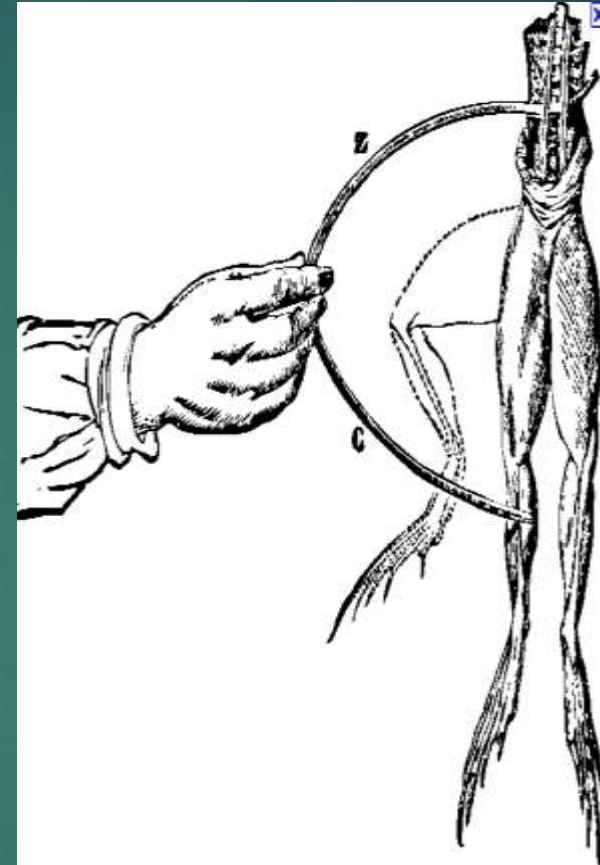
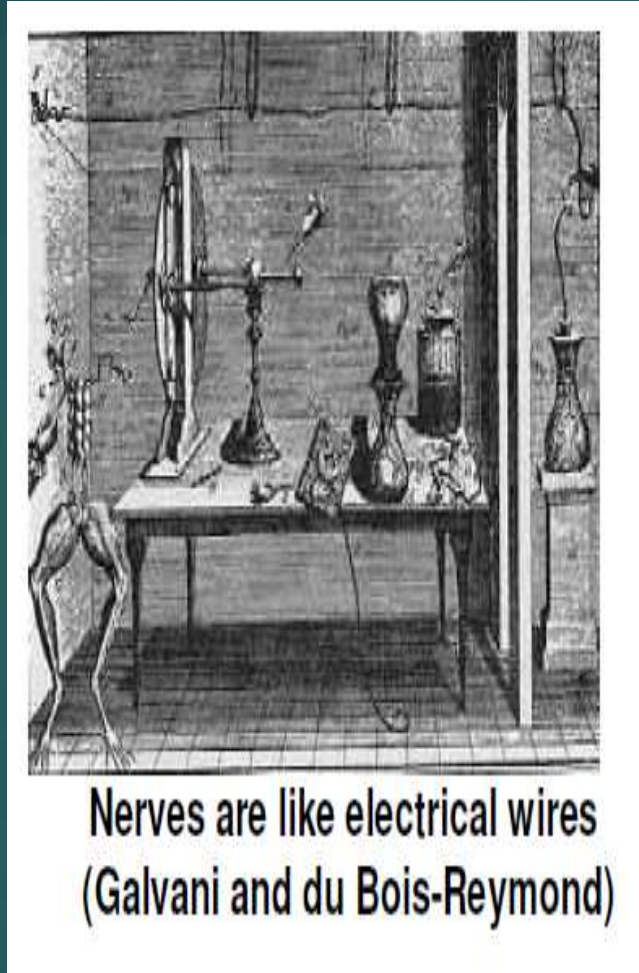
- ▶ Bonnet Syndrome:
- ▶ Vivid, complex visual hallucinations occur in psychologically normal people. They **think they are not real**. **Disappear if close eyes**.
- ▶ He documented it in his 87 year old grandfather, who was **nearly blind from cataracts** in both eyes but perceived men, women, birds, carriages, buildings, tapestries and scaffolding patterns.
- ▶ Most people affected are elderly with visual impairments, like macular degeneration or glaucoma.
- ▶ Also a musical hallucination version.

Amazing Frog Leg: Luigi Galvani: 1737-1798



Animal electricity is a property of nerve and muscles;
First step toward idea of electrical basis of neural activity.

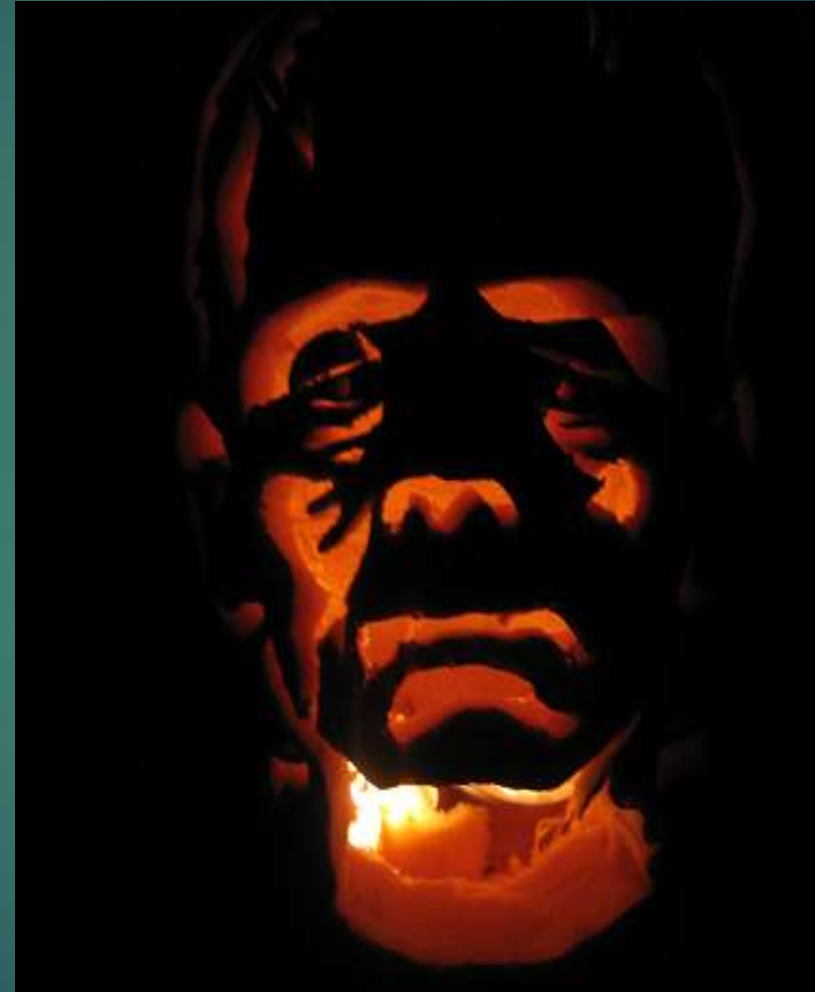
“Reanimation” of Frog Leg: nerves & electricity, 1783



Luigi Galvani makes a frog leg muscle move using electricity by putting the frog leg in between one plate of copper and one plate of tin; later disproved: electricity in Galvani's experiment was actually produced by a chemical reaction caused by acids present on the frog's skin.

Luigi Galvani & Mary Shelley: Frankenstein

- ▶ Galvani inspired one of the most famous works in all of English literature.
- ▶ Intrigued by the possible implications of the scientist's work, Mary Shelley reportedly discussed Galvani with her husband, Percy Shelley, and Byron,
- ▶ In her novel *Frankenstein*, the prospect that electricity could animate lifeless flesh was clearly seeded in her mind.



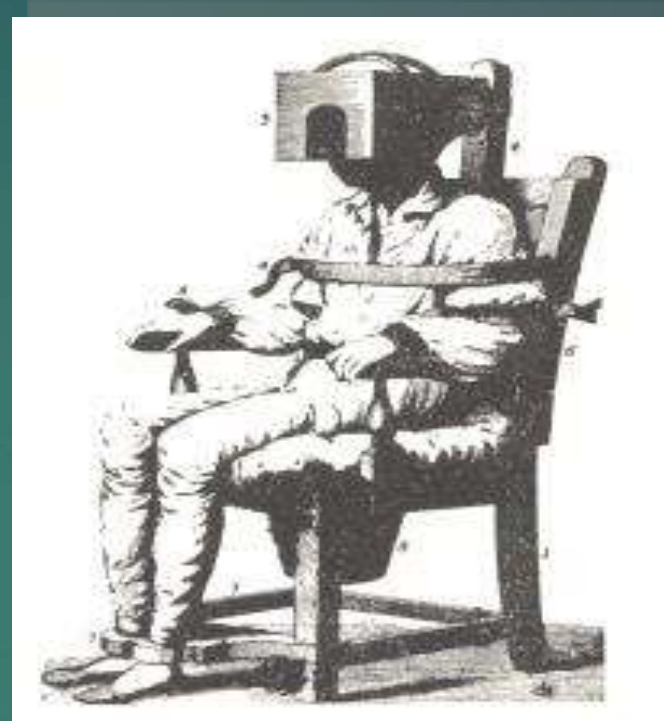
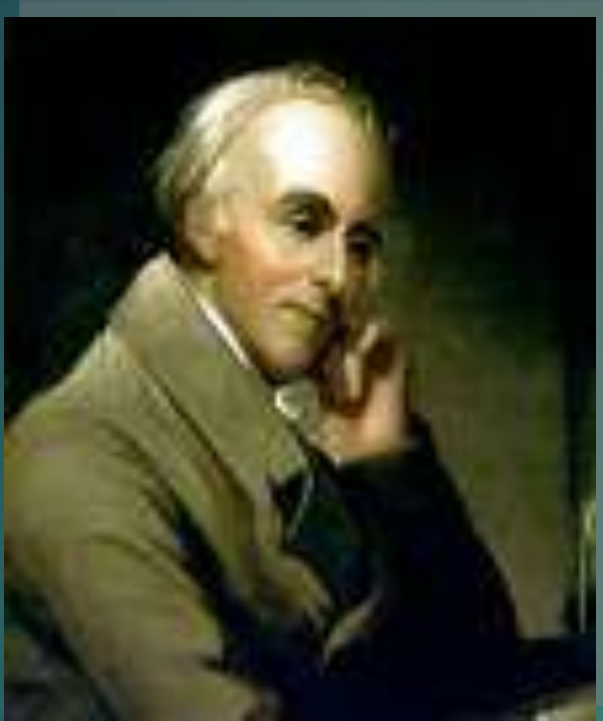
CJV's pumpkin carving of Frank

Philippe Pinel, 1745-1826



- ▶ French physician who was instrumental in the development of a more humane psychological approach to the custody and care of psychiatric patients
- ▶ Classification of mental disorders: melancholia, mania (insanity), dementia, and idiotism
- ▶ Father of modern psychiatry
- ▶ 1794: Publishes "A Treatise on Insanity"
- ▶ One of first descriptions of schizophrenia

Benjamin Rush 1746 -1813



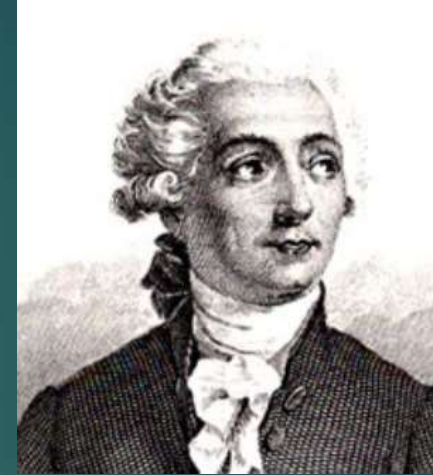
Medical Inquiries and Observations upon the Diseases of the Mind , 1812

"Father of American Psychiatry", first mental health textbook; Savant Syndrome

Univ. of PA; Signatory of the Declaration of Independence , attended the Continental Congress; hated George Washington; reconciled Jefferson and Adams

15 blinks after decapitation?

- ▶ 18th century French chemist Antoine Lavoisier
- ▶ In 1794, was condemned to death for illegal financial deals
- ▶ Told his assistant that he would try his best to blink for as long as he could after being beheaded. Reputed blinked 15 x.



Unfortunately this is a myth.

Franz Joseph Gall, 1758-1828

Localization of function in brain

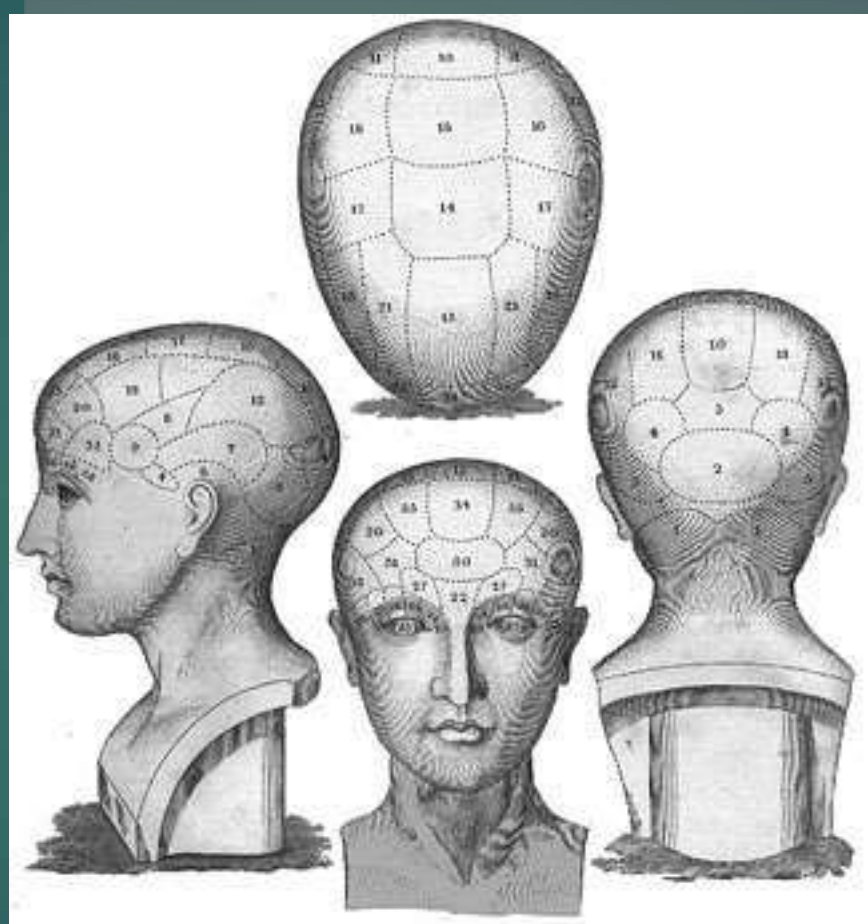


Franz Josef Gall (1758-1828)

Larger a particular convolution in a person's brain the greater the role that particular personality attribute will play in his character

- Austrian anatomist: Craniology
- 1808: Cortex is functionally specialized
- Development of function correlated with size of cortical area
- 27 or 31 well developed cortical areas, each with a specific mental function and each found at a specific location, pushed on skull and produced palpable bumps
- He set the stage for what became known as the anatomoclinical method: the use of brain autopsy at death to correlate pathological changes responsible for neurological or cognitive deficits

Phrenology: Bumps make the Man



Gall's inspiration: soldier who had sword thrust thru left eye socket into left frontal area with loss of speech (Gall called this “memory for words”)

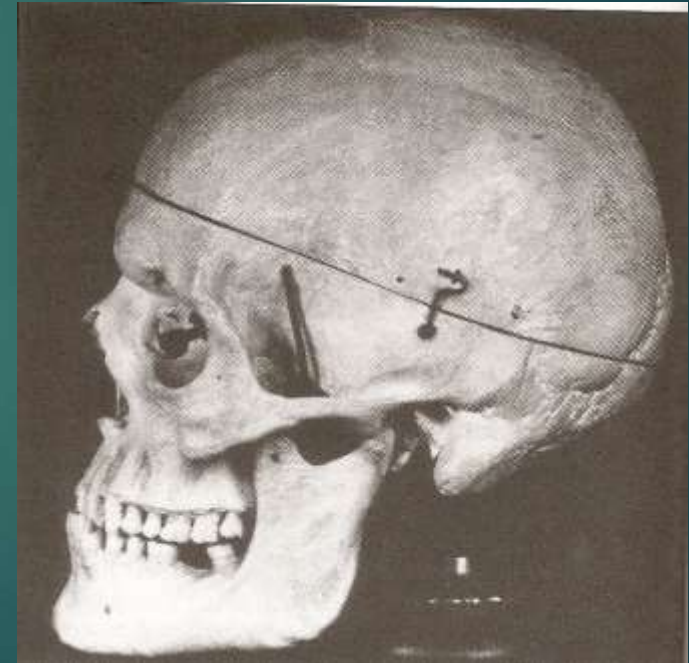
Gall The Neuroanatomist

- Made important discoveries in neuroanatomy:
 - Cortical cells are connected with subcortical structures,
 - crossing of the pyramids,
 - white and grey matter composition of the spinal cord,
 - connectedness of the cerebral hemispheres by commissural fibers
- One of the first complete account of a relation between left frontal brain damage and aphasia

Johan Caspar Spurzheim, 1776-1832

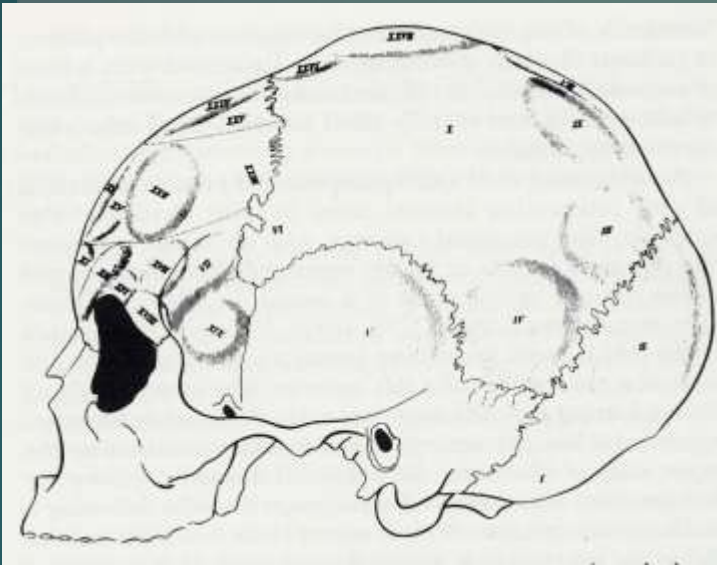


Coined “phrenology”; First Popularizer of Phrenology

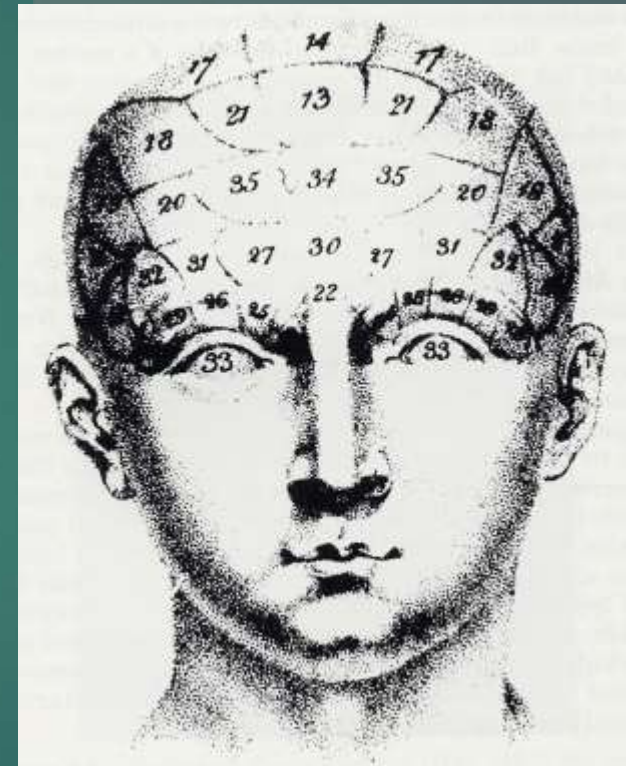


Gall & Spurzheim published *Anatomie et Physiologie du Systeme Nerveux* in 1810;
1st description of many brain structures

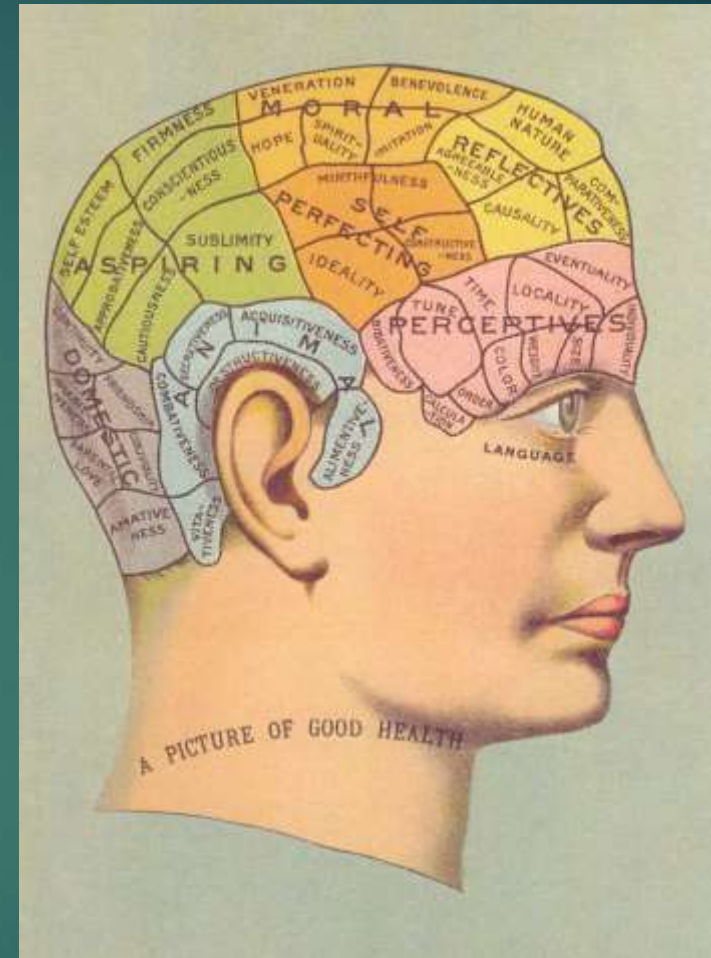
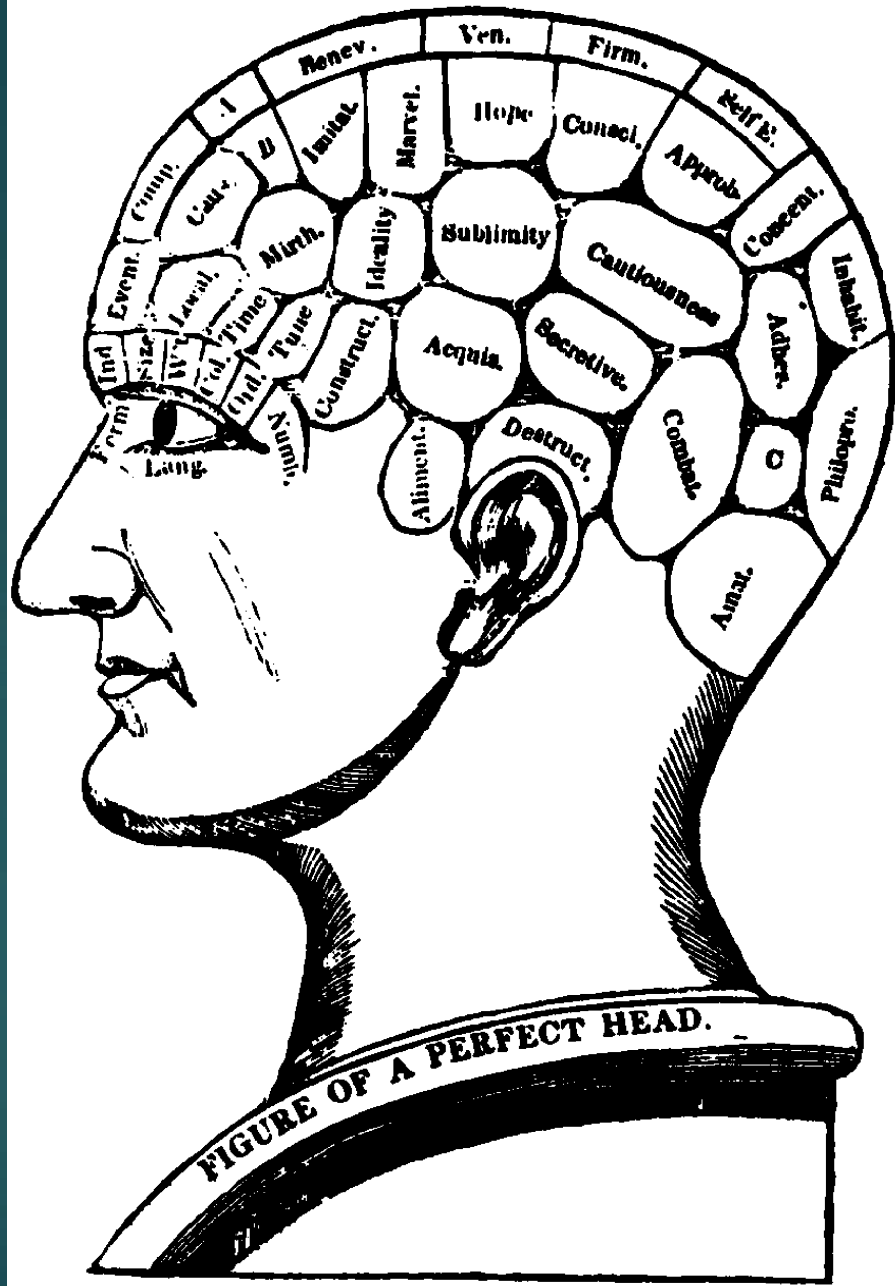
Phrenological Maps

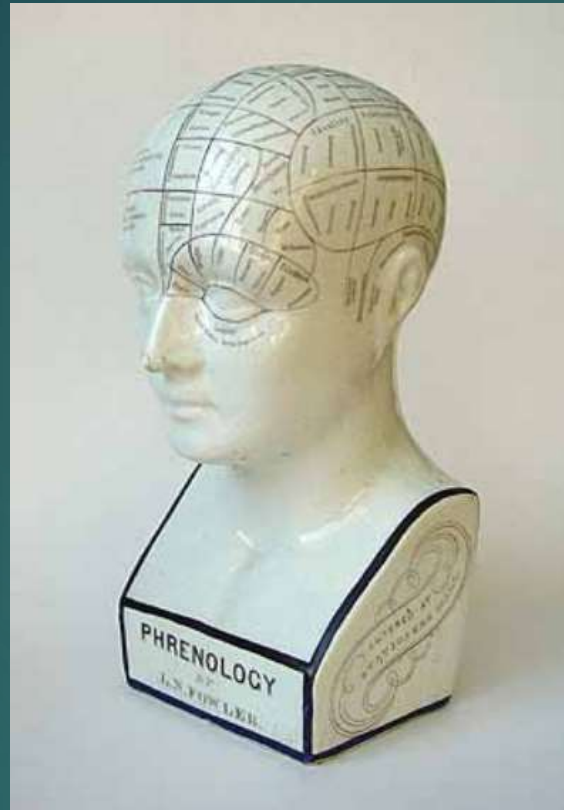


Gall's map: 27 "faculties"



Spurzheim's map





Dave, Lea, Noelle, Dr. Elizabeth Twamley

Dr. Charles Vella's gift to his daughter Dr. Lea Vella on receiving her Ph.D. in June 2014 from UCSD Neuropsych program. Go Lea! Proud Papa!

A Mapping of Gall's 27 Faculties to Potentially Related Neuroimaging Research.

Gall got 25 traits (but not locations) correct

Table 1. A Mapping of Gall's 27 Faculties to Potentially Related Neuroimaging Research

Faculty	Modern equivalent for neuroimaging	Regions implicated	References
Impulse to propagation	Viewing of romantic lover versus other individuals	Basal ganglia	Aron et al. (2005)
Tenderness for the offspring or parental love	Mothers viewing own versus other child	Amygdala, insula, anterior cingulate, superior temporal gyrus	Leibenluft, Gobbin, Harrison, & Haxby (2004)
Friendly attachment or fidelity	Viewing friend versus a stranger	Right temporoparietal cortex	Sugiura et al. (2005)
Valour, self-defense	Punishment of defectors in economic games	Dorsal striatum	de Quervain et al. (2004)
Murder, carnivorousness	Less active in murderers	Prefrontal cortex	Raine et al. (1994)
Sense of cunning	—	—	—
Larceny, sense of property	Activated in relation to hoarding behavior in OCD	Left precentral gyrus and right orbitofrontal cortex	Mataix-Cols et al. (2004)
Pride, arrogance, love of authority	Related to arrogance scores	Prefrontal cortex	Yang et al. (2005)
Ambition and vanity	Activation for judgment about self versus others	Medial prefrontal cortex	Ochsner et al. (2005)
Circumspection	Activation correlated with harm avoidance	Nucleus accumbens	Matthews, Simmons, Lane, & Paulus (2004)
Aptness to receive an education or the memoria realis	Activation during reasoning tasks correlated with general intelligence	Parietal cortex	Lee et al. (2006)
Sense of locality	Scenes versus nonscenes	Parahippocampal cortex	Epstein & Kanwisher (1998)
Recollection of persons	Activated by judgments about face identity versus occupation	Fusiform gyrus	Turk, Rosenblum, Gazzaniga, & Macrae (2005)
Faculty for words, verbal memory	Use of memory strategies	Prefrontal cortex, extrastriate visual cortex	Kirchhoff & Buckner (2006)
Faculty of language	—	—	—
Disposition for coloring, and the delighting in colors	Greater activity in grapheme-color synesthetes	Area V4	Hubbard, Arman, Ramachandran, & Boynton (2005)
Sense for sounds, musical talent	Activation in MEG and gray matter volume correlated with musical aptitude	Auditory cortex	Schneider et al. (2002)
Arithmetic, counting, time	Activity correlated with arithmetic skill	Angular gyrus	Menon et al. (2000)
Mechanical skill	Greater activity for observing actions in skilled versus unskilled groups	Left premotor, intraparietal, superior temporal cortex	Calvo-Merino, Glaser, Grèzes, Passingham, & Haggard (2005)
Comparative perspicuity, sagacity	—	—	—
Metaphysical perspicuity	—	—	—
Wit, causality, sense of inference	More active for viewing causal events than for noncausal events	Area MT, superior temporal sulcus, inferior parietal sulcus	Blakemore et al. (2001)
Poetic talent	Generation of creative versus uncreative narrative	Right medial frontal cortex	Howard-Jones, Blakemore, Samuel, Summers, & Claxton (2005)
Good nature, compassion, moral sense	Judging personal versus impersonal moral dilemmas	Medial prefrontal cortex, posterior cingulate, angular gyrus	Greene, Sommerville, Nystrom, Darley, & Cohen (2001)

Note. The 27 faculties are from Whye (2004). OCD = obsessive-compulsive disorder.

Hyrtl's Phrenological Skull Collection



Joseph Hyrtl (1810-1894), an anatomist and phrenologist also from Vienna, sold his collection of [139 skulls to Philadelphia's Mütter Museum](#) and they are still on display.

Neuropsychological (Phrenology) Test, 1905



Cautionary Tale: Many “current” theories will eventually be discredited

Modern Example of Phrenological Reading



Psycograph Phrenological Device, circa 1934



Phrenology Machine



- ▶ Psycograph by Lavery and White, a machine which could do a phrenological reading complete with printout. It is said that this device netted its owners about \$200,000 at the **1934 Century of Progress Exposition in Chicago**.

Sir Charles Bell, 1774-1842

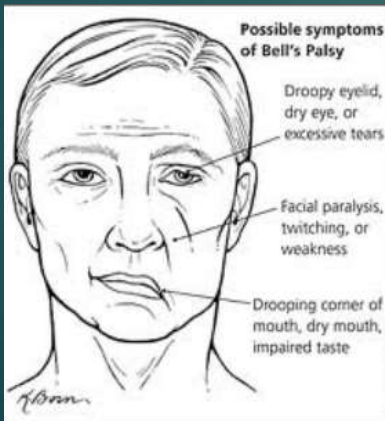


Univ. of Edinburgh, Scotland

1811: Sensory Nerves

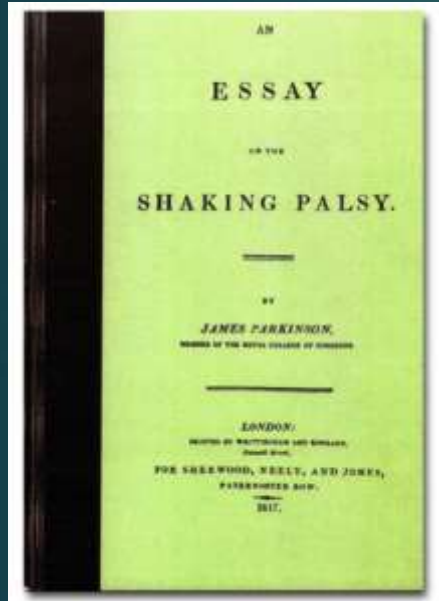
Established that the nerves of the special senses could be traced from specific areas of the brain to their end organs.

He clearly demonstrated that spinal nerves carry both sensory and motor functions and that sensory fibers traverse the posterior roots whereas the motor fibers run through the anterior (Bell's Law).



He also demonstrated facial paralysis ipsilateral to facial nerve VII lesion (Bell's palsy).

James Parkinson, 1775-1824: **Brain translates intentions into actions**



First description of syndrome, Paralysis agitans, 1817, based on his observations, i.e. involuntary tremor in the limbs combined with difficulty in initiating and controlling movements. He notes that although it is **physically debilitating**, the disease generally does not affect the mental lucidity of the patient.

Charcot specialized in the disorder and named it “Parkinson’s Disease” in 1876.

Due to dopamine depletion

First insight that brain mechanisms translate thoughts and intentions into physical actions.

Jean-Etienne-Dominique Esquirol 1782-1840



Favorite student of Philippe Pinel (founder of psychiatry)

Manuscript on “**mental retardation.**”

Differentiated between insanity & mental retardation; insanity has a period of normal intellectual functioning

Des Maladies Mentales, 1838

First modern text about mental disorders, 1st DSM

Marie-Jean-Pierre Flourens, (1794-1867)

Backlash to Phrenology, Ablation studies

French physiologist

Gave Spurzheim the brain of “imbecile” to exam,
labeled as Laplace’s (French mathematician) brain

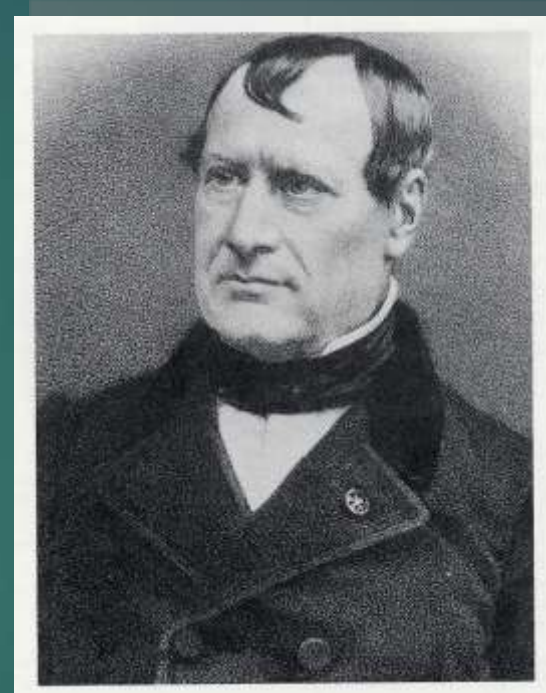
Cortex cannot be divided into functional units!

Good Laboratory methods:

- Experimental lesions in the cortex of animal
- Found that the effects were the same no matter what part of cortex he removed

But wrong subject..

- His behavioral assessments were crude
- And he studied mostly hens, ducks, pigeons, and frogs



Examen de la phrenologie, 1851

Cerebral Holism

(Diffuse representation)



- ▶ **Pierre Flourens** (1824) set up lab to attack Gall's mind-brain equivalence.
- ▶ By removing cortex, all perceptions, motor function, and judgment were abolished.
- ▶ Removal of cerebellum affected equilibrium and motor coordination.
- ▶ Destruction of brain stem caused death.
- ▶ Extensive cortical lesions in birds and rabbits showed little behavioral change, which led him to believe that these functions are represented diffusely around the brain.
- ▶ Flourens erroneously suggested the myth that only 10 percent of brain tissue is used

Flourens, Thomas Jefferson, & John Adams

- ▶ In 1825, **Thomas Jefferson wrote to his friend John Adams:**
- ▶ “I have lately been reading from the most extraordinary of all books. It is Flourens’ experiments on the function of the nervous system, in vertebrated animals. He takes out the cerebrum completely, leaving the cerebellum and other parts of the system uninjured. The animal loses all its senses of hearing, seeing, feeling, smelling tasting, is totally deprived of will, intelligence, memory, perception, yet lives for months...in a state of the most absolute stupidity.”
- ▶ Adams replied: “Incision knives will never discover the distinction between matter and spirit. That there is an active principle of power in the Universe is apparent, but in what substance that active principle resides, is past our investigation.”
- ▶ Jefferson = scientific curiosity; Adams = religious skepticism & apprehension

Flourens 2: Cerebral Holism (Diffuse representation)

- First experimental evidence that higher functions are cortical.
-
- Opposed Localization theory & discredited phrenology
- Removed bird brain parts and observed resulting behaviors
- Claimed birds recovered regardless of damage location
- Claimed brain was an integrated whole
- Loss of function correlated with extent of brain tissue damage (now = need for functional networks)
- 1823 - Cerebellum regulates motor activity

Phrenology vs. Equipotentiality

Phrenology

- Localization
- Right theory, wrong methods
- Attempted to localize “traits”
- Became a pop fad

Equipotentiality

- Amount, not localization
- Right methods, wrong theory
- Wrong animal model
- Similar to current network theory

Bartolomeo Panizza 1785 – 1867



Universita di Pavia

Italian Anatomist

Occipital lobe is essential for vision

Golgi was his student

Moritz Heinrich Romberg (1795-1873)



- ▶ He described the classic, "Romberg sign" and stated that no ataxic can stand still with eyes shut. If problem with proprioception can still maintain balance by using vestibular function and vision.
- ▶ In the Romberg test, the patient is stood up and asked to close his eyes. A loss of balance is interpreted as a positive Romberg sign.

Not a test of cerebellum: test is 90% sensitive for lumbar spinal stenosis



Romberg sign

- ▶ A person requires at least two of the three following senses to maintain balance while standing:
 - ▶ proprioception (the ability to know one's body in space);
 - ▶ vestibular function (the ability to know one's head position in space);
 - ▶ vision (which can be used to monitor [and adjust for] changes in body position).
- ▶ A patient who has a problem with proprioception can still maintain balance by using vestibular function and vision. In the Romberg test, the standing patient is asked to close his or her eyes. A loss of balance is interpreted as a positive Romberg's test.
- ▶ = you are drunk

Jean-Baptiste Bouillaud, 1796 – 1881:

Aphasia - Correlation better than description

1825: Loss of speech after frontal lesion - presented a large series of cases of loss of speech following frontal lesions



Student of Gall

One of the first to use larger samples for research

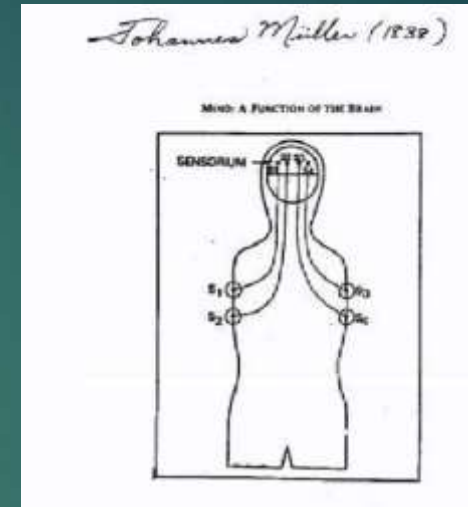
Suggested left hemisphere controlled various right-handed acts
Provided a method for determining localization of function, which moved neuropsychology from the descriptive to correlational level

Founded the Phrenological Society

Lesion study: Pushed frontal area in brain of a man with gun shot wound and it reduced speech; Drilled frontal hole in a dog

Johannes Peter Muller 1801-1858:

Perception determined by nerve pathway



Doctrine of Specific Nerve Energies:
Sensory perception

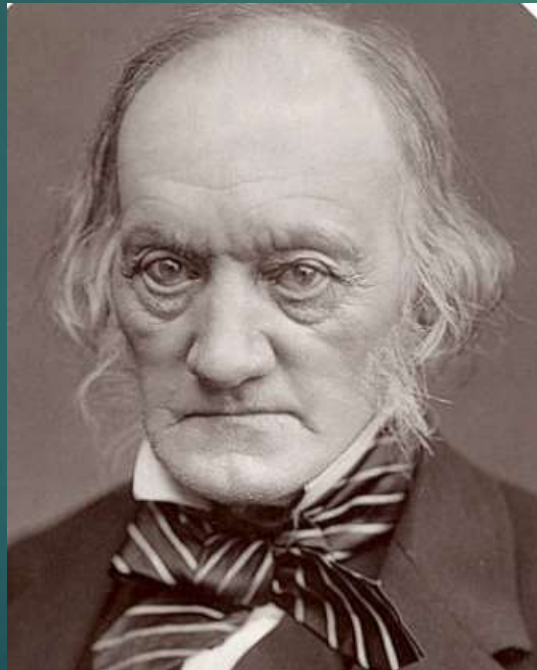
Friedrich-Wilhelms-Universität zu Berlin:

Elements of Physiology: Nature of perception is defined by the pathway over which the sensory information is carried i.e., the difference between seeing and hearing is not caused by differences in the stimuli themselves but by the different nervous structures that these stimuli excite. The kind of sensation following stimulation of a sensory nerve does not depend on the mode of stimulation but upon the nature of the sense organ. Despite the sensory input's being mechanical, the experience is visual.

Senses can be mixed up i.e. simulaesthesia

Roger Sperry showed that it is the location in the brain to which nerves attach that determines experience.

Sir Richard Owen 1804-1892



- ▶ Great English biologist of Victorian era, comparative anatomist and paleontologist
- ▶ Anti-Darwinian
- ▶ Coined the terms
 - ▶ “Dinosauria” (terrible reptile)
 - ▶ “Prefrontal” lobe

Guillaume-Benjamin-Amand Duchenne (de Boulogne)

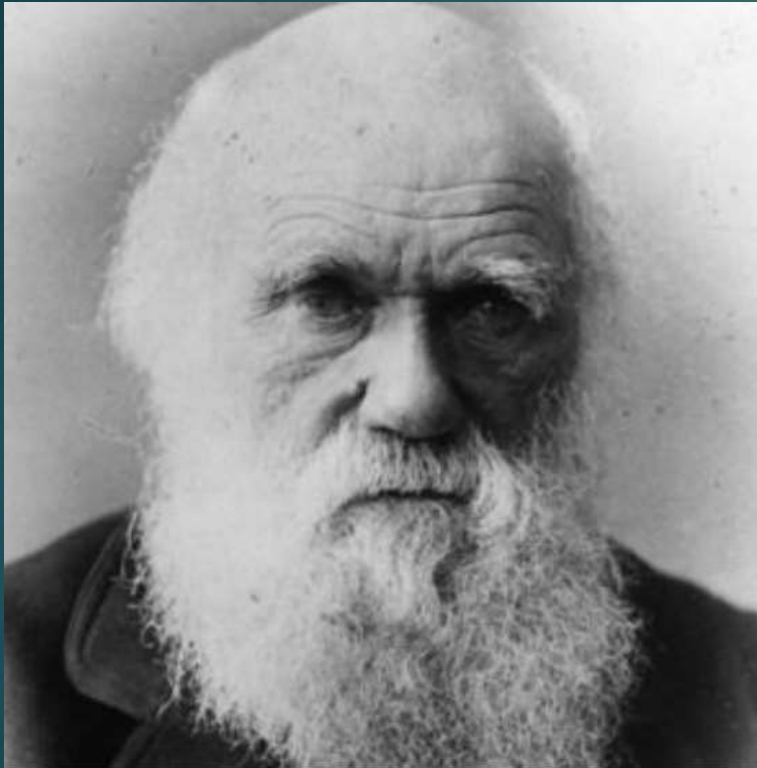
1806-1875



Charcot was his student

- ▶ Hôpital Hôtel-Dieu de Paris
- ▶ Science of muscular electrophysiology (electromyography).
- ▶ Duchenne's electrical experiments on the facial musculature exerted an enormous influence through Charles Darwin's *The Expression of the Emotions in Man and Animals*
- ▶ Greatest contributions were made in the myopathies (muscle diseases) that now bear his name, Duchenne Muscular Dystrophy, Duchenne-Aran spinal muscular atrophy and Duchenne-Erb paralysis

Charles Darwin 1809-1882



- ▶ 1872: *The Expression of the Emotions in Man and Animals*
- ▶ Origins of emotional responses and facial expressions in humans and animals
- ▶ Theory of Mind: Only humans blush: they are the only ones capable of self-consciously imagining what others are thinking of them.

Theodor Schwann, 1810-1888: Cell Theory



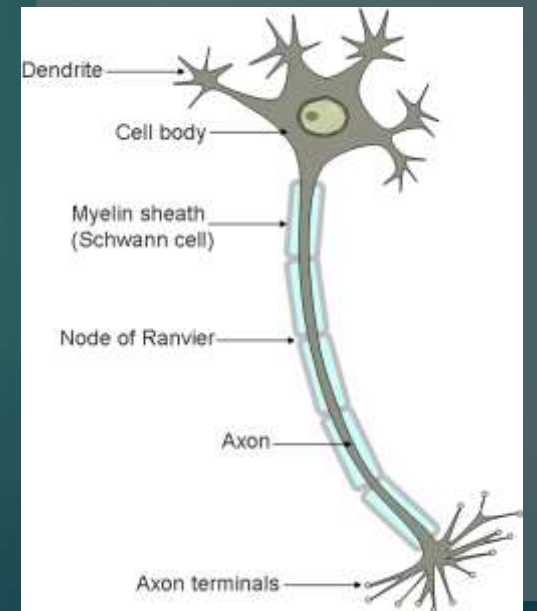
University of Liège

German physiologist

Cell theory: "All living things are composed of cells and cell products"

Schwann cells

Student of J. Muller



Rudolph Albert von Kölliker, 1817-1905:

Neurons have axons



Student of Muller

University of Würzburg

Clear proof that axons are continuous with cortical nerve cells

He saw the value of the new Golgi staining method for the investigation of the central nervous system

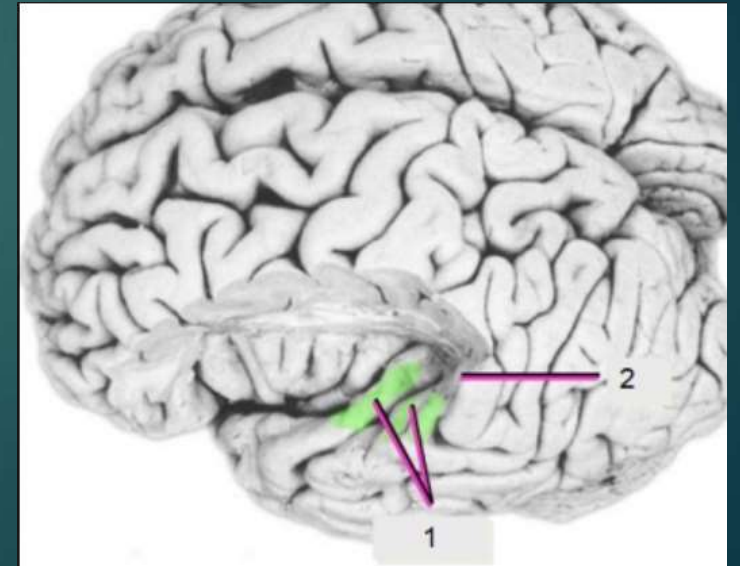
Coined word "axon"

Supported neuron doctrine

Richard Heschl 1824 - 1881



- ▶ First physician to describe the transverse temporal gyrus or **Heschl's gyrus** in the temporal lobe.
- ▶ Primary incoming **auditory stimuli**.



Hermann von Helmholtz, 1821-1894



Student of Johannes Muller

- ▶ German Physiologist & physicist
- ▶ Theories of sensory physiology: vision, ideas on the visual perception of space, color vision research, and on the sensation of tone, perception of sound
- ▶ 1849: measures speed of frog nerve impulses (90f/s)
- ▶ Sensory physiology of Helmholtz was the basis of the work of Wilhelm Wundt
- ▶ Conservation of energy

Sir Francis Galton 1822 - 1911



Obsessed with individual differences and their distribution

- 1884-1890: Tested 17,000 individuals on height, weight, sizes of accessible body parts, + behavior: hand strength, visual acuity, RT etc.

British Psychologist; Cambridge; **Darwin's cousin**

1869: *Hereditary Genius*: Intelligence is inherited; high achievement is genetic; first scientific attempt to measure intelligence.

Coined the term "nature and nurture" in 1876 & "eugenics" in 1883. Irony: Galton had no children.

Eugenics: He advocated restrictions on the "breeding of the feeble minded," later codified into law.

He also felt that intelligence varied by race, with Caucasians being of the highest mental ability.

THE SECOND INTERNATIONAL EXHIBITION OF EUGENICS

HELD SEPTEMBER 22 TO OCTOBER 22, 1921,
IN CONNECTION WITH THE

SECOND INTERNATIONAL CONGRESS OF EUGENICS

IN THE
AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK

*An account of the organization of the exhibition, the classification of the exhibits,
the list of exhibitors, and a catalog and description of the exhibits*

BY
HARRY H. LAUGHLIN
Chairman of the Committee on Exhibits

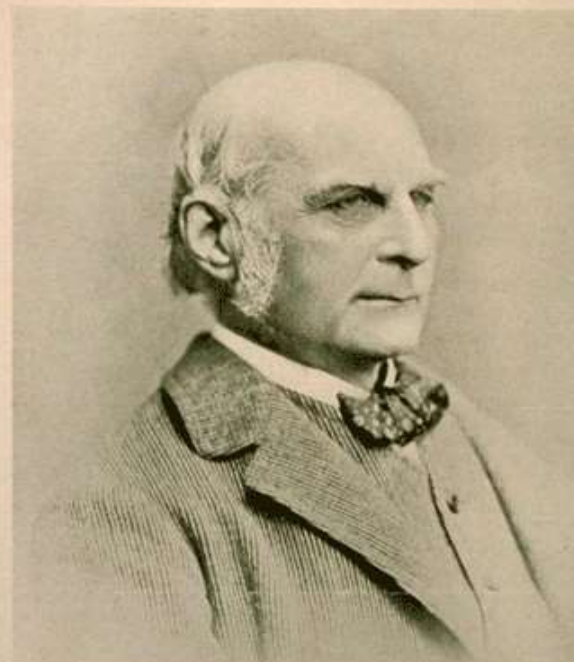
FORTY-SEVEN ILLUSTRATIONS

BALTIMORE
WILLIAMS & WILKINS COMPANY
1923

Eugenics Congress Announcement

Number 2. *The Exhibit*

Education Hall, American Museum of Natural History
New York City, August 22-September 22, 1932



Sir Francis Galton, Founder of the Science of Eugenics

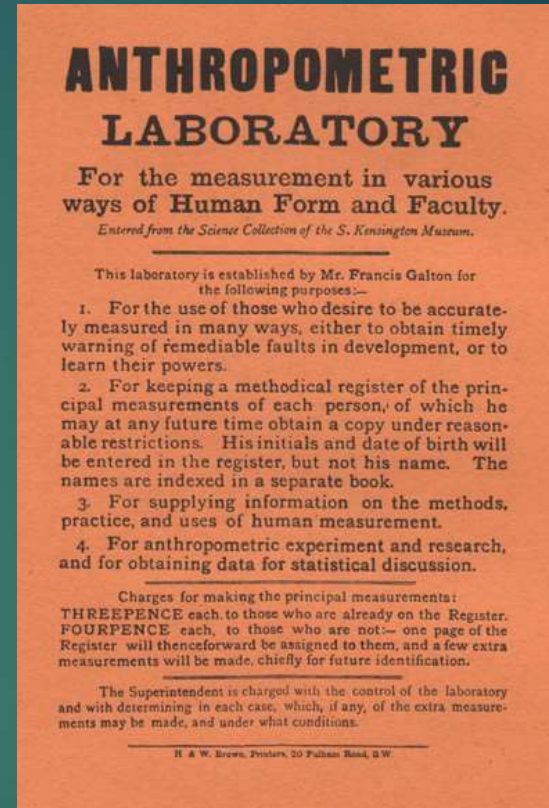
*This picture, taken in 1895, showing Galton aged 75, 71, with permission, reproduced from Pearson's
"Life of Galton," vol. II*

"The term National Eugenics is here defined as the study of the agencies,
under social control, that may improve or impair the racial qualities of
future generations, either physically or mentally." *Paragraph from Galton's will, 1908*

Third International Congress of Eugenics

*Honorary Presidents, Leonard Darwin and Henry Fairfield Osborn
President, Charles B. Davenport
New York City, August 21-23, 1932*

Galton's Anthropometric Lab



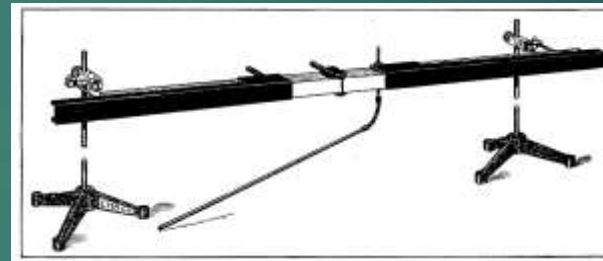
- ▶ Sets up an anthropometric laboratory at the International Exposition of 1884;
- ▶ For 3 pence, visitors could be measured with:
 - ▶ The Galton Bar - visual discrimination of length
 - ▶ The Galton Whistle (aka “dog whistle” - determining highest audible pitch

Galton

- ▶ Galton Whistle (circa 1900)



- ▶ Galton Bar



Considered by some the founder of psychometrics

Pioneered rating scales & questionnaires

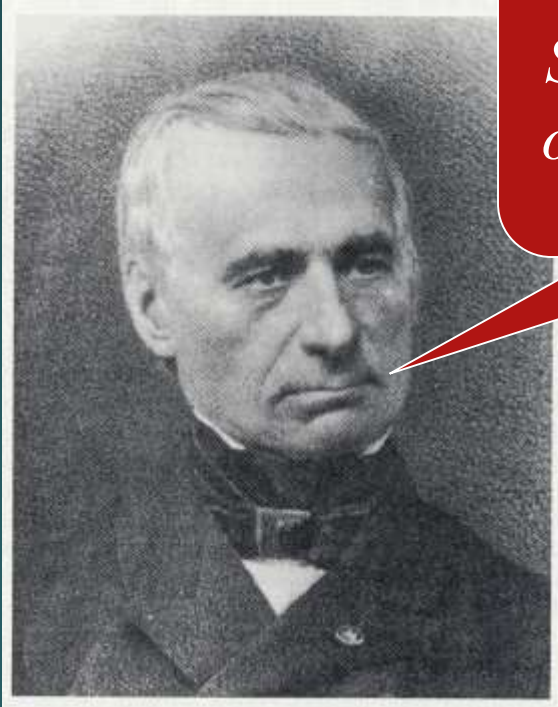
First to document individuality of fingerprints

First to apply statistics in the measurement of humans

Founder of eugenics

Studied efficacy of prayer

The French Speech Debates I



*Speech is a function
of the anterior lobes*

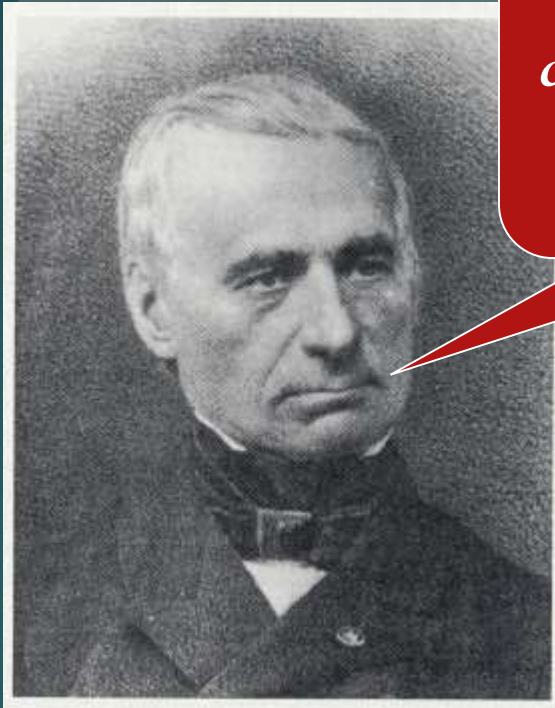


No it ain't

Jean-Baptiste Bouillaud
(1796-1881)

Gabriel Andral
(1797-1846)

The Speech Debates II



I've studied a lot of cases of speech loss and they all have frontal damage

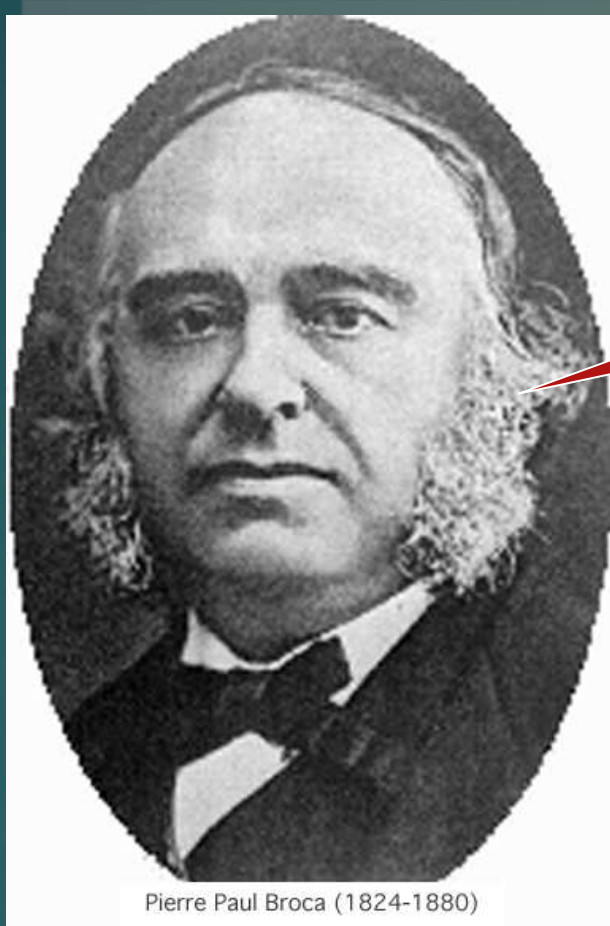


So have I, and not all of them do, AND some people with frontal damage don't have speech loss!

Jean-Baptiste Bouillaud
(1796-1881)

Gabriel Andral
(1797-1846)

The Speech Debates III



Pierre Paul Broca (1824-1880)

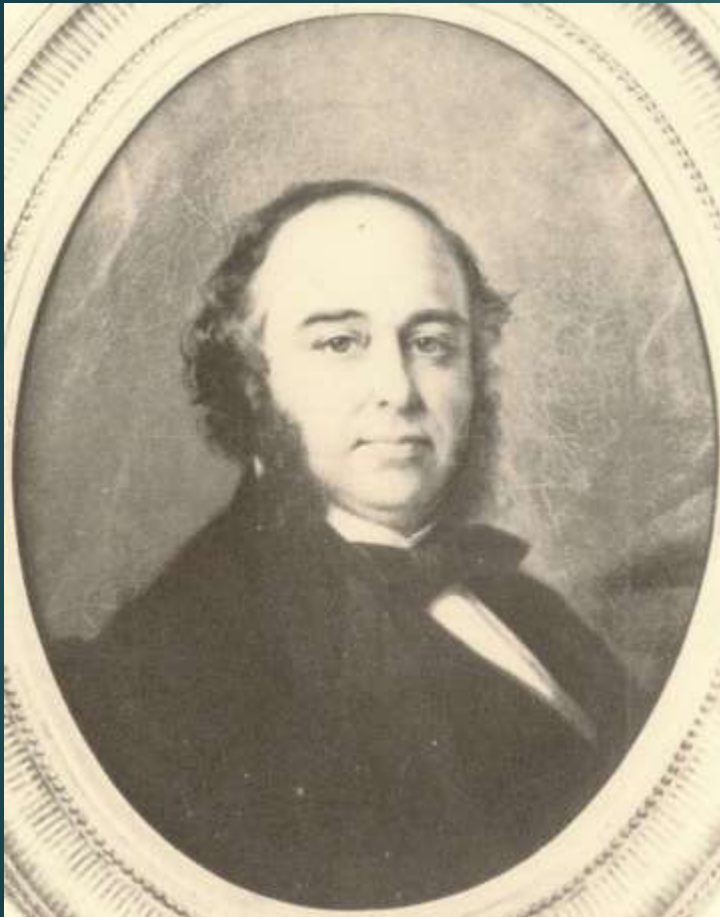
**Paul Broca
(1824-1880)**

*Settle down boys, let me
settle this for you.*

- Highly respected scientist, believed to be fair and unbiased
- Thorough in his approach
- Head of several academic societies:
Paris Medical Society
- Awesome sideburns

Paul Broca, 1824-1880

Cortical Localization/Asymmetry, Expressive Aphasia



A 51 yo shoe maker patient, Leborgne, known as Tan, with loss of speech was transferred to Broca's care. He could utter only "tan" (and "sacre nom de Dieu" if frustrated) x 21 years, had right paralysis x 10 years, normal tongue, gesticulated with left hand, and comprehended speech well. He died 6 days later, and Broca examined his brain, and presented the case the next day at the Anthropological Society Meeting in Paris.

"Aphemia" = Expressive Aphasia

2nd & 3rd LF gyrus.

Historical Neuroscience Patient #1: “Tan”

- ▶ Historical patient data: Louis Victor Leborgne, born on July 21, 1809, a man who spent nearly half of his life in a hospital, unable to communicate with others; literate (prior assumed he was a lower-class illiterate who had suffered from syphilis); Several tanneries (*moulin à tan*) operated where he grew up.
- ▶ Broca: integrity of the left frontal lobe is crucial to speech and that damage to this region results in aphasia. He eventually pinpoints the site of the speech center of the brain as being in the third gyrus of the prefrontal cortex (Brodmann’s area 44). This section of the frontal lobe is now known as Broca's area.

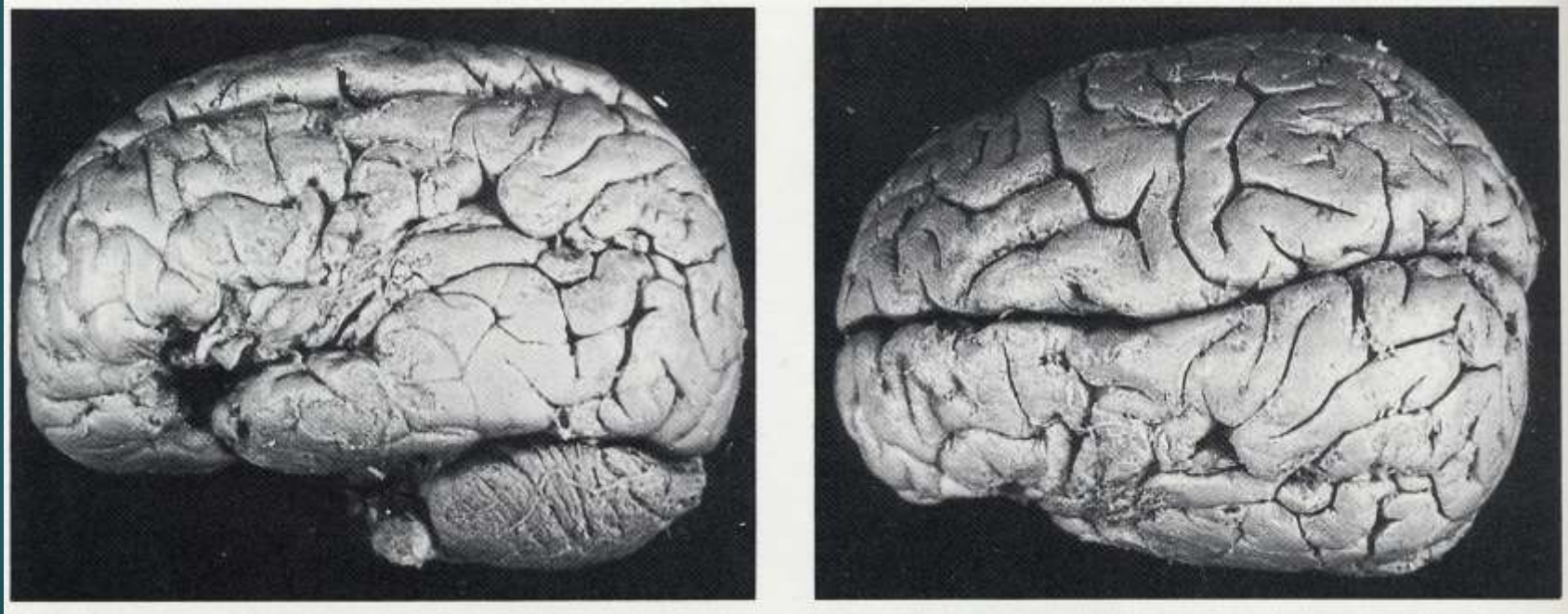
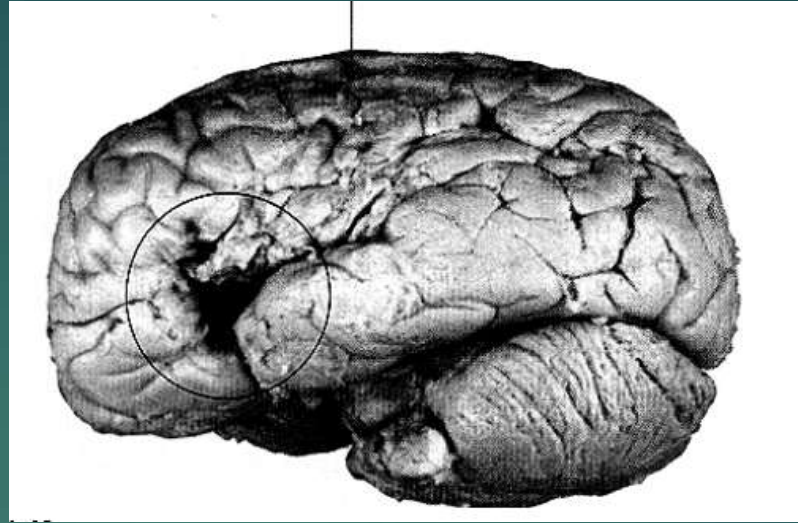
Broca and Broca's Area:

“Nous parlons avec l'hémisphère gauche”



Often recognized as the first localization of function:
“We speak with the left hemisphere.”

Tan's Brain



Damasio MRI'd Tan's brain and found more extensive damage

Broca's Publications

- ▶ 500 articles:

- ▶ Aphasia

Skull of poet Schiller

- ▶ Tumors

Skin color in negroes at birth

- ▶ Blood transfusions

Skull of murderer Lemaire

- ▶ Hypnosis

Art of making fire

- ▶ Nymphomania

Dissemination of Basque language

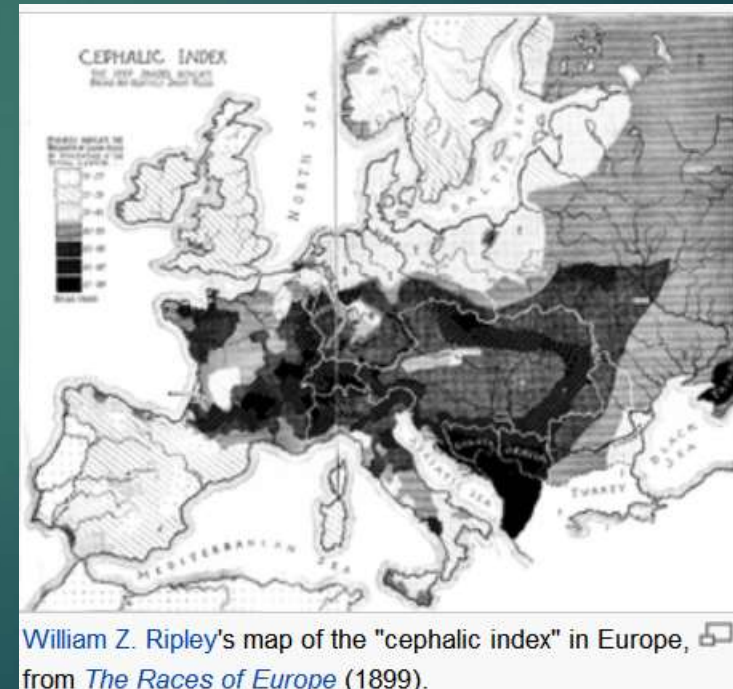
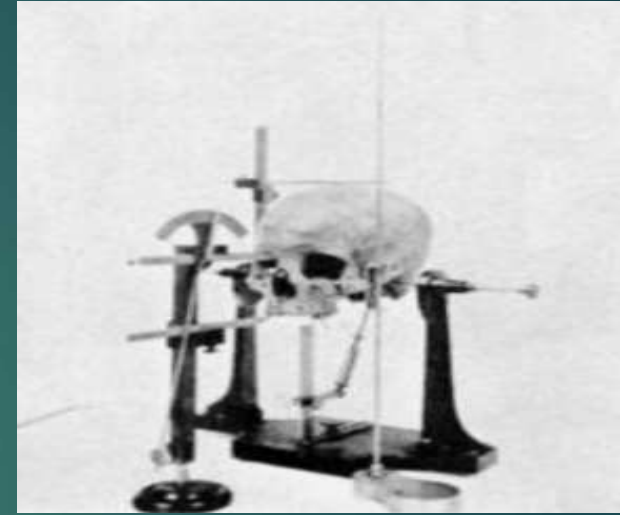
- ▶ Hospital hygiene

Origin of Celts

- ▶ Skulls

Broca, the Anthropologist: Craniometric Obsession

- ▶ Broca advanced the science of cranial anthropometry by developing 19 new types of measuring instruments (craniometers) and numerical indices.
- ▶ Theory of enlarging European brain
- ▶ The uses that reputable scientists, including racist ones, made of Broca's measurements and conclusions is discussed in by Stephen Jay Gould in *The Mismeasure of Man* (1981): conclusions 1st, determines interpretation of facts (although German brains larger than French!)
- ▶ Gould: Broca as sexist, racist, chauvinist pseudo scientist



Broca's Contribution

- ▶ Offered the **first model of the neurology of language**; contributions to study of cortical functions
 - ▶ Broca's expressive aphasia: syndrome consisting of an inability to speak despite intact vocal mechanisms and normal comprehension
 - ▶ Coined the term aphemia
 - ▶ Correlated aphemia with an anatomical site (Broca's area)
 - ▶ Elaborated the concept of cerebral dominance of language in the left hemisphere
- ▶ Widely criticized by many historians, many of whom judged his contributions as not original, not enduring, or not accurate

Broca's own brain cast

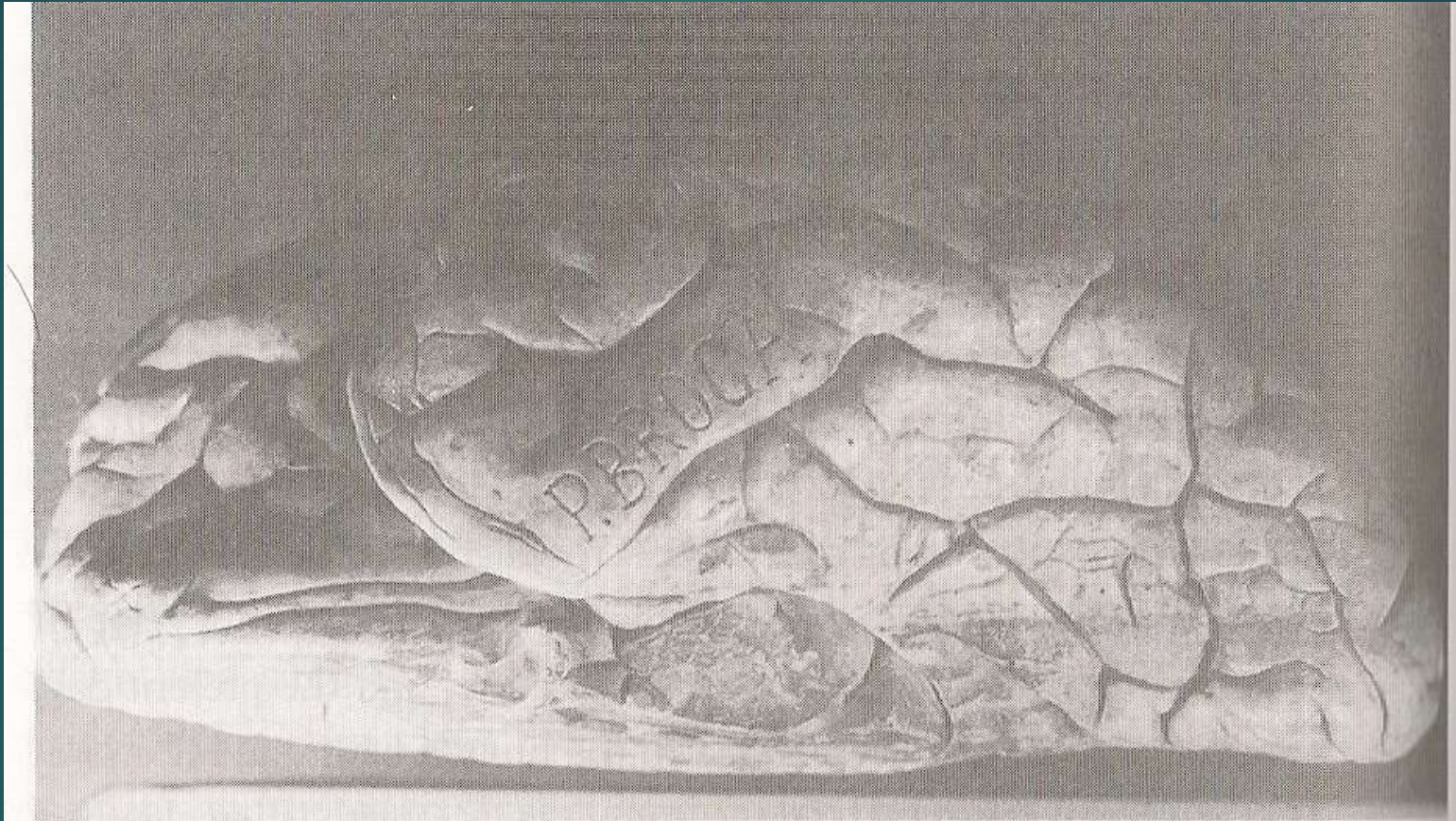


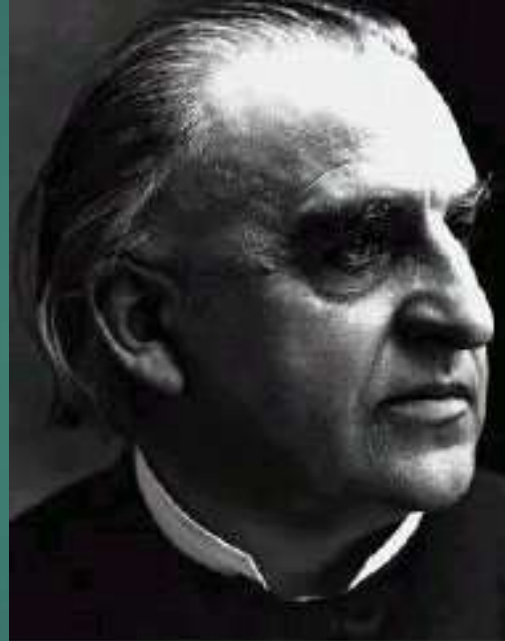
Figure 4.3: Cast of Broca's brain. The inscription 'P. Broca' is etched across the area that bears his name

Broca's Rule: Cerebral asymmetry

- ▶ Broca: Language is located on side opposite dominant hand: right hand, left hemisphere
- ▶ Klaus Conrad, 1949: 800 bullets to head in WWII (200 aphasics): Aphasic right handers had left hem. damage, but only half of aphasic left handers had same
- ▶ Current: 70 % of left handers have left language; 15% on right; rest, either.

Jean-Martin Charcot, 1825 – 1893

Foremost neurologist of late 19th century France



Hôpital Salpêtrière, Paris; student of Duchenne

1877 *Lectures on the Diseases of the Nervous System*

Great Students: Freud, Babinski, Janet, Tourette, Binet, Bleuler, Marie, Bekhterev

Charcot at Neurology Grand Rounds



Charcot, Babinski, and “Queen of Hysterics”

Charcot's Contributions

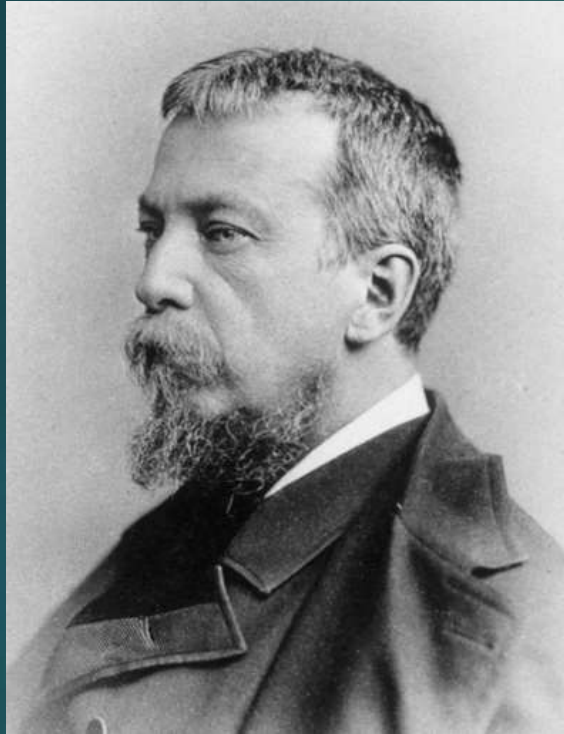
- ▶ Brought **neurology into modern era**
- ▶ **Signs** (objective i.e. fever) and **Symptoms** (subjective i.e. fatigue) approach
- ▶ **Technique of Clinical Signs + brain autopsy review**
- ▶ First Chair of Neurology
- ▶ **Described major neurological conditions:**
 - ▶ Multiple Sclerosis
 - ▶ Parkinson's (named it)
 - ▶ Amyotrophic lateral sclerosis, 1874
 - ▶ Gilles de Tourette's
 - ▶ Epilepsy (named "Jacksonian" seizures)
 - ▶ Hysteria

John Langdon Haydon Down, 1828-1896



- ▶ British physician
- ▶ 1866 - publishes work on “Congenital Mongolian type of Idiot” (Down’s Syndrome)
- ▶ DSM 5: intellectual disability (intellectual developmental disorder)
not DSM-IV diagnosis of mental retardation
- ▶ Pro-women and anti-slavery

Silas Weir Mitchell 1829-1914



American neurologist

Civil War surgeon

*Injuries of Nerves and Their
Consequences, 1872*

Phantom Limb Syndrome:

First modern report of what he
evocatively referred to as a post-
amputation sensory “ghost.”

Wilhelm Wundt, 1832-1920



Student of Muller

- ▶ University of Leipzig
- ▶ Father of experimental psychology
- ▶ 1879: One of the first formal laboratories for psychological research
- ▶ Productive: 490 works, (average 110 pages long)
- ▶ Studied religious beliefs, mental disorders and abnormal behavior, and mapped damaged areas of the human brain.

Students: Spearman, Titchener, Ferrier, Kraepelin, Cattell, Bekhterev

Theodor Hermann Meynert 1833 - 1892



First Psychiatric Clinic, Vienna

German-Austrian neuropathologist
and anatomist

Founder of cerebral cortex
cytoarchitectonics (cell histology)

Frist to suggest the cortex behind the
central fissure is sensory in function

Eponyms: basal optic nucleus of Meynert,
substantia innominata of Meynert

His students: Freud, Pick, Korsakoff, Wernicke, Flechsig, Binswanger, Bekhterev

John Hughlings Jackson, 1835-1911:

Oliver Sacks of 19th Century



Student of Charles-Édouard
Brown-Séquard

National Hospital, Queen Square, London

Father of English Neurology

Great clinical observations: from clinical observation of “Jacksonian” marching seizures, he concluded that control of muscles must be topographically mapped in the brain & that body areas with most use have most neurons representing them (& are most seizure prone).

Seminal contributions to the diagnosis and understanding of epilepsy in all its forms;

Not origination in medulla but in cortex

Jackson's Contributions

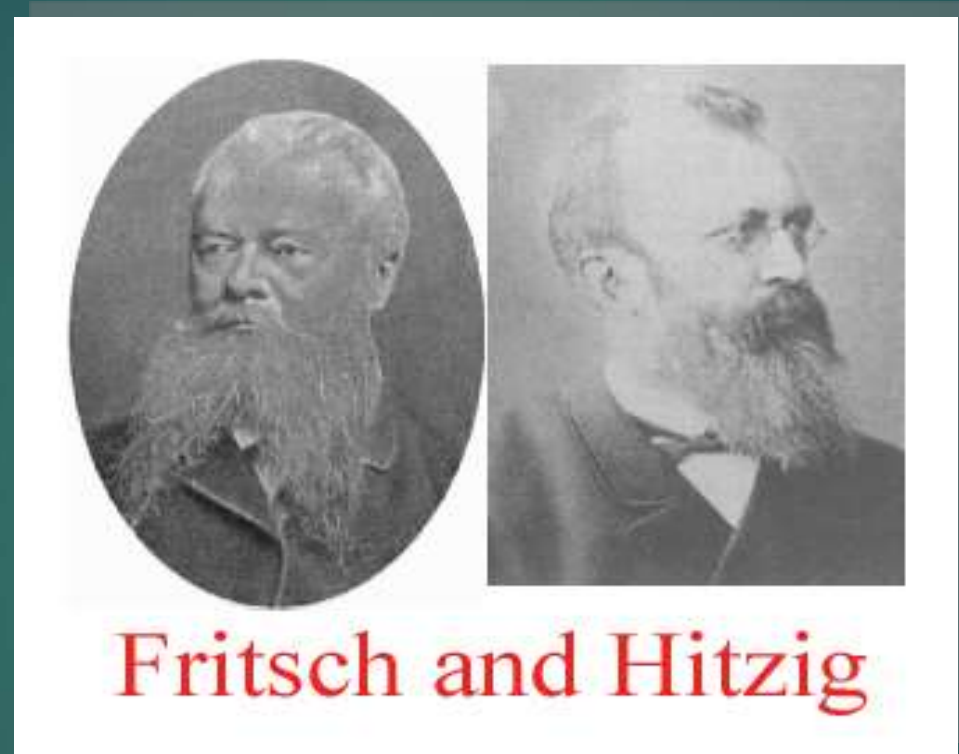
- ▶ 1863, Described Jacksonian marching seizures (suffered by wife Elizabeth)
- ▶ Psychomotor seizures
- ▶ Right Hemisphere has specialized functions: Aphasia (emotional language, i.e. cursing, “no”) & visual spatial abilities
- ▶ Concept of ‘Negative’ symptoms’ (due to an absence of function, i.e. loss of consciousness) vs. ‘Positive’ symptoms (caused by the functional release of the lower centers) (i.e. muscle contractions): role of inhibition
- ▶ Release signs, i.e. infant palmer grasp
- ▶ With his friends Sir David Ferrier and Sir James Crichton-Browne, Jackson was one of the founders of the journal *Brain*.

Cesare Lombroso 1836-1909: **Neurobiology of Violence**



- ▶ Italian criminologist
- ▶ **Criminality was inherited**, and that someone "born criminal" could be identified by **physical defects** (sloping forehead, asymmetric skull)
- ▶ Artistic genius was a form of hereditary insanity.
- ▶ **Humane Tx of prisoners**

Gustav Fritsch and Eduard Hitzig: **Cortical Motor Area, Frontal abstraction**



In 1870 the German physiologists Gustav Theodor Fritsch (1838-1927) and Julius Eduard Hitzig (1838-1907) performed the first direct electrical stimulations of the mammalian cerebral cortex.

On the Electrical Excitability of the Cerebrum, 1870

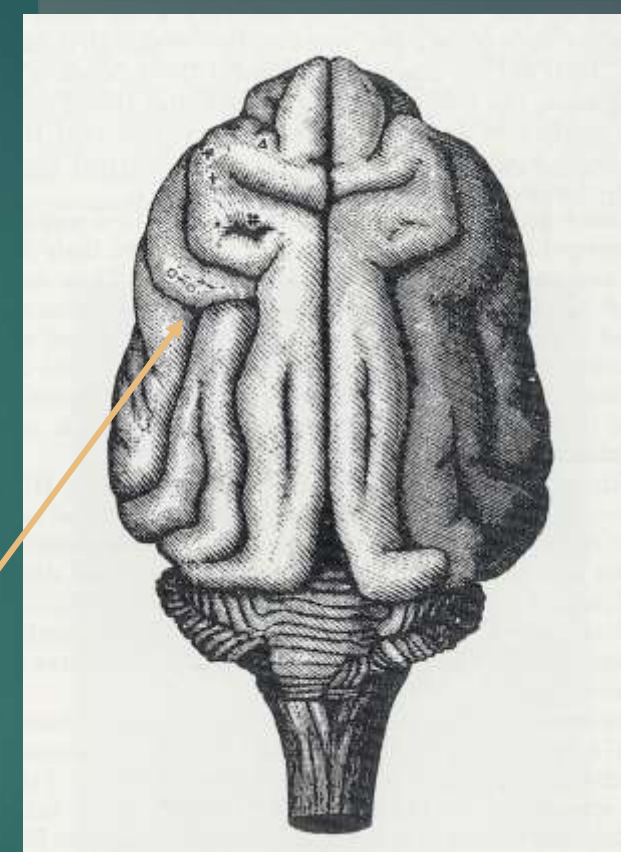
Laboratory confirmation of localization of function in cortex I



Eduard Hitzig
(1838-1907)

Fritsch & Hitzig
(1870) identified
motor cortex in the
dog using electrical
stimulation

Stimulation here
caused the dogs
limbs to twitch on the
opposite side of the
body



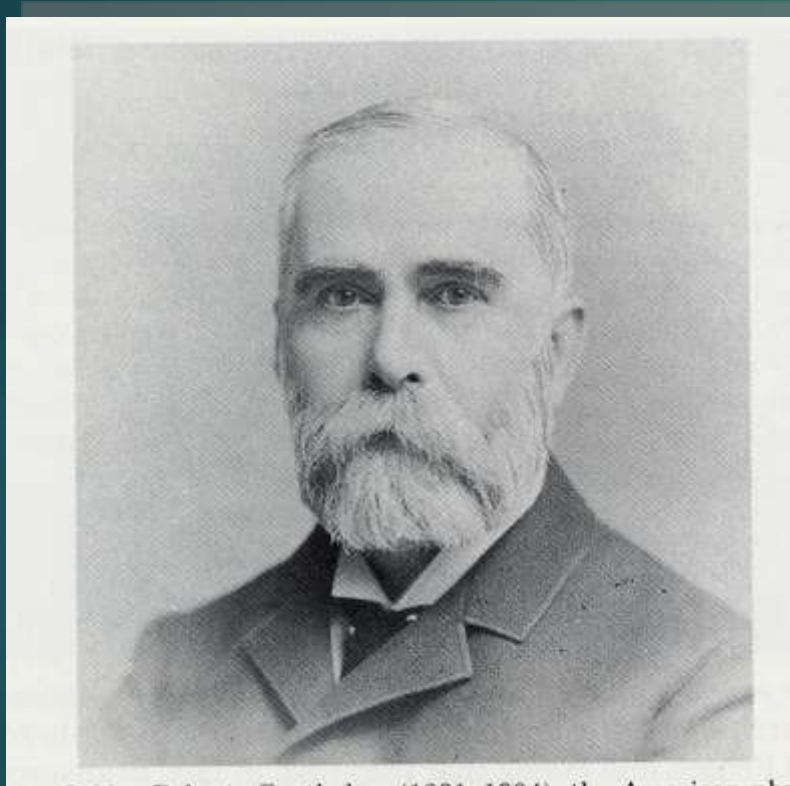
Monumental studies on electrical stimulation of the cerebral cortex. He carefully defined the limits of the motor area in the cerebral cortex of dogs and monkeys.

Fritsch & Hitzig

- Overtured 3 of Flouren's central ideas:
 - That the cortex is unexcitable
 - That cortex plays no role in producing movement
 - That functions are not localized

Roberts Bartholow (1831-1904):

A controversial demonstration in humans II



Roberts Bartholow (1831-1904)

1874: An American physician electrically stimulated cortex in a dying, “feeble-minded” girl, Mary Rafferty.

(Her brain was apparently already exposed from an ulcerated skull)

Movement and sensations were elicited on the opposite side of the body.

David Ferrier (1843-1928): Laboratory confirmation of localization of function in cortex III

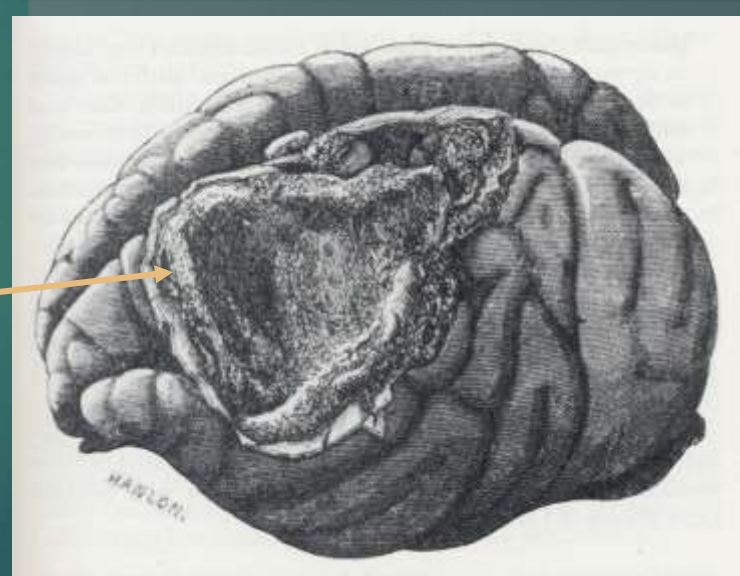


Student of Hughlings Jackson,
Wundt, von Helmholtz

National Hospital, Queen Square, London

1875 David Ferrier replicated F&H's electrical stimulation experiments in the monkey and documented more detailed maps: different regions of motor and sensory cortex controlled different body parts

And lesions to the monkey's motor cortex produced motor weakness



David Ferrier: **Triumph of Localization**

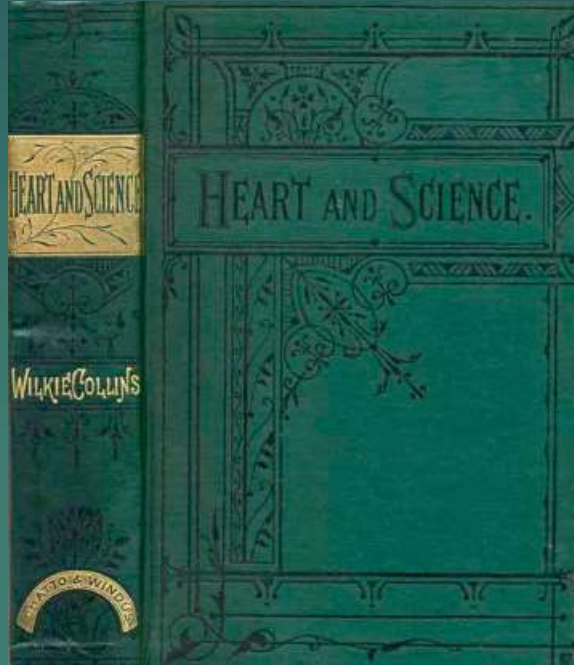
The Functions of the Brain, 1876 (dedicated to J. H. Jackson); first cortical maps

The Localisation of Cerebral Disease, 1878

Sensory projection area

Supported Hughlings Jackson's release theory of frontal lobe (higher controls lower functions).

First Animal Rights: The Anti-Vivisectionist Response & Novels

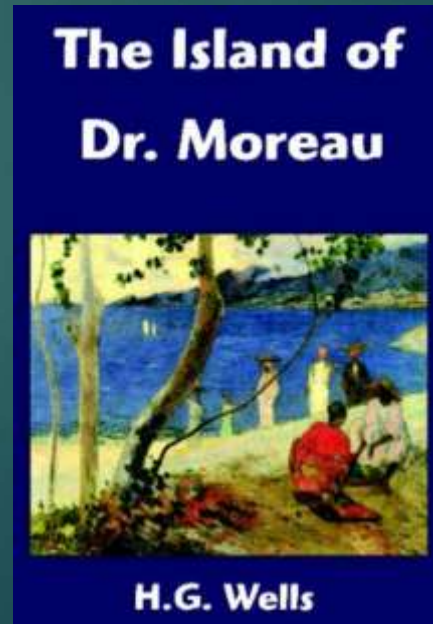


1883 Wilkie Collins novel of bad MD who is a vivisectionist , who ultimately suicides after releasing his animals

Frances Power Cobbs:

On 17 November 1881, David Ferrier appeared in Court, charged with “perform[ing] experiments, calculated to give pain to two monkeys, in violation of the restrictions imposed by the Vivisection Act.”

Society for the Protection of Animals Liable to Vivisection sued: Law required permit for animal Surgery; Turned out assistant did surgery and had permit

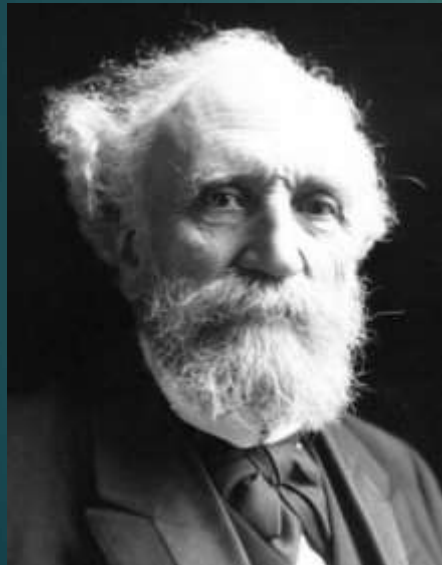


Animal rights in 1903-1910: Brown Dog Affair



Political controversy about vivisection that raged in Edwardian England from 1903 until 1910. It involved the infiltration of University of London medical lectures by Swedish women activists, pitched battles between medical students and the police; police protection for the statue of a dog, a libel trial at the Royal Courts of Justice, and the establishment of a Royal Commission to investigate the use of animals in experiments.

Theodule Ribot, 1839-1916



- ▶ *Les maladies de la volonte*, 1883
- ▶ *Les maladies de la memoire*, 1881
- ▶ Introduced the distinction between anterograde and retrograde memory
- ▶ Ribot's Law of retrograde amnesia: Most recent memories disappear and old memories survive
- ▶ Memory is associative: more pathways to a memory, the better the memory retrieval
- ▶ Concept of "anhedonia"

Wilhem Konrad Roentgen, 1845-1923



1895: X-ray



Ill fitting shoes more dangerous than x-rays!

Buster Brown Shoe Stores in 1950s:
Shoe-fitting Fluoroscope
Charlie's first x-ray.

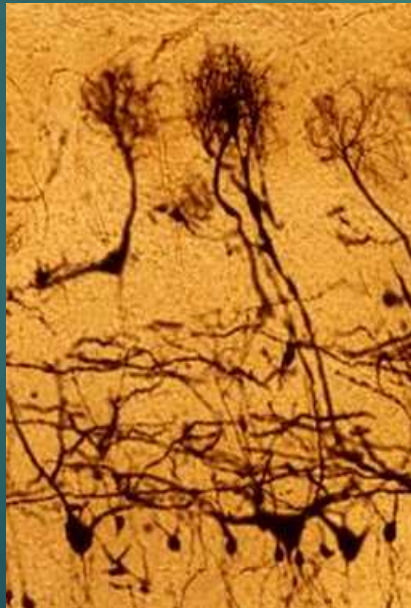
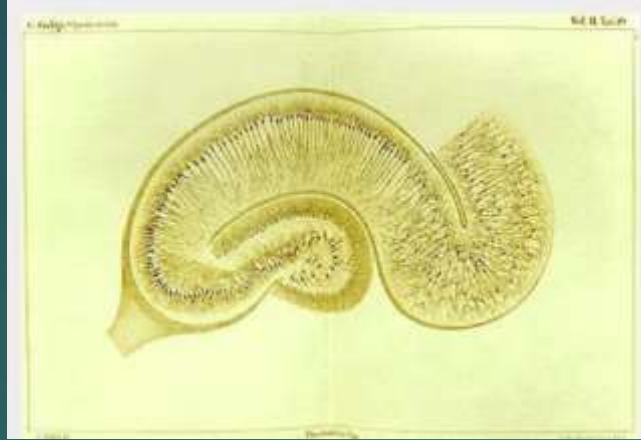


FDA banned it in 1953

Camillo Golgi, 1843-1926: Silver Nitrate stain



Student of
Panizza



- ▶ Univ. of Pavia
- ▶ Italian neuropathologist
- ▶ Working by candlelight in a hospital kitchen that he had converted into a laboratory, Golgi discovered a technique in the 1870s for impregnating brain and other tissue with a silver solution in such a way that made it possible to stain nerve cells black and view under the microscope.
- ▶ Golgi's method or Golgi stain, a nervous tissue staining technique.
- ▶ He discovered a method of staining nervous tissue which would stain a limited number of cells at random, in their entirety.
- ▶ Thought nerves did not have synapses
- ▶ Many studies of gliomas

Who?: **Layed back Neuroscientist**



Santiago Ramon Y Cajal 1852-1934



Spanish Neuroanatomist, Madrid Univ.

Father of Modern Neuroscience

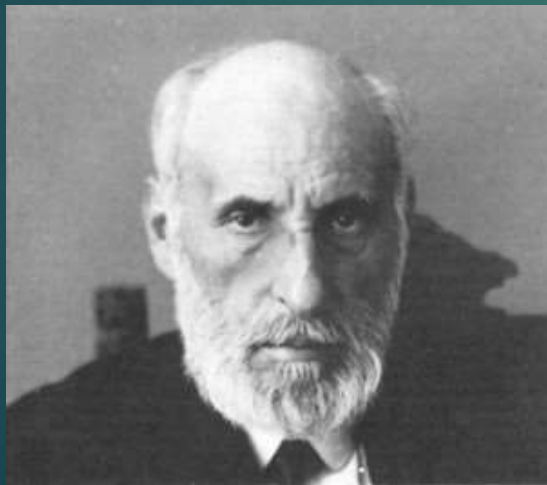
Improved Golgi staining technique

Neuron Doctrine: nerve cell is separate entity; separation by synaptic space

1906 Nobel Prize in Medicine with Golgi

Upset by Golgi's attack on his Neuron theory at Nobel award

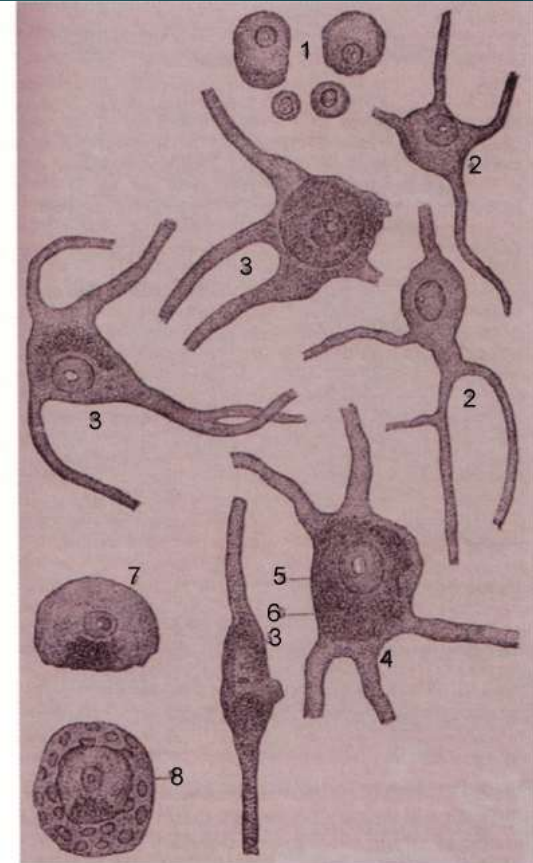
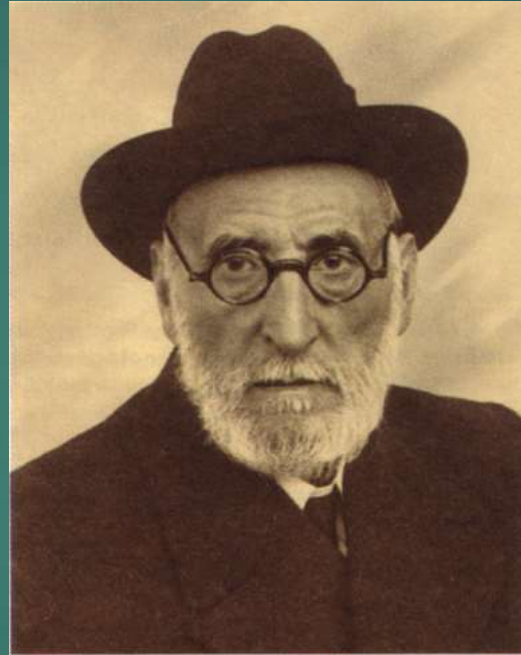
(1891- Wilhelm von Waldeyer coins "neuron")



Ramon y Cajal's neuron doctrine: the working assumption of brain science

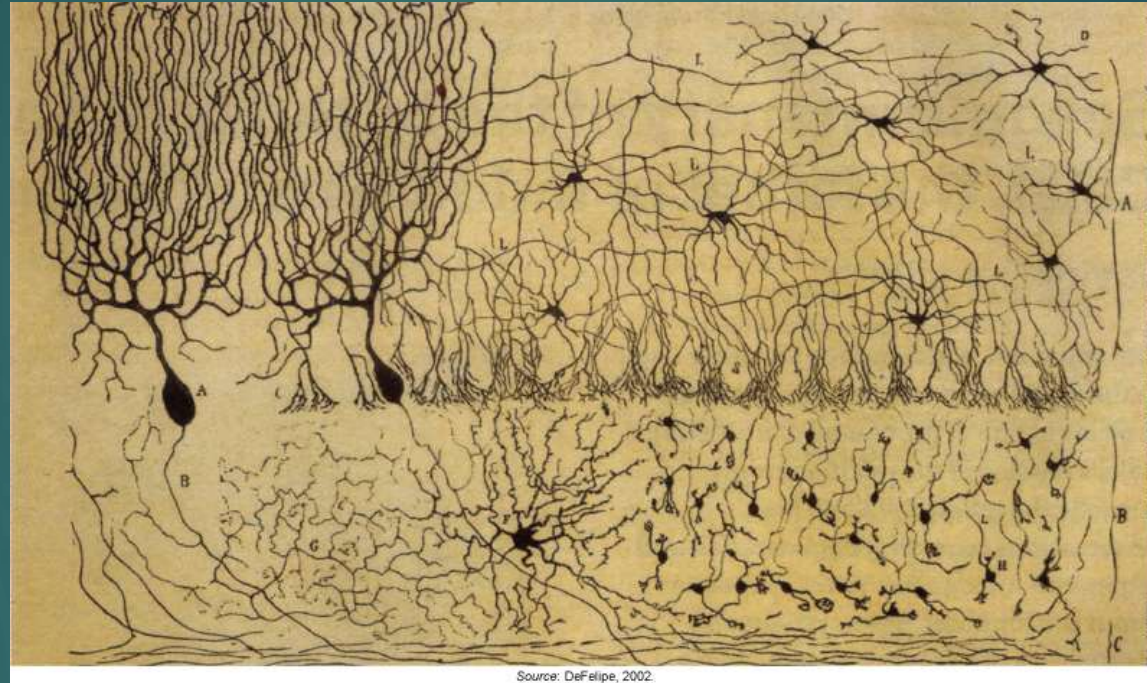
Santiago Ramon y Cajal was a founder of brain science.

An open and important question of his time was regarding the nature of the nervous system -- whether it consisted of billions of separate cells or whether it was essentially one great continuous network.



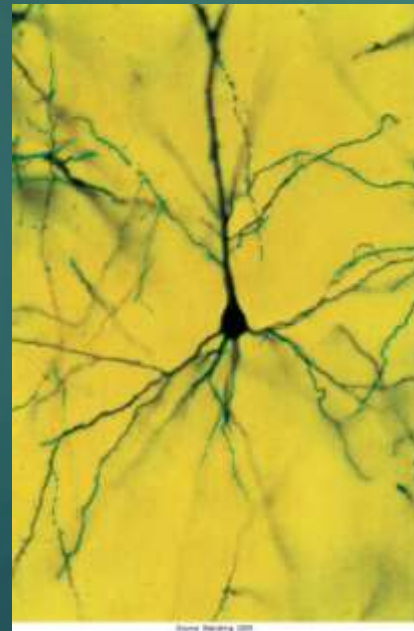
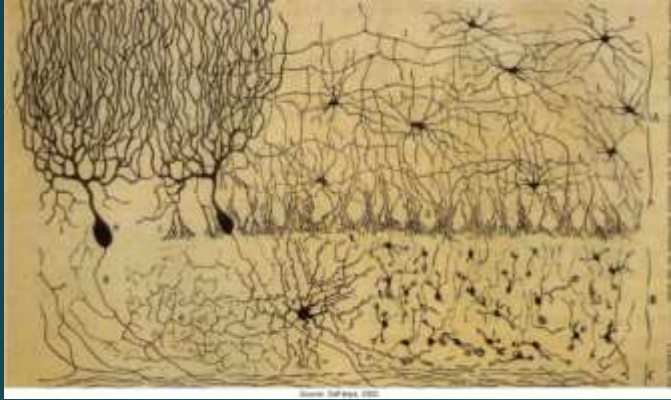
Source: DeFelipe, 2002.

Ramon y Cajal's neuron doctrine



Cajal used Golgi stains to bring out basic facts about nerve cells under the light microscope.

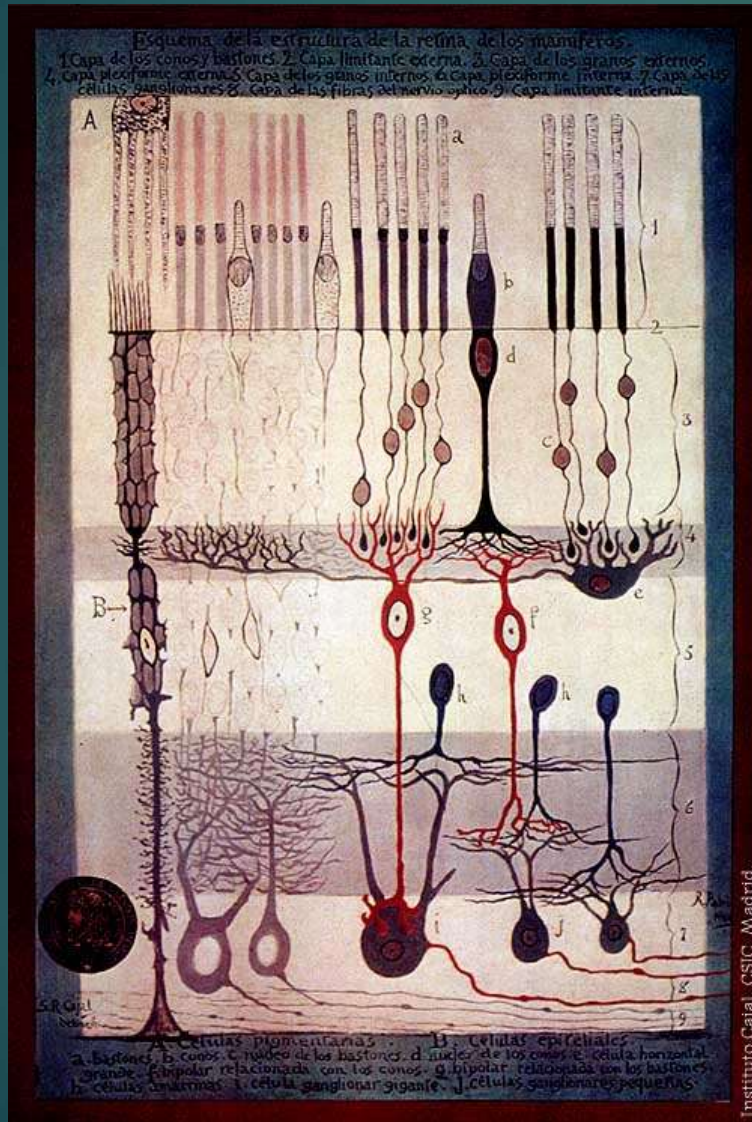
Ramon y Cajal's neuron doctrine



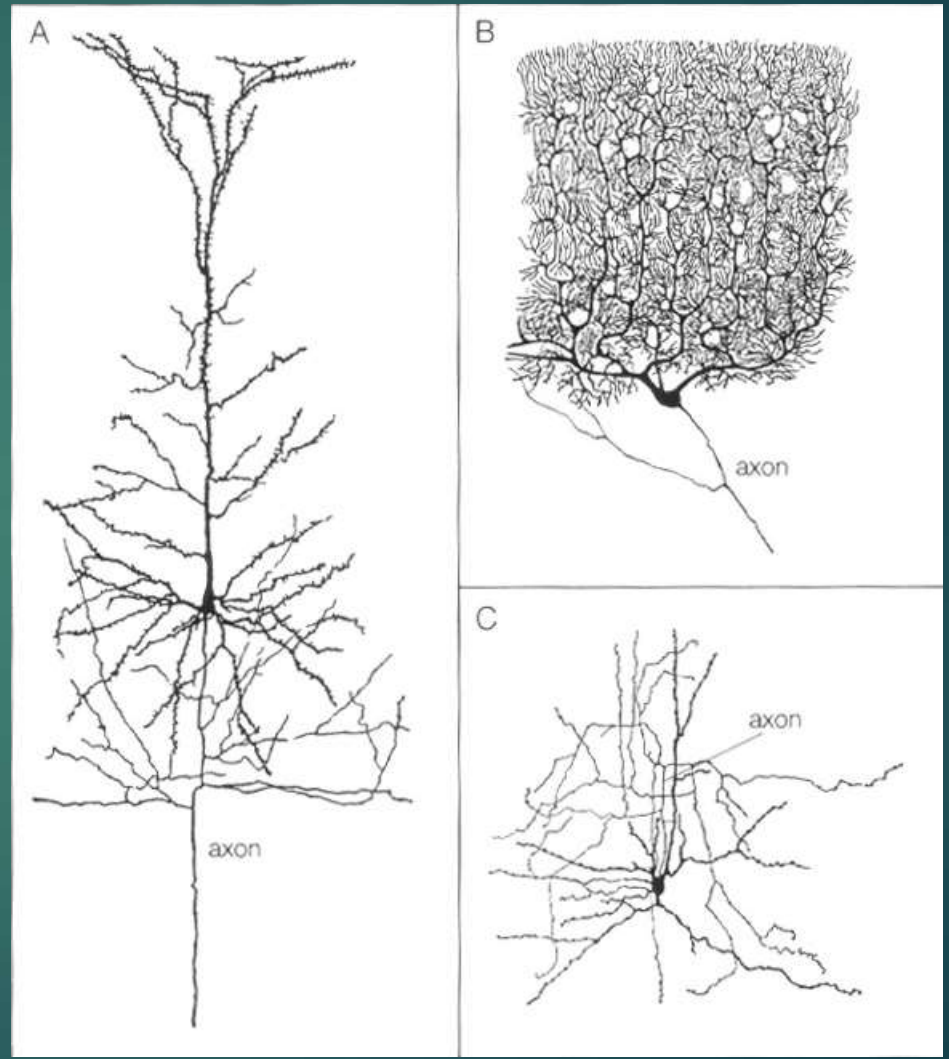
Cajal is credited with the *neuron doctrine*, one of the founding assumptions of brain science, stating that “the nervous system consists of numerous nerve cells (neurons), anatomically and genetically independent”.

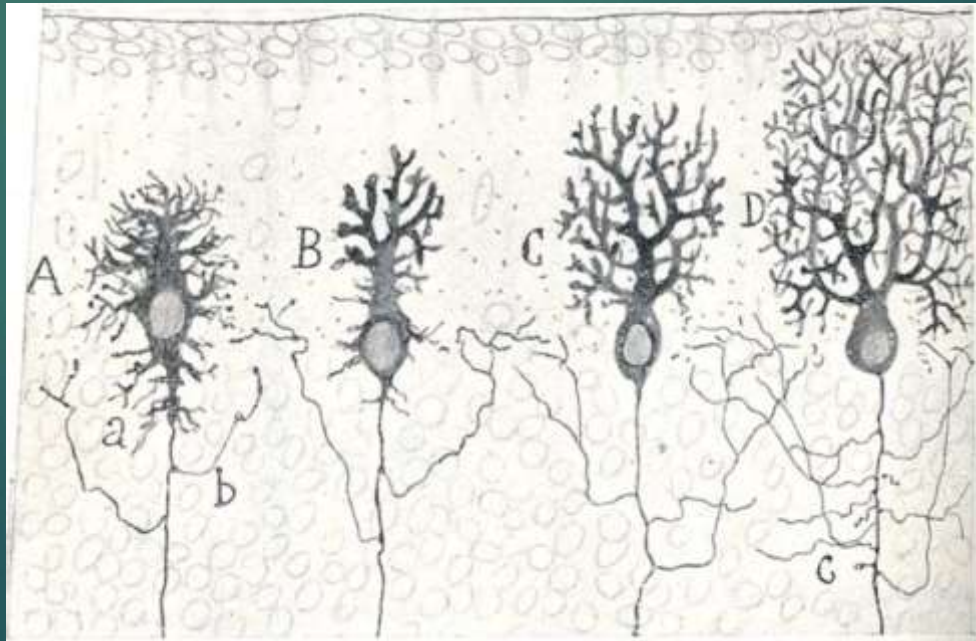
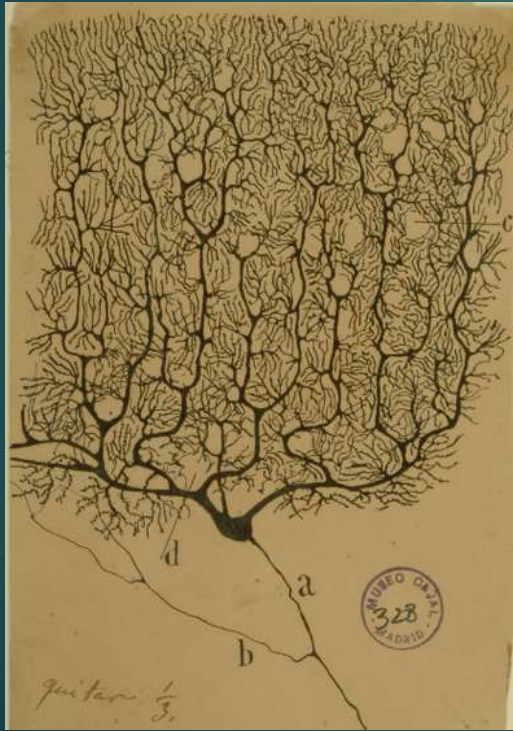
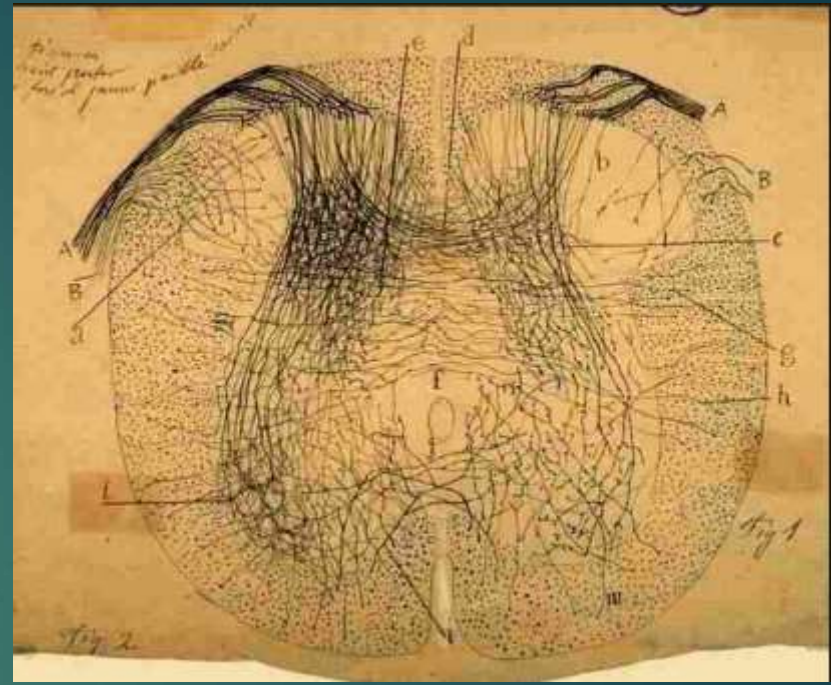
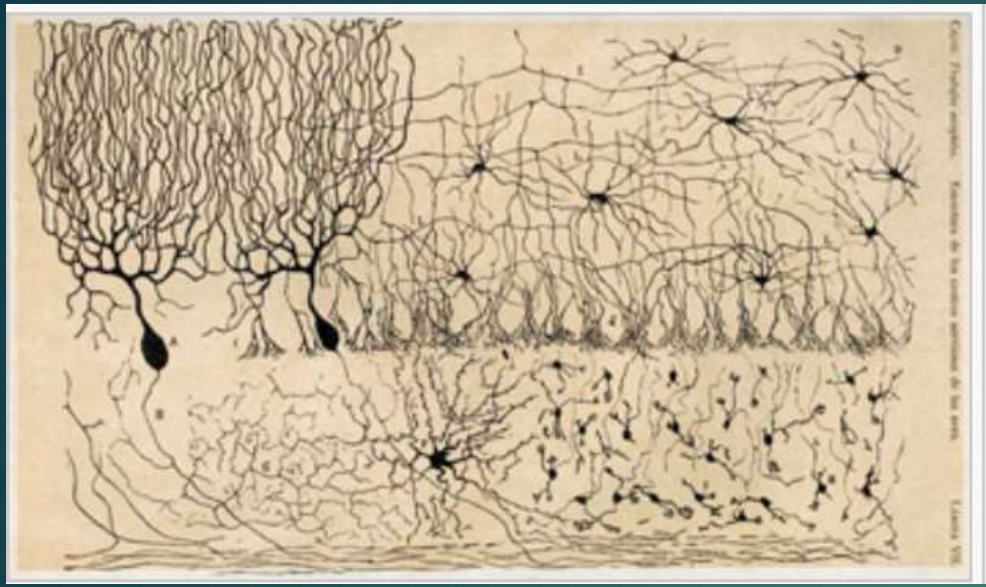
Today's methods for studying neuronal microstructure are advanced versions of the Golgi-Cajal approach.

Santiago Ramón Y Cajal Drawings

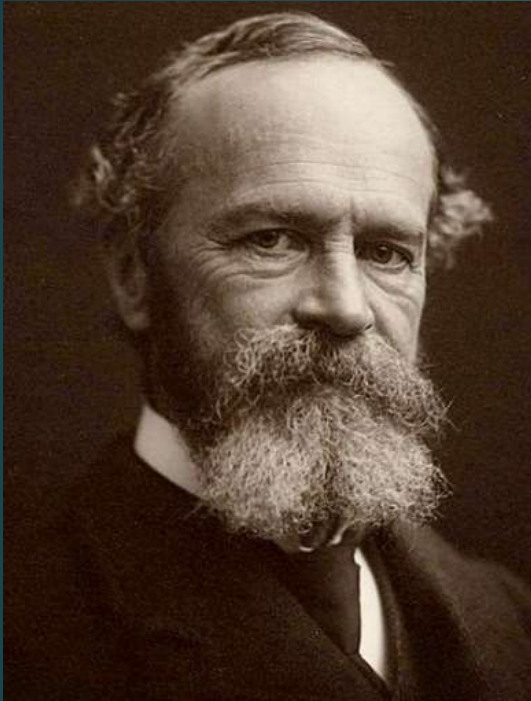


Instituto Cajal, CSIC, Madrid.





William James, 1842 - 1910



1875: first experimental psychology course at Harvard

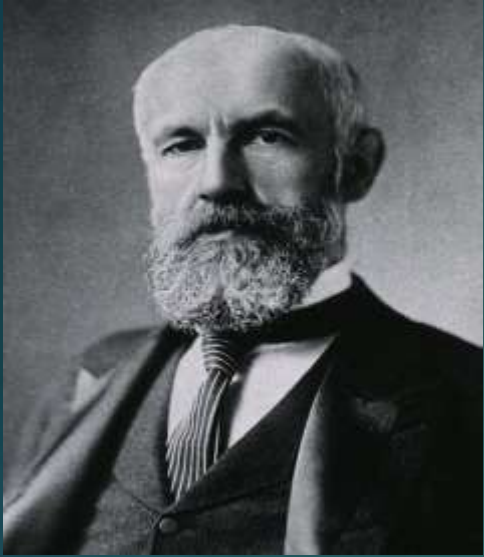
James was one of the leading thinkers of the late nineteenth century

Father of American Psychology

1890: *The Principles of Psychology* (1200 pages in 2 volumes)

James–Lange theory of emotion: The theory holds that emotion is the mind's perception of physiological conditions that result from some stimulus. In James's oft-cited example, it is not that we see a bear, fear it, and run; we see a bear and run; consequently, we fear the bear.

Granville Stanley Hall 1844 –1924



Student of William James



First dissertation with word psychology in it,
Harvard university; In 1878, he earned the first
psychology doctorate awarded in America

First psychology lab in America in 1883

In 1887, Hall founded the *American Journal of Psychology*

First President of the APA

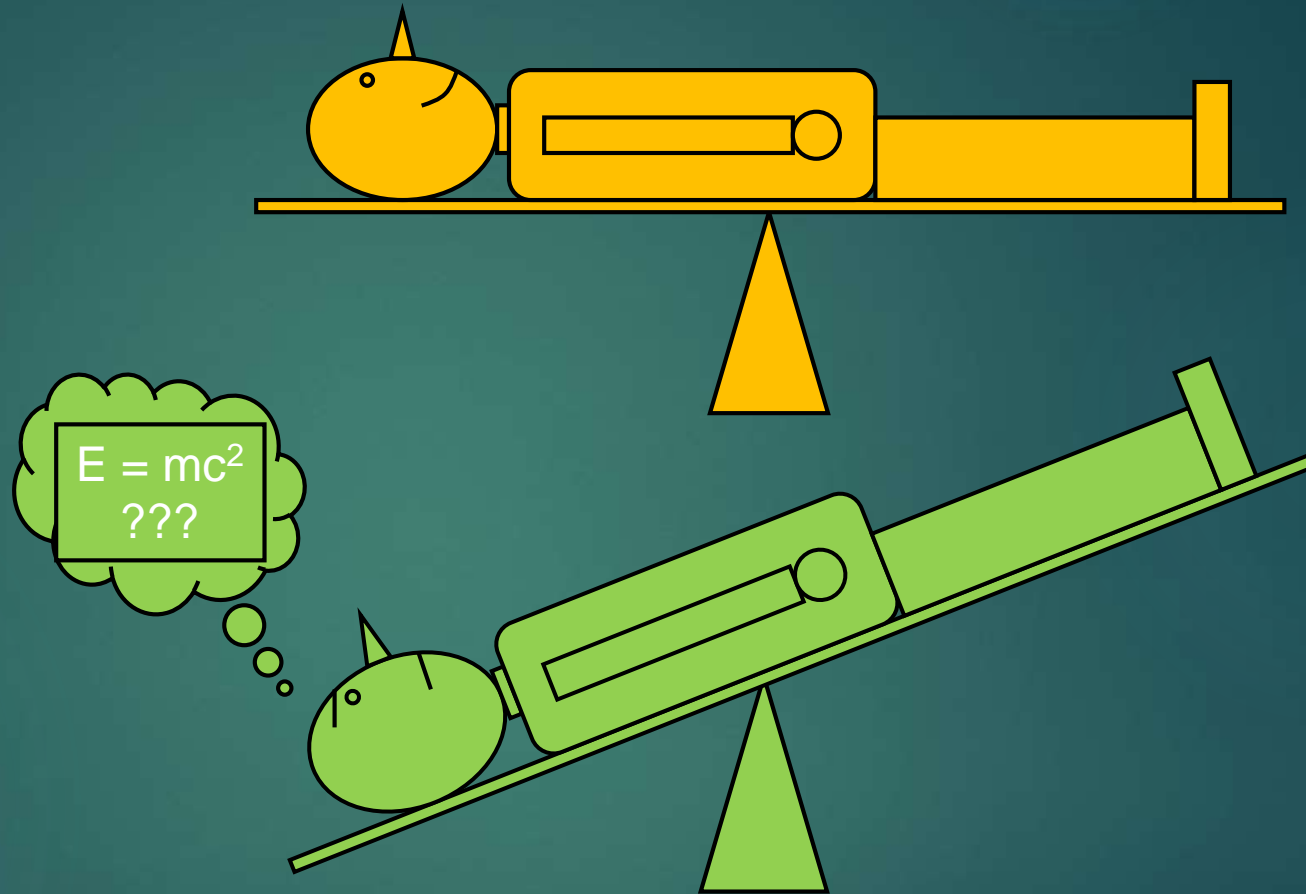
First President of Clark University

Invited Freud and Jung to lecture there in 1909.

1901: The First “Brain Imaging Experiment”



Angelo Mosso
Italian physiologist
(1846-1910)

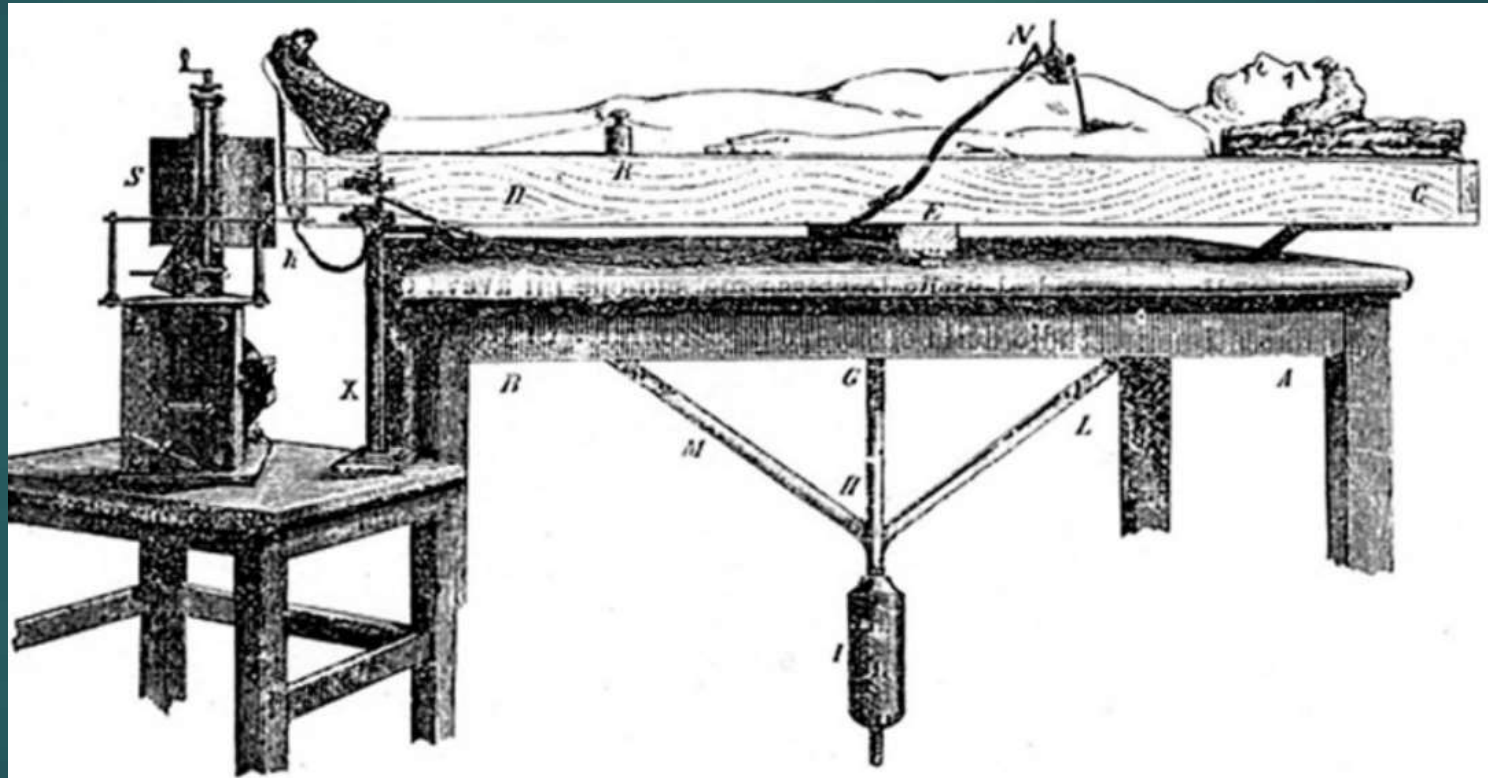


“[In Mosso’s experiments] the subject to be observed lay on a delicately balanced table which could tip downward either at the head or at the foot if the weight of either end were increased. The moment emotional or intellectual activity began in the subject, down went the balance at the head-end, in consequence of the redistribution of blood in his system.”

-- William James, *Principles of Psychology* (1890)

Angelo Mosso, 1846-1910:

1st Brain Activity Measurement Device



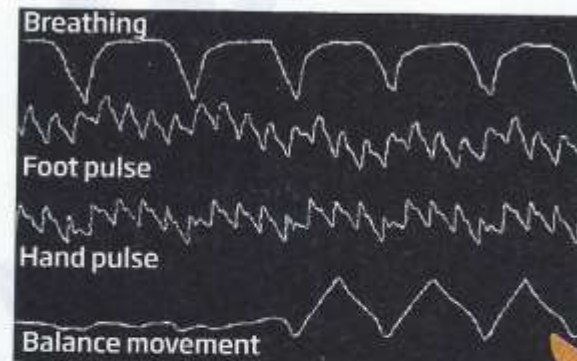
BALANCING ACT In the 1880s, Angelo Mosso used the human circulation balance illustrated here to measure the movement of blood to the brain during

Reading math text tips balance more than reading newspaper

Complex Machine to weigh the soul

A rush of blood to the head

A 19th-century device to measure brain activity placed subjects on a level balance. The idea was that greater mental activity causes more blood to flow to the brain, making the balance sway

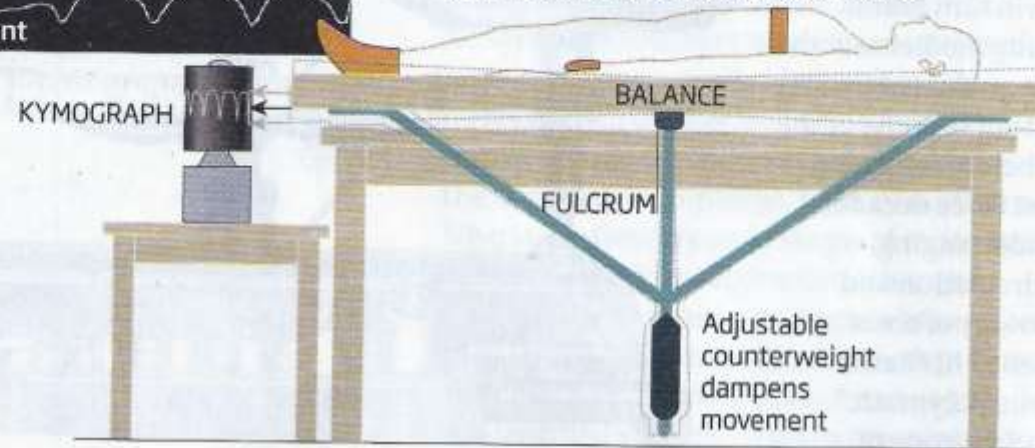


ORIGINAL KYMOGRAPH TRACE

A kymograph records this sway, and once pulse and breathing-related movements are subtracted it is thought to record the level of mental exertion

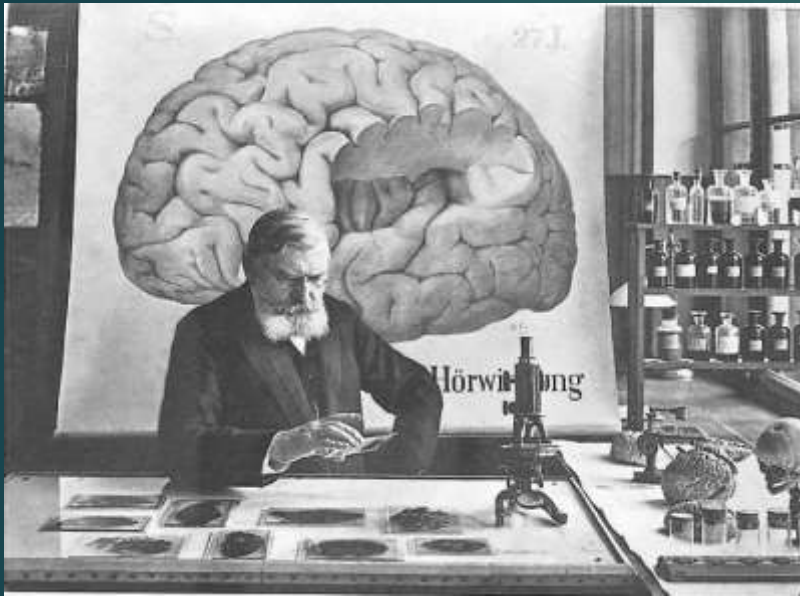
Sensors on the chest, feet and hands record other movements that could skew results

SOURCE: SANERONE ET AL (2013) | BRAIN



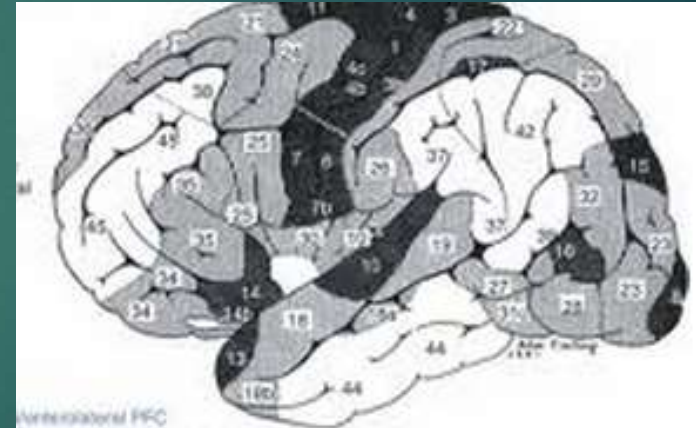
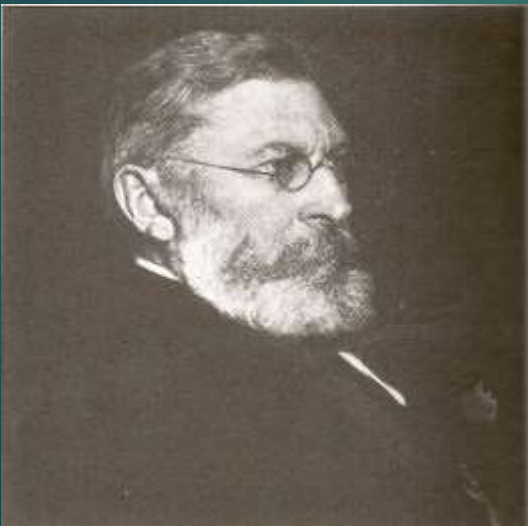
Balance tipped faster when reading a philosophy text

Paul Emil Flechsig, 1847-1929



University of Leipzig
German neuroanatomist,
psychiatrist and neuropathologist

1893: Mylenization in the brain



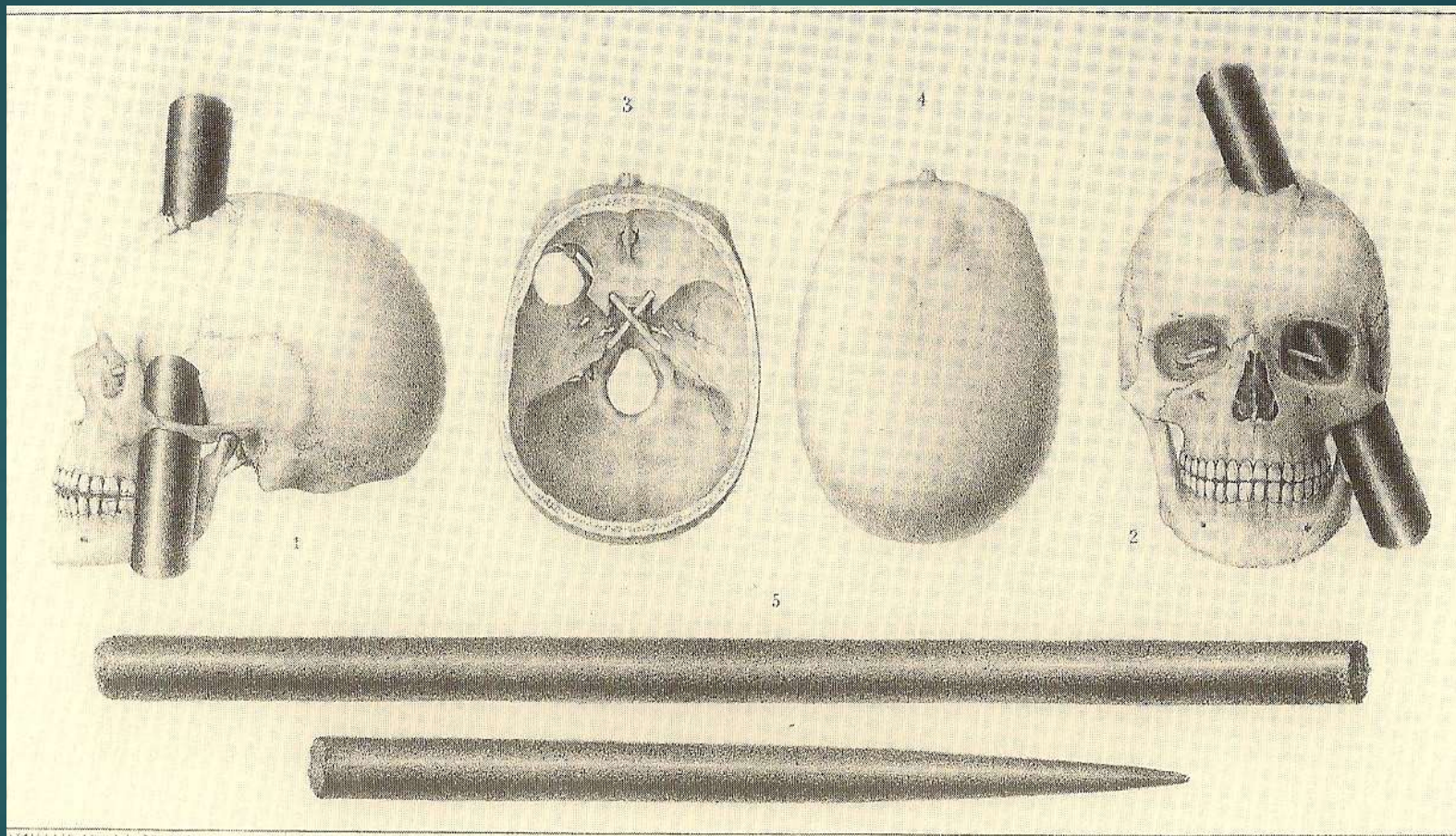
Students: Emil Kraepelin and Oskar Vogt
(mentor to Korbinian Brodmann).

Famous Neurology Patients

Lesion studies based on pathology:

- ▶ Broca's patient Tan
- ▶ Phineas T. Gage
- ▶ Roger Sperry's split-brain patients
- ▶ Wilder Penfield's epileptic patients
- ▶ Henry Molaison (patient H.M.)
- ▶ Clive Wearing (see YouTube)

1848: Most Famous Localization Case



History's most famous brain-injury survivor: Phineas Gage: 1848

- ▶ 25-year-old foreman of a construction gang on Sept. 13, 1848, preparing a railroad bed outside Cavendish, Vt.
- ▶ As usual, he was using a pointed iron rod -- 3 feet, 7 inches long and 13 1/4 pounds -- to tamp gunpowder and sand into a hole drilled in the rock.
- ▶ But on that day, the mixture exploded, sending the rod through his left cheek and out through the top of his head.
- ▶ "Here is business enough for you," Gage told the first doctor.



Examined by Drs. Williams, John Harlow MD. Henry J. Bigelow MD. **Latter stated "no sequelae"**



John Harlow MD describes Phineas in 1868



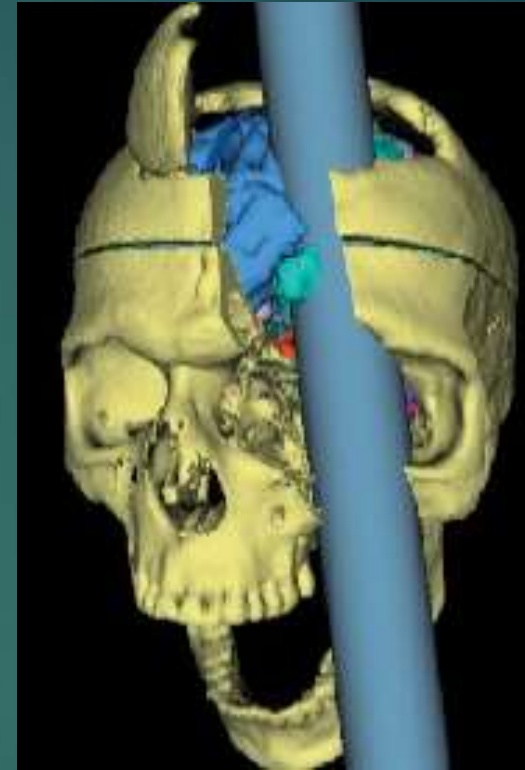
First to exam Phineas in 1848:
A phrenologist; but got Gage's
skull and rod for Harvard in 1867.

“His contractors, who regarded him as the most efficient and capable foreman in their employ previous to his injury, considered the change in his mind so marked that they could not give him his place again. He is fitful, irreverent, indulging at times in the grossest profanity (which was not previously his custom), manifesting but little deference for his fellows, impatient of restraint or advice when it conflicts with his desires, at times pertinaciously obstinate, yet capricious and vacillating, devising many plans of future operation, which are no sooner arranged than they are abandoned in turn for others appearing more feasible. In this regard, his mind was radically changed, so decidedly that his friends and acquaintances said he was "no longer Gage."”

Phineas Gage, 1848

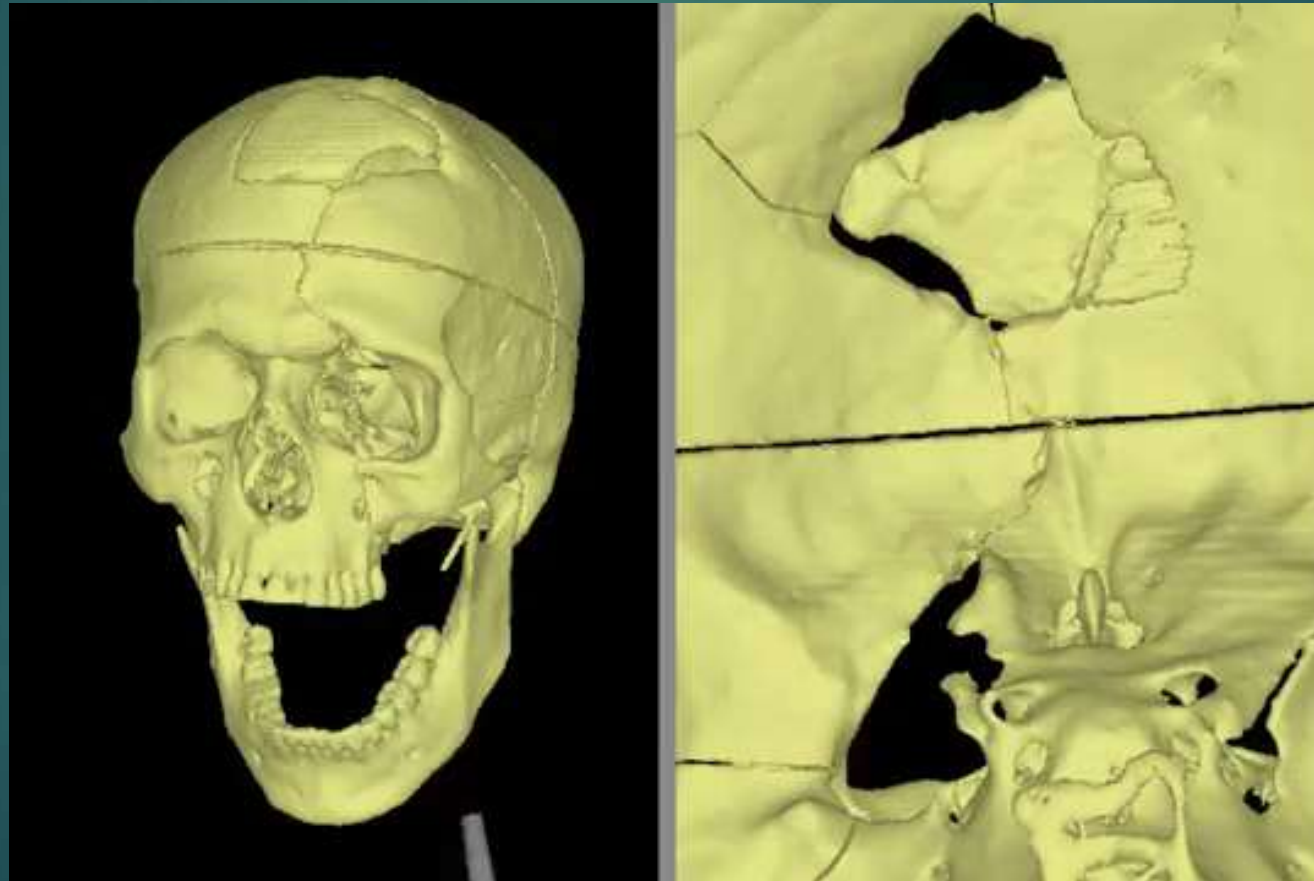


Life mask at [Harvard Medical School's Warren Anatomical Museum](#)



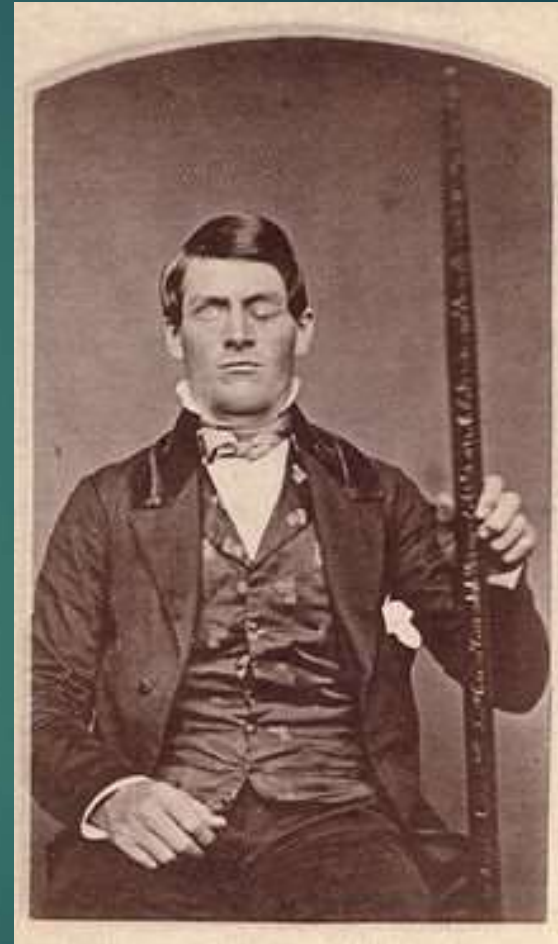
The image Peter Ratiu and Ion-Florin Talos published in the *New England Journal of Medicine* in 2004.

The Phineas Gage Event



Arrow on picture to start

“The battered whaler”: Which is correct picture?



Picture of whaler and his harpoon or ??: In 2007, Bev Wilgus posted a scan of the image on Flickr, and titled it “One-Eyed Man with Harpoon”

From the collection of Jack and Beverly Wilgus

Phineas Gage: first case to suggest a link between brain trauma and personality change.

- ▶ For a year Phineas gave lectures and exhibited himself and his tamping iron throughout New England.
- ▶ Worked as an ostler (stableman) at Jonathan Currier's Hanover Inn in Dartmouth, NH, for 18 months.
- ▶ Went to Valparaiso, Chile to work as a stage-coach driver.
- ▶ After about another 5-6 years Phineas became ill and returned, probably in 1859, to his family, then resident in San Francisco. After again regaining his health, his mother said he "was anxious to work" and did so as a farm laborer in Santa Clara County.

Phineas Gage

- ▶ In February 1860 he began to have epileptic seizures and only after they had begun did he become restless, dissatisfied with his employers, moving often from one job to another.
- ▶ The seizures became more frequent and he died, at age of 36, in May 1860 of repeated attacks (*status epilepticus*) in San Francisco. Buried on Parnassus Hill; later body moved to Colma
- ▶ Phineas had survived his accident for eleven and a half years. Gage had supported himself all his life at hard, honest work

Legacy of Phineas Gage

- ▶ Belief that Gage suffered significant personality change suggested that key parts of the personality resided in the frontal lobe.
- ▶ His history did not lead to the development of lobotomy, which was based on the theory that removing portions of the frontal lobe could cure mental derangement and depression.



Legacy of Phineas Gage

- ▶ *Odd Kind of Fame*, by Malcolm Macmillan:
 - ▶ Gage was mythologized into a wastrel, vagrant, gambling, drifting, sexually dangerous, violently quarrelsome drunken bully, "near-criminal sociopath": because so little was known about him, he was an empty canvas onto which later writers could project the symptoms they imagined he "ought" to have had based on where they imagined his injury to have been.
- ▶ Damasio's portrait of Gage in "Descartes Error" is utterly inaccurate.
- ▶ His initial moderate changes may have persisted only a few years, so that by the end of Gage's life people saw him as essentially normal.

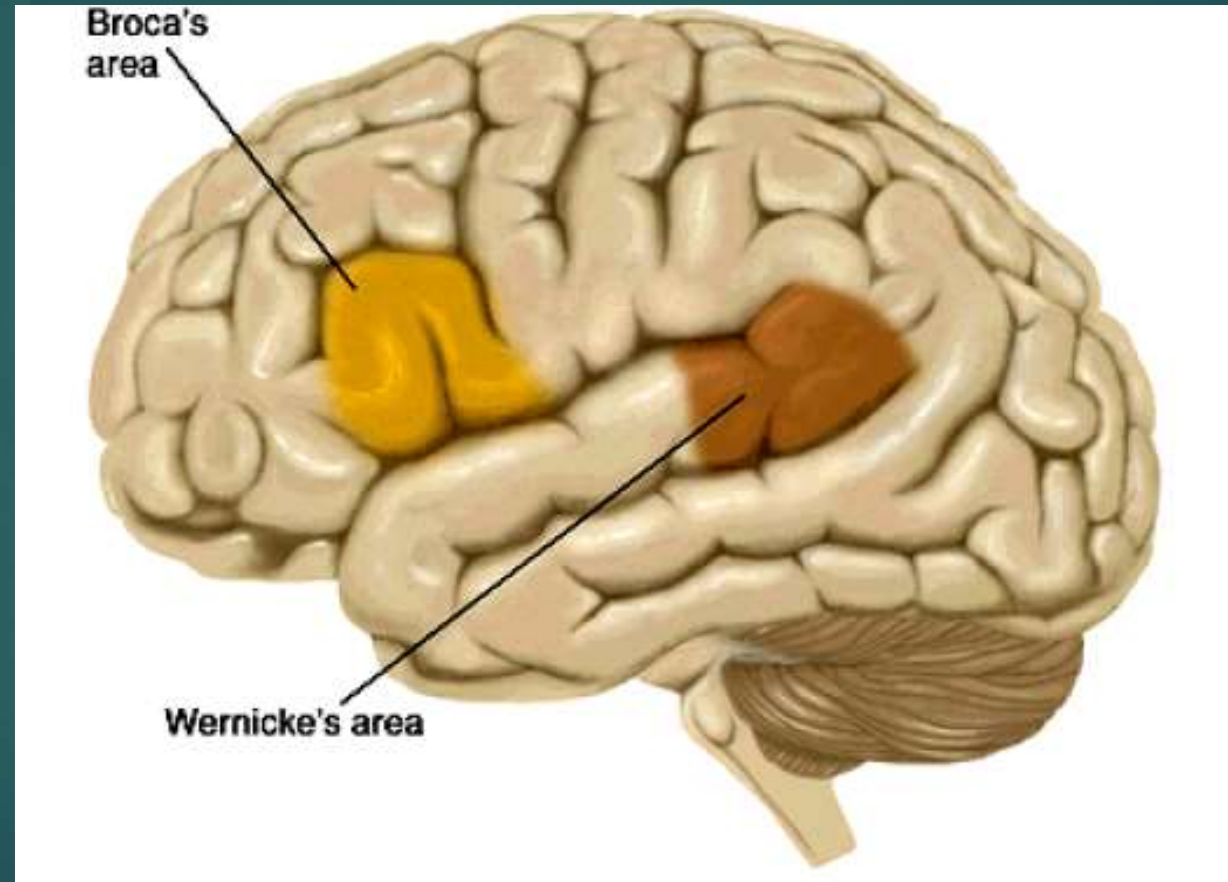
Carl Wernicke, 1848-1905



Student of Meynert

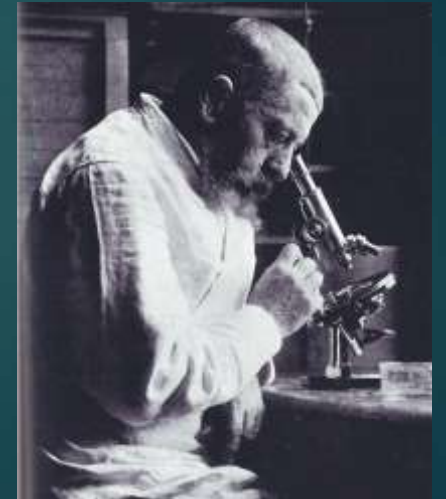
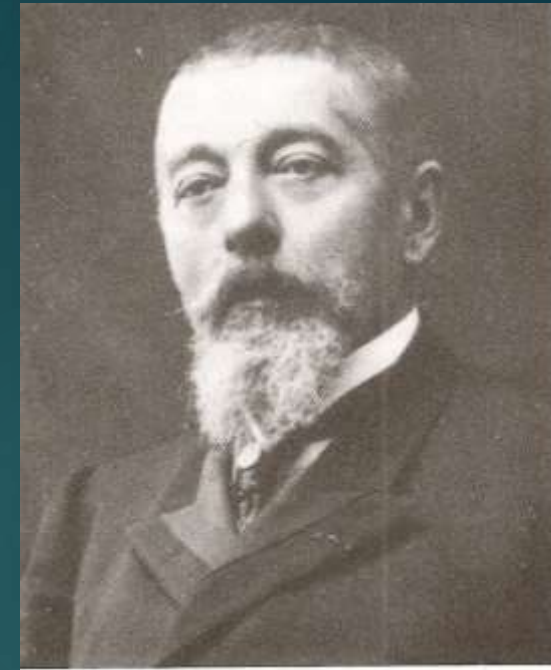
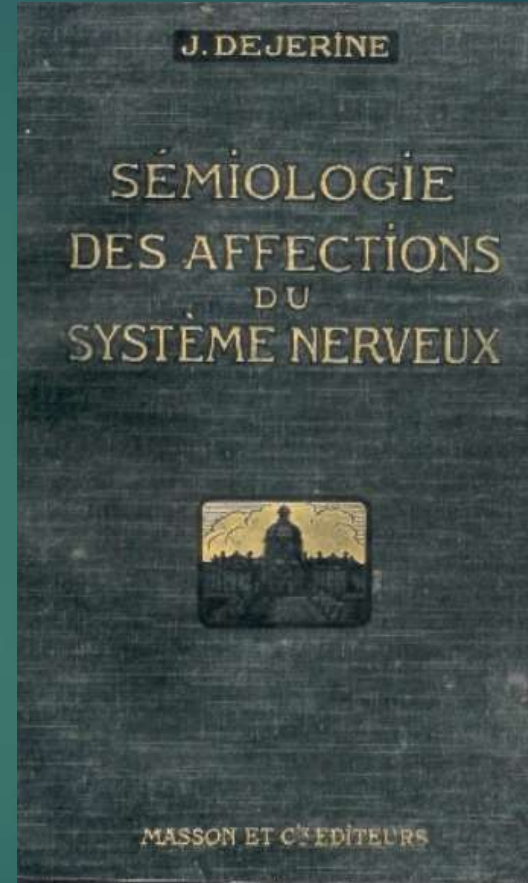
- German neurologist, University of Breslau
- 1874 *Der aphasische Symptomen-Komplex*
(as 26 y o medical intern)
- Lesion of left superior temporal gyrus
- Receptive (fluent) Aphasia
- Interconnections of functional areas
produce complex behaviors
- Disconnection concept:
undamaged area looks damaged if
disconnected
- 1881 *Textbook of Brain Disorders*

Expressive vs. Receptive Aphasia

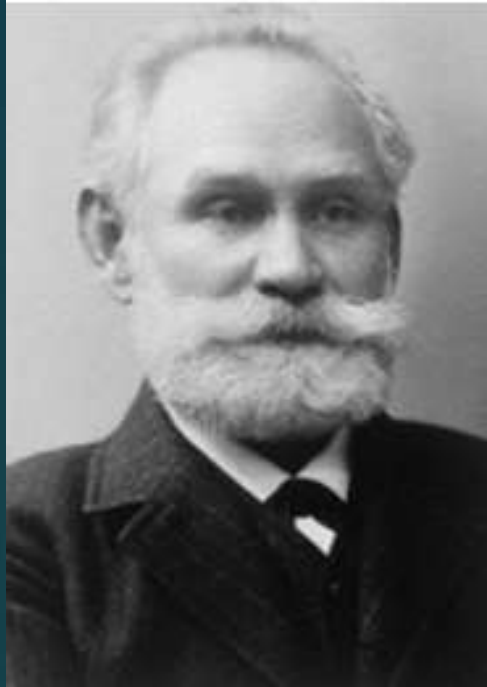


Jules-Joseph Dejerine 1849 – 1917

- ▶ French neurologist, Univ. of Paris
- ▶ **First callosal syndrome**: lesion to the corpus callosum that caused **alexia without agraphia**. Dejerine interpreted this case as a disconnection of the speech area in the left hemisphere from the right visual cortex.
- ▶ Word blindness (alexia) from of lesions of the left supramarginal and angular gyri.
- ▶ Father of MS study
- ▶ Counter transference



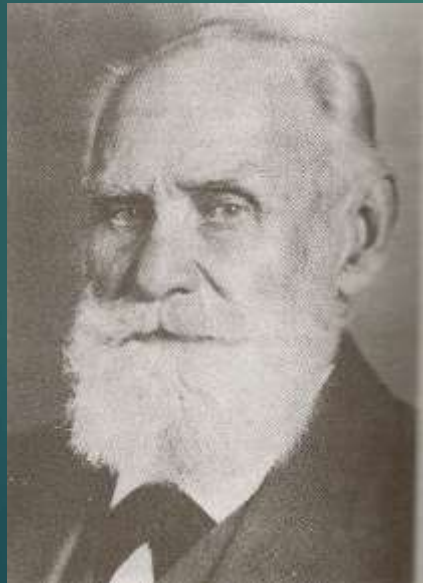
Ivan Pavlov, 1849-1936



Imperial Medical Academy

1904 Nobel Prize for digestive system research.

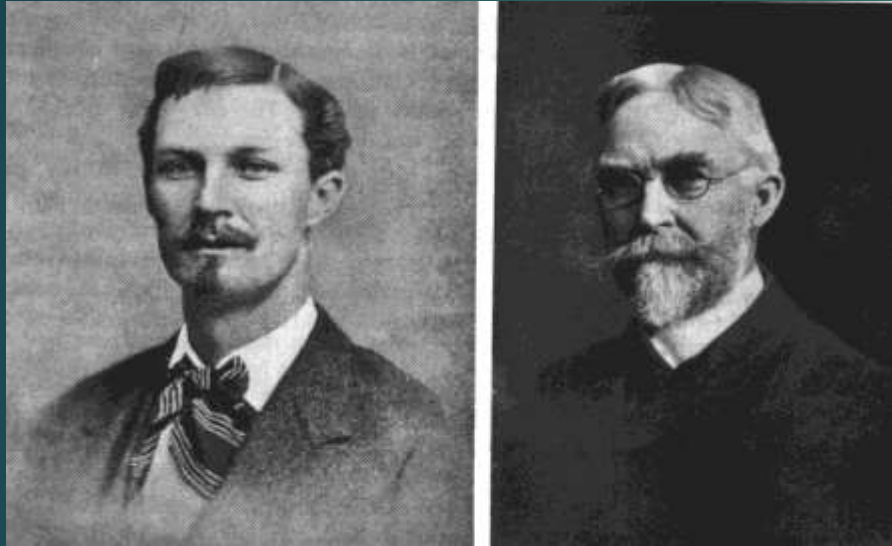
First describing the phenomenon of classical conditioning.



Rarely used bell as stimulus: assistant entry or metronome



George Huntington, 1850-1916

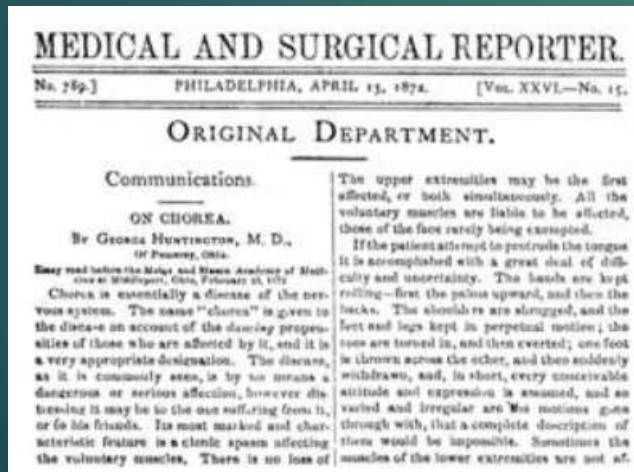


American physician

1872, Huntington's Disease

Huntington's Symptoms:

- ▶ Changes of personality, depression
- ▶ Involuntary movements (chorea)
- ▶ Bradykinesia (slow movements)
- ▶ Dementia



Hermann Ebbinghaus 1850 - 1909

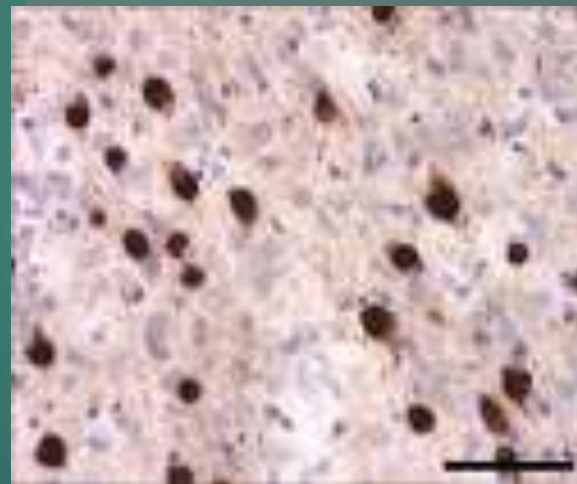


- University of Berlin
- 1885: *Über das Gedächtnis* (Memory. A Contribution to Experimental Psychology)
- Pioneered the experimental study of memory
- Discovery:
 - forgetting curve
 - learning curve
 - spacing effect

Arnold Pick, 1851- 1924: **Pick's disease (FTD)**



Student of Meynert



Charles University
in Prague

Czech neurologist

Claimed first to name reduplicative paramnesia; but Bonnet in 1788 did

1891: first to use the term dementia praecox

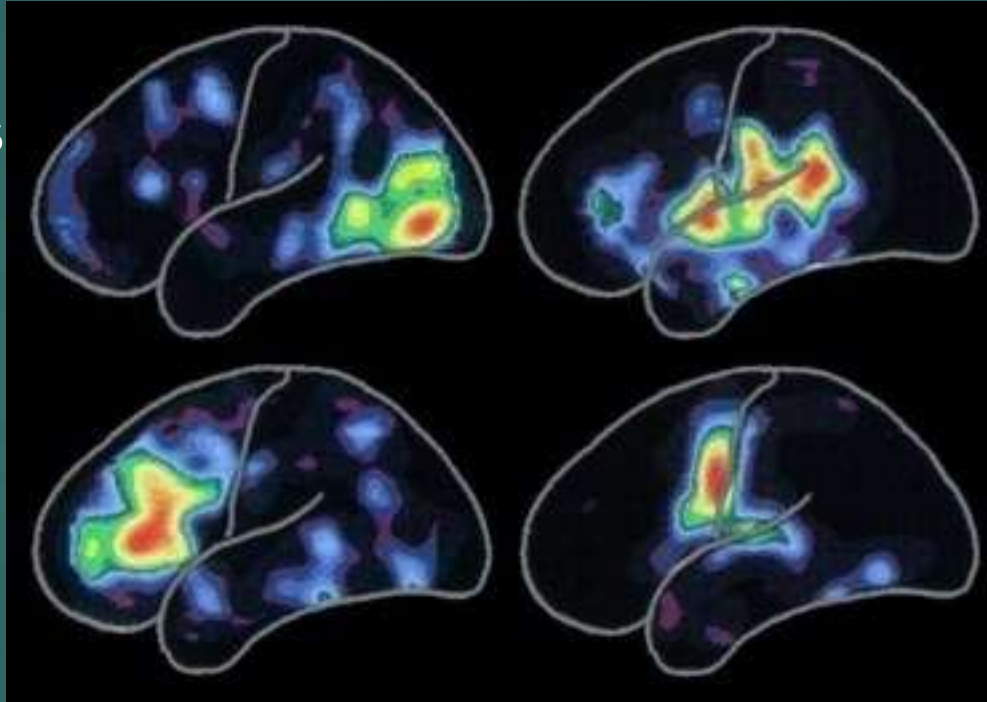
1892 – 1906 - 350 publications, the most famous on frontal lobar cortical atrophy (Pick's disease). He wrote a textbook on neuropathology. He was an expert in aphasia and apraxia.

Splendid 1870s in Neurology: Localizationist Feast

- ▶ Fritsch & Hitzig: motor projection area
- ▶ Ferrier: sensory projection area
- ▶ Broca: left frontal expressive aphasia
- ▶ Wernicke: left temporal receptive aphasia
- ▶ Dejerine: angular gyrus (Alexia)
- ▶ Liepmann: Apraxia
- ▶ Korsakoff: Amnesia
- ▶ Agraphia
- ▶ Amusia
- ▶ Acalculia

Modern Localization & Equipotentiality = neural processing networks:
fMRI of reading and speech

Reading Words



Hearing Words

Thinking about
Words

Speaking
Words

Again: Carl Wernicke, 1881

- ▶ Wernicke's Encephalopathy:
- ▶ Describes encephalopathy syndrome of chronic alcoholism
 - ▶ acute confusion,
 - ▶ visual problems,
 - ▶ gait difficulty
- ▶ 1980s: Idea that Wernicke's is acute phase of Korsakov's disease
- ▶ Originally thought of as different stages of same disease, but can get either independently

Sergei Sergeivich Korsakoff, 1853-1900



University of Moscow

1887, “On a polyneuritic psychosis with a singular disturbance of concentration and pseudo-reminiscences”

1887 Korsakov’s Syndrome (cerebropathica psychica toxaemica):

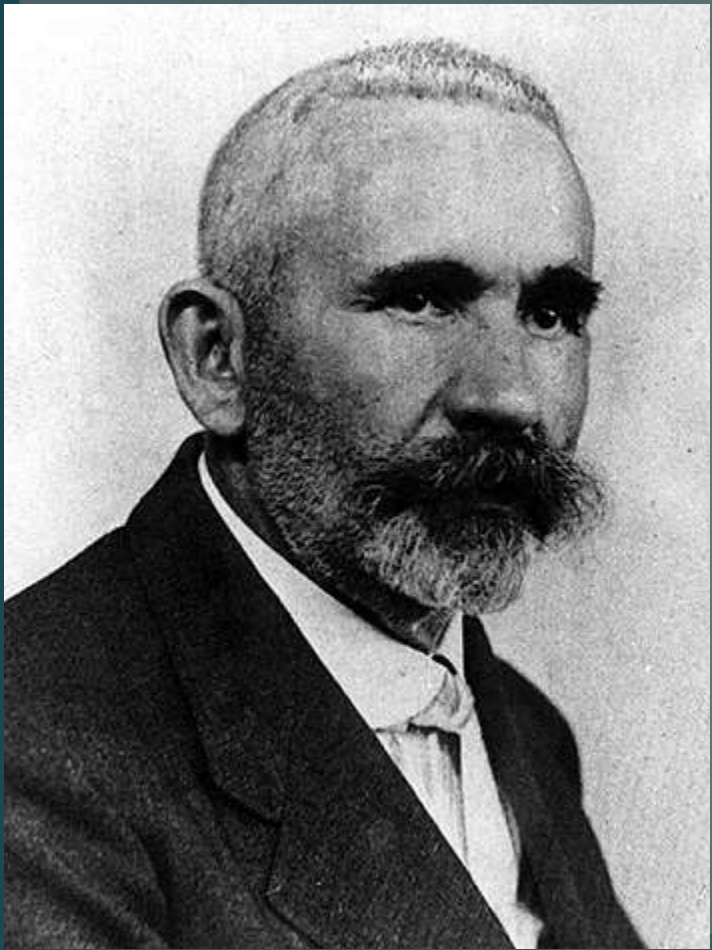
(Hemorrhages in Mammillary bodies due to thiamine (B1) deficiency due to alcoholism (or anorexia, malabsorption); less since B1 in bread)



Psychiatric reformer

Student of Meynert

Emil Kraepelin, 1856-1926: The **Linnaeus of Psychiatry**



Student of Wundt & Flechsig

University of Munich

Founder of contemporary scientific psychiatry

1883, *Psychiatric Handbook at 27*,
went through 9 editions

1883: coins “neuroses” & “psychoses”

1896: describes “dementia praecox” (schizophrenia)

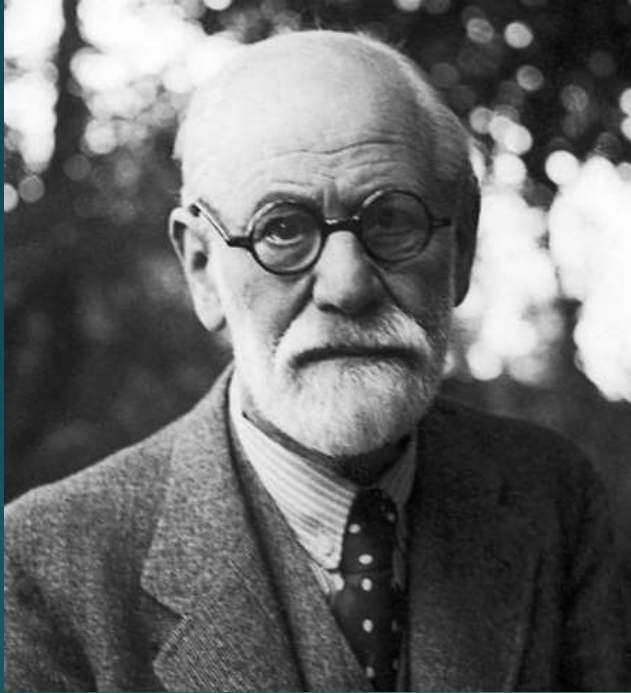
Biological theory of psychiatry

1910 Names “Alzheimer’s” disease

Discovery of the Brain Analysis Device for Internal Consciousness

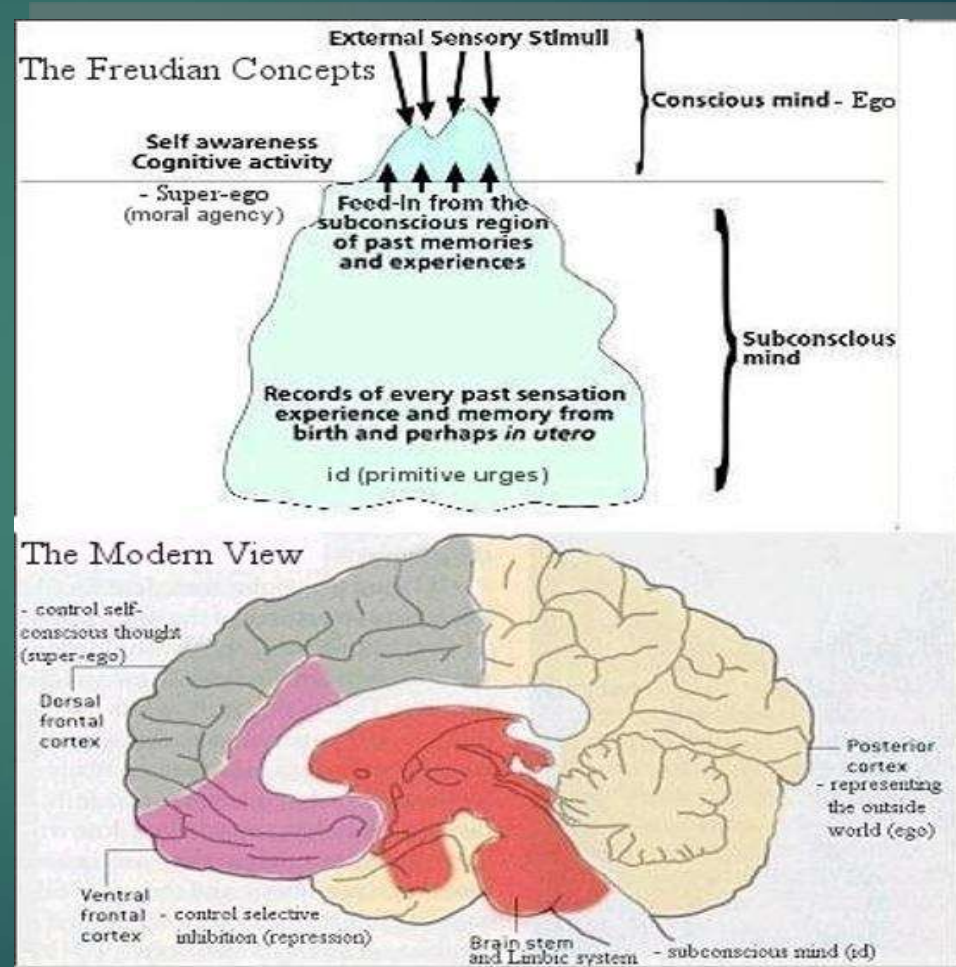


Sigmund Freud, 1856-1939: Neurologist, Psychoanalysis



Student of Meynert, Charcot

Translated Charcot on hysteria
1891: coined "agnosia"



ID, Superego, Ego

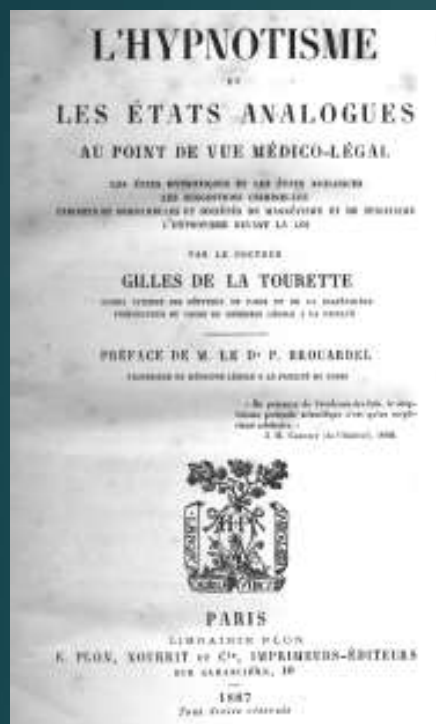
Joseph Jules François Félix Babinski 1857-1932



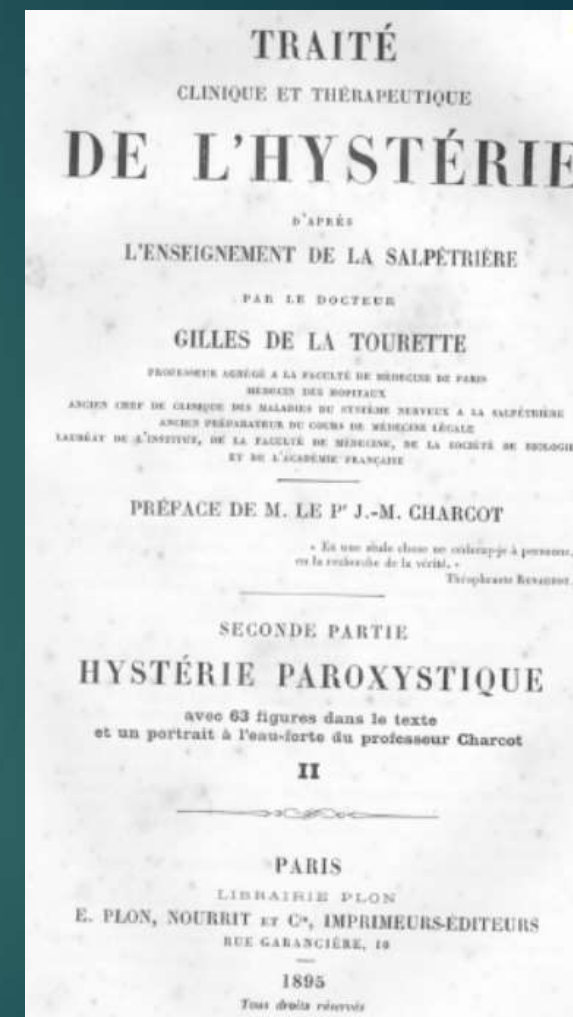
Student of Charcot

- ▶ Hôpital Pitié-Salpêtrière, Paris
- ▶ French neurologist. He is best known for his 1896 description of the Babinski sign (spread toes up when soles touched), a pathological plantar reflex indicative of corticospinal tract damage.
- ▶ First to present acceptable differential-diagnostic criteria for separating hysteria from organic disease
- ▶ Identified Anosognosia (denial of deficit)

Georges Gilles de la Tourette, 1857 – 1904



Residents at rest



His magnum opus: *Traite clinique et therapeutique de l'hysterie* (1800 pages!)

Georges Albert Edouard Brutus Gilles de la Tourette, 1857-1904: **Jumping Lumberjacks of Maine**



Hôpital Salpêtrière, Paris

French psychiatrist and neurology;
student & coworker of Charcot.

Hypnosis and hysteria were his specialties

1881 translated article on Jumping Lumberjacks of Maine:

Identified syndrome of uncoordinated movement, echolalia, coprolalia; 1885 wrote description of a cursing Marquise of Dampierre and 8 others.

Charcot named syndrome after him

In 1893, Rose Kamper, claiming she was hypnotized, shot him 3 times. He survived to die of neurosyphilis at 46.

1884: *Maladie des tics*

Irony: **Gilles is his surname**; Tourette is the town

Eugen Bleuler, 1857-1932



Student of Charcot

His students: Jung, Rorschach

- ▶ University of Zürich
- ▶ Swiss psychiatrist
- ▶ Understanding of mental illness
- ▶ Coined the terms autism and schizophrenia in 1911.
- ▶ Schizophrenia previously known as dementia praecox.

Alfred Binet, 1857 - 1911



Question: "My neighbor has been receiving strange visitors. He has received in turn a doctor, a lawyer, and then a priest. What is taking place?"

Sorbonne

1905, "New Methods for the Measurement of the Intellectual Level of Subnormals"

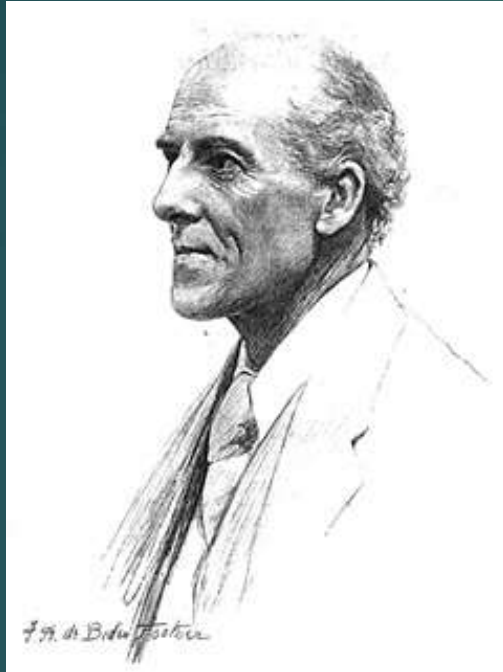
In 1903 the French government appointed Alfred Binet (and others) to a special commission to investigate how best to educate children with special needs.

With the help of his assistant, Theodore Simon, Binet set about to devise a method to identify those children with special needs.

The result was the Binet-Simon Scale, the first of its kind, in 1905 (30 items of increasing difficulty). Idea of "Mental Age."

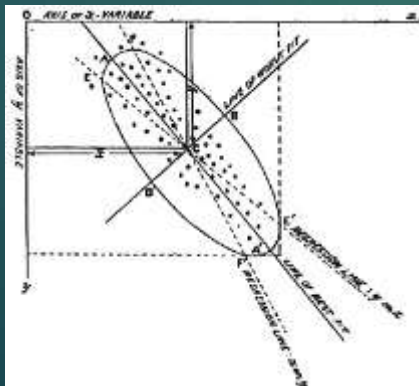
Student of Charcot

Karl Pearson, 1857 – 1936



Founded the first University Statistics Department.

- He defined the modern concepts:
 - correlation,
 - regression
 - dependent vs. independent variables



Student of Galton's

Student: David Wechsler

Vladimir Mikhailovich Bekhterev, 1857-1927:

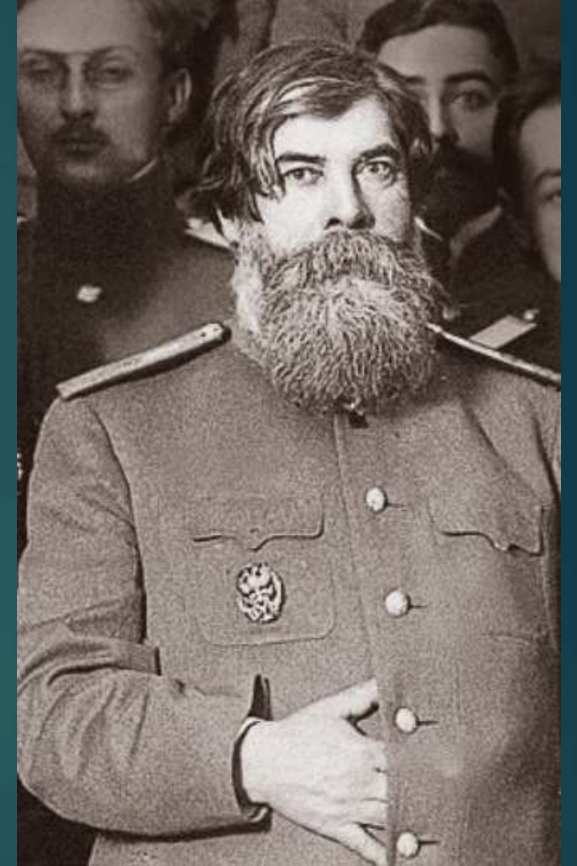
Hippocampus required for memory

Russian Neurologist, Brain Institute, RAS

He is best known for noting the role of the hippocampus in memory, his study of reflexes, and Bekhterev's Disease.

Competition with Ivan Pavlov regarding the study of conditioned reflexes. He used conditioning in humans.

Diagnosed Stalin with "grave paranoia." Later that day Bekhterev suddenly died.



Student of Wundt, Flechsig, Meynert, Charcot

Sir Charles Scott Sherrington, 1857 -1952: **The Synapse**

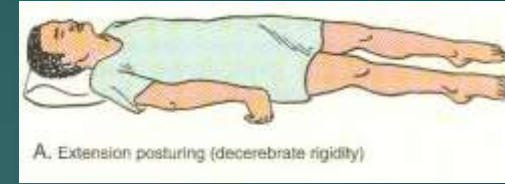


Students: Penfield, Eccles,
Cushing

English neurophysiologist, Oxford

Coined 'synapse'

Decerebrate rigidity



Cerebellum is head ganglion of the proprioceptive system

He envisioned the brain as "an enchanted loom"

1902: **cortical mapping of hands & face**

1906: *The Integrative Action of the Nervous System* (describes synapse & motor cortex)

1932 Nobel Prize in Physiology or Medicine with Edgar Adrian for functions of neurons

The Most Famous Neuroscience Menu

SYLLABUS

*

Gastronomic Experiments

FOR THE DEVELOPMENT OF

An International Synaptic
System

INTEGRATING

Certain Newly Medulated
Neurons

WITH

THE HIGHER CENTER,
PROFESSOR C. S. SHERRINGTON,
M.D., LL.D., F.R.S.

SILLIMAN LECTURER

Accompanied by
EXPLOSIONS FROM BROCA'S CONVOLUTION
by the
BIOLOGICAL QUARTET

Concluded by
DEMONSTRATIONS BY PROFESSOR MENDEL ON
VARIOUS HUMAN SUBJECTS
SCRATCH REFLEX
KNEE JERK
SHIVERING
SPINAL SHOCK

Summary of Results PROFESSOR SHERRINGTON

PROTOCOLS

*

SOME OF NATURE'S FIRST
EXPERIMENTS WITH THE
SYNAPTIC SYSTEM
ON THE HALF SHELL

APPLICATIONS OF
CARMINE STAINING FLUID
WITH A SPOON

ULTRAMARINE BRAIN FOOD
STARVATON ARMY STAPLE

METAMERES OF
SKELETAL MUSCULATURE FROM
A HIGHER VERTEBRATE

DECEREBRATED SQUAB EXHIBITING
TOASTOTROPISM

VERDANT PROPRIONOCICEPTOR
ALLEVIATOR
PROTEID SECRETION OF
HYPERTROPHIED SEBACEOUS
GLANDS

MICROTOME SECTIONS BY
FREEZING PROCESS
SACCHARINE STIMULI OF
TRIGEMINUS

CAFFEINE FOR
VASO-MOTOR REACTIONS

James McKeen Cattell, 1860-1944



Cattell established **psychology as a legitimate science**

First to use the term “mental test”

1890 - **Mental tests and measurements**, *Mind*, 15, 373-380 (mostly sensory & motor tests; zero correlation with grades)



Co-editor of *The Psychological Review* (1894-1903), editor and publisher of the *Journal of Science* (1894-1944), **founder of the Psychological Corporation**, in 1921, and founder of the Science Press (1923),

Explored his interior with **hashish**.

Sir Henry Head, 1861 -1940: Doctor as subject



English neurologist, Cambridge Univ.

Conducted pioneering work into the somatosensory system and sensory nerves.

Much of this work was conducted on himself, in collaboration with the psychiatrist W. H. R. Rivers, by severing and reconnecting sensory nerves and mapping how sensation returned over time.

1920 *Studies in Neurology*: argues that speech is not a localized function

Neurophysiology of sensory perception in the cerebral cortex, focusing particularly on patients' spatial perceptions of their own bodies.

Alois Alzheimer, 1864-1915: 1901, Auguste Deter and Dementia



Städtische Anstalt, Frankfurt am Main



Auguste Deter: 51 y.o.. woman; 5 years in his clinic
1st sx of pathological jealousy of husband, "I have lost myself," then rapid decline with amnesia

Alzheimer: histopathology & neurosyphilis specialty;
replaced Wernicke; worked with Kraepelin;

1906: first description of presenile degeneration & its pathology



Student of von Kölliker

Alzheimer (7) & Lewy (10)



Alzheimer and some of his co-workers in the
'Anatomical Laboratory' in Munich, about 1906

1) Lotmar, 2) Mrs Grombach, 3) Rosenthal, 4) Cerletti
5) Allers (?), 6) Bonfiglio, 7) Alzheimer, 8) Achucarro (?), 9) Perusini (?), 10) Lewey

Cerletti is 4

Lewey is 10

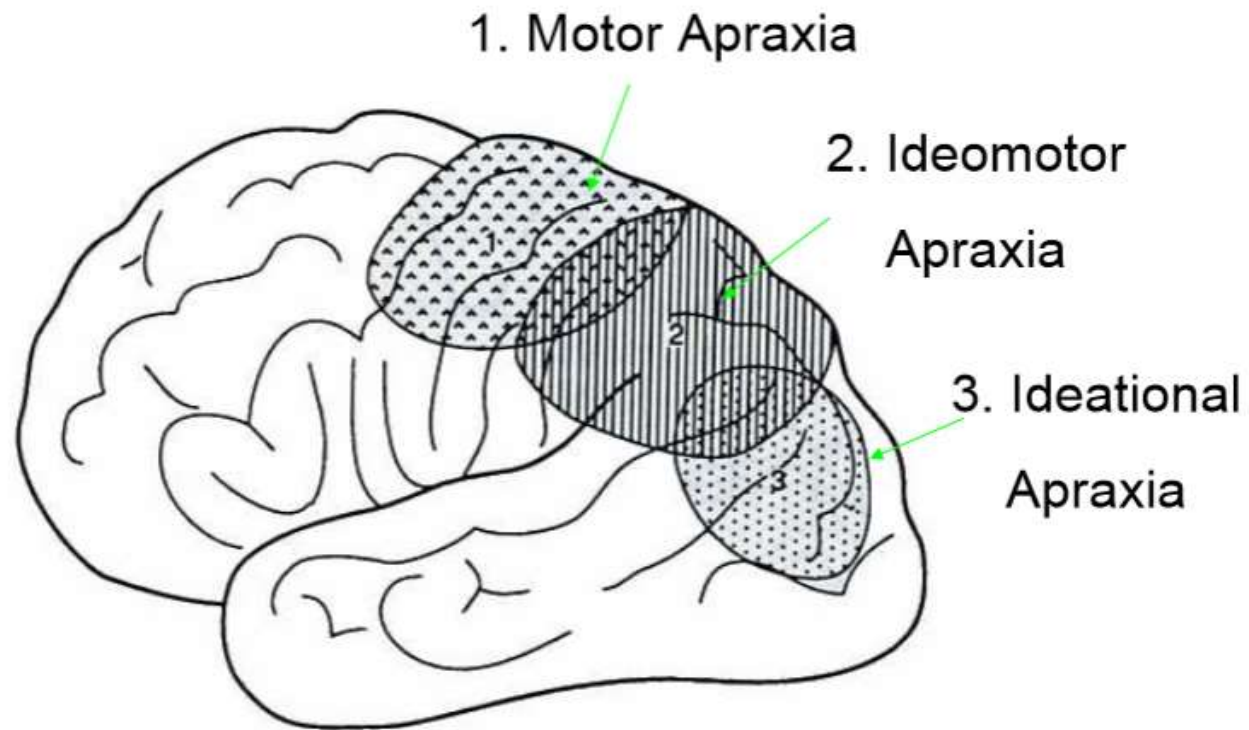
Hugo Karl Liepmann, 1863 -1925



- ▶ German neurologist and psychiatrist
- ▶ Apraxia: no actions to command (Parietal lobe) (due to disconnections between sensory and motor areas)
- ▶ Disconnection theory
- ▶ Left hemisphere played a special part in the production of complex movements, noting that left hemisphere lesions frequently produced bilateral apraxia

Apraxia (Movement to command) & role of Parietal lobe

APRAXIA: LIEPMANN (1920)



Charles Edward Spearman, 1863-1945



Student of Wundt

University College London

English psychologist

Invented factor analysis

Intelligence as the “g-factor”

Henry Goddard, 1866 – 1957: **Immigration fears**

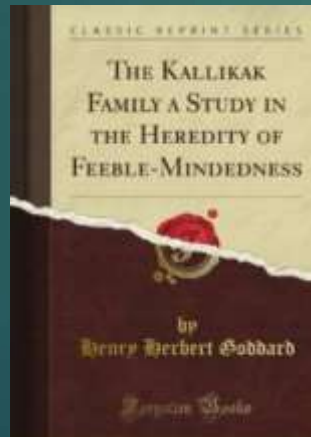
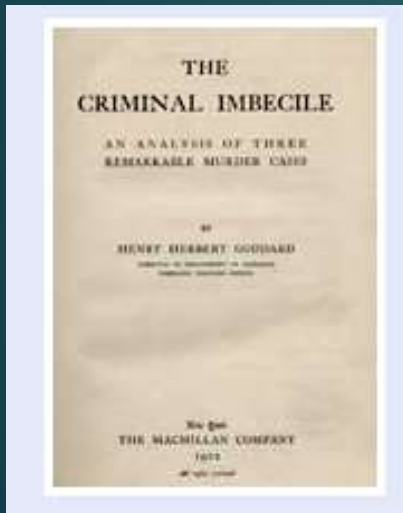


1906-1918: director of Vineland (NJ) Training School for Feeble Minded

1908: First translation of Binet-Simon Scale

Father of American IQ Testing

Henry Goddard believed that a single recessive gene caused low intelligence.



Goddard privately avored forced sterilization of the mentally defective and publicly advocated programs of segregation, echoing public's fear of “mentally defective” immigrants

Infamous study of the Kallikak family: eugenics

Reacting to the public's concerns, the government invited Goddard to help test immigrants at Ellis Island, a program that contributed to an exponential rise in the number of deportations.

Ellis Island Testing

Tickets for
all Points

Mental
Testing



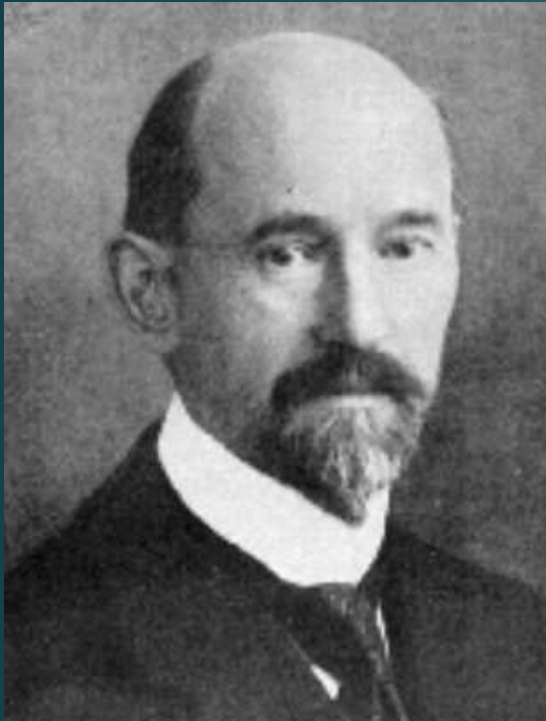
Seguin Form board (now TPT; one of first nonverbal tests for Intellectual Disability)

IQ Testing Consequence: First 3 Strikes Law

- ▶ 1909: California passes a eugenics law and is the second state in the Union following Indiana to pass a sterilization law. The state's law is considered one of the most severe.
- ▶ Those considered feeble-minded, prisoners displaying sexuality, and persons convicted of three crimes were forcefully sterilized.
- ▶ Prisoners would be later excluded but those placed in insane asylums were then added to the law. For Adolf Hitler: California proved that large-scale compulsory sterilization programs were feasible
- ▶ Only banned in 2014

Korbinian Brodmann, 1868-1918:

Histological Topography of the Brain



University of Munich

German neurologist who became famous for his definition of the cerebral cortex into 52 distinct regions based on their cytoarchitectonic (histological) characteristics.

Established the basis for comparative cytoarchitectonics of the mammalian cortex.

Identified 6 cortical layers.

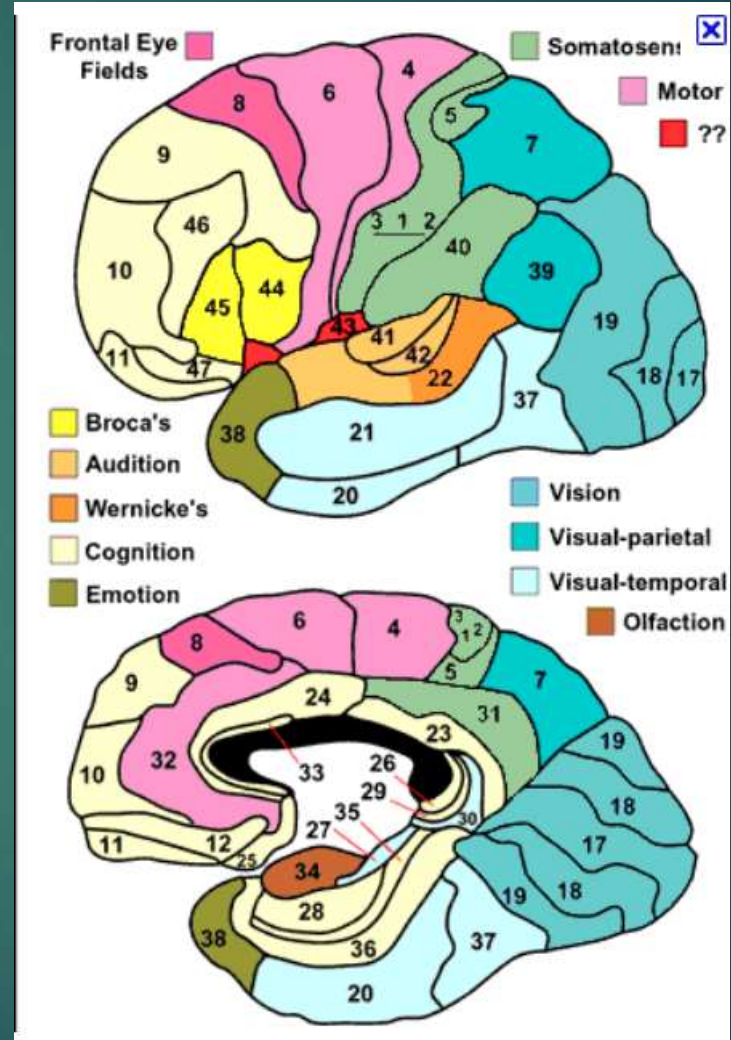
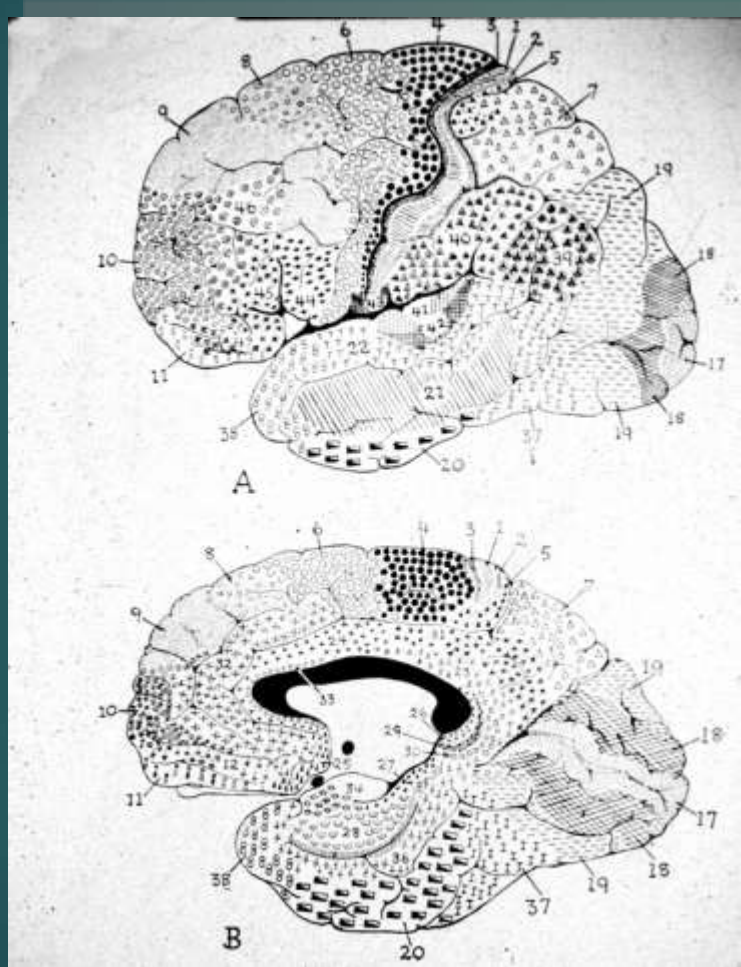
BA#: Numbers were the order in which he studied them

Student of Binswanger, Alzheimer & Vogt

Comparative Localization

Studies in the Brain Cortex, 1909

Brodmann's Cytoarchitectonic Map



Harvey Williams Cushing, 1869-1939



1928: “2 physiologists”
(Cushing & Pavlov)

Student of William Osler

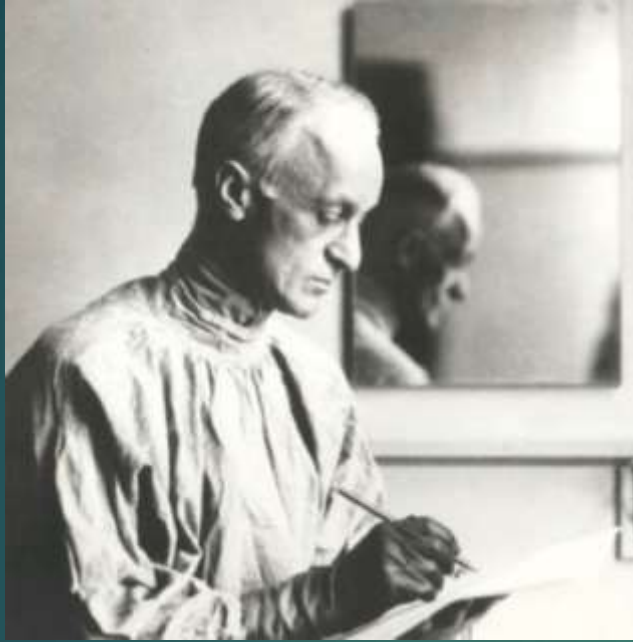
Father of modern neurosurgery

Considered the greatest neurosurgeon in the history of field

Before him brain tumors were considered inoperable; 90% death rate from blood loss

1909 – one of first to electrically stimulate human sensory cortex

Harvey Cushing

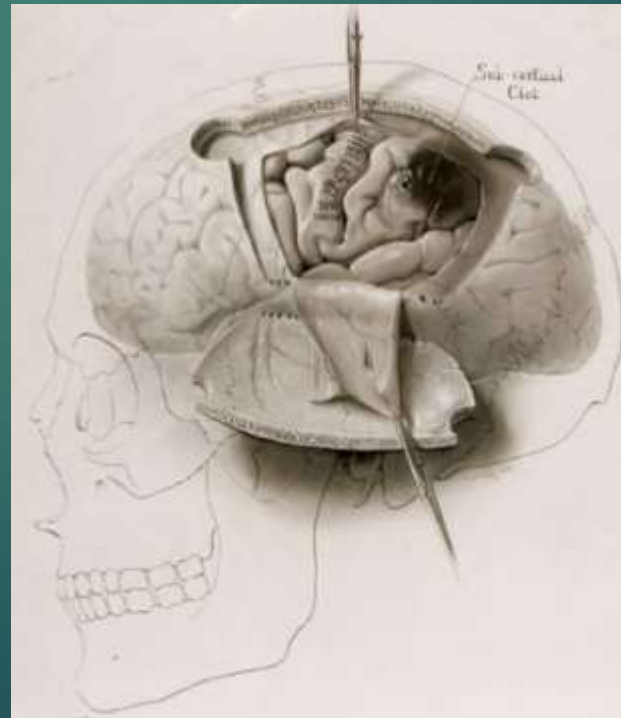


Collected works of Andreas Vesalius; had an MI lifting one of his books

"The Pituitary Body and its Disorders"

"Cushing's Syndrome": (hyper cortisol, hippocampal atrophy)

Cushing wrote a biography of William Osler, for which he was awarded the Pulitzer Prize in 1926.



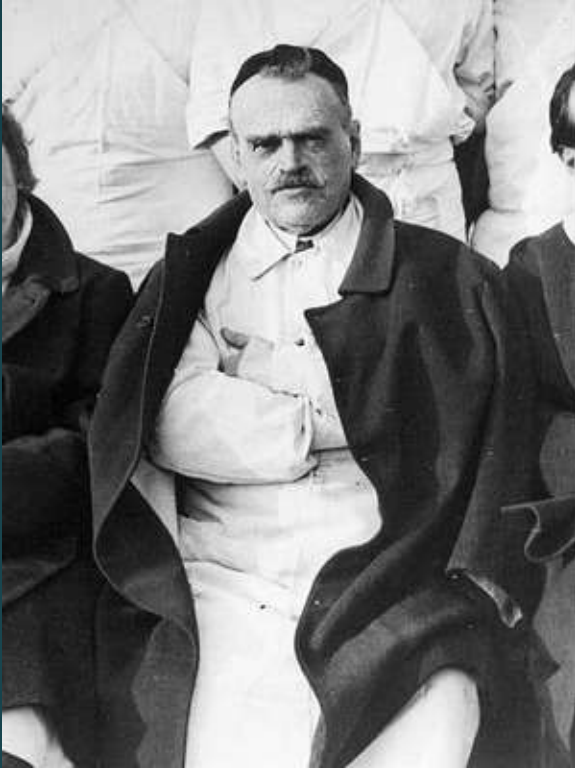
One of his drawings

Solomon Carter Fuller, 1872–1953



- ▶ A neurologist and the United States's first African-American psychiatrist.
- ▶ Dr. Fuller studied under Emil Kraepelin in 1894 and Alois Alzheimer.
- ▶ He published the first comprehensive clinical review of all Alzheimer's cases known at the time
- ▶ The first person to translate much of Alois Alzheimer's work on AD from German to English.

Jean Marie Joseph Capgras, 1873-1950



French Psychiatrist

Capgras Syndrome:

delusional misidentification syndrome (loved one replaced by doppelganger)

Disconnection between the temporal cortex (facial recognition is ok) and the limbic system, involved in emotions (familiarity is lost).

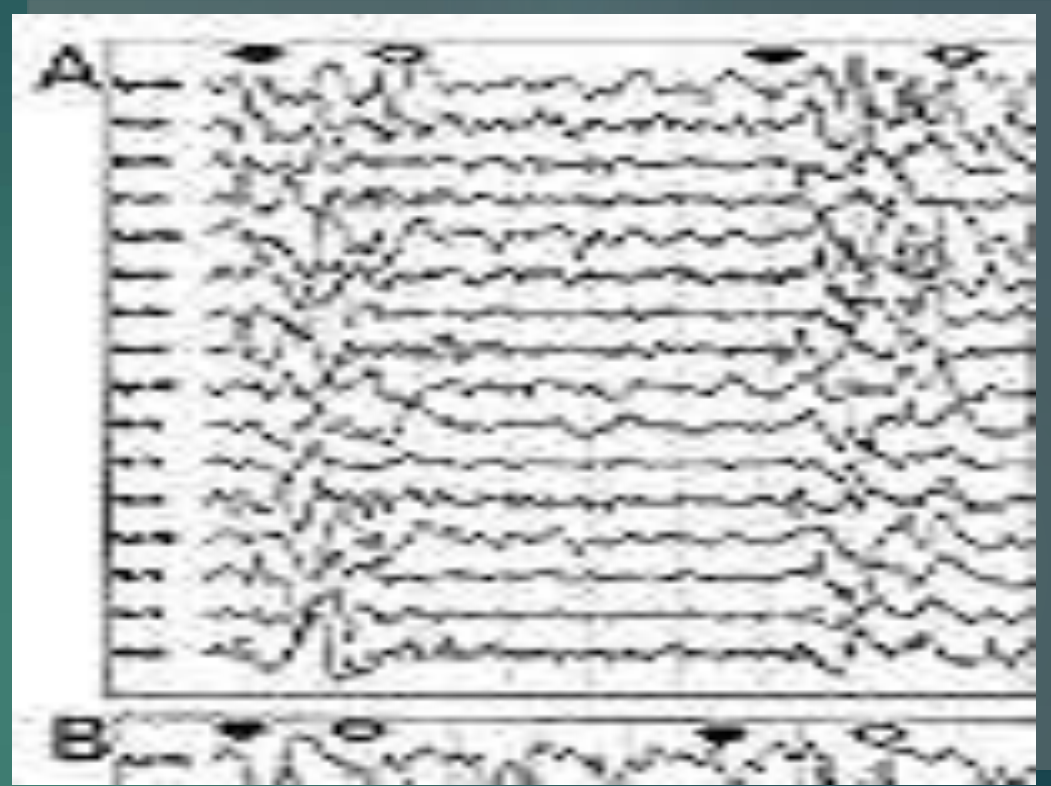
Opposite of prosopagnosia: ok familiarity but lost facial recognition

Hans Berger, 1873 -1941



1875 - Richard Caton is first to record electrical activity from the brain

Student of Binswanger



University Mental Asylum, Jena, Germany

1929: Electroencephalogram (EEG)

1929: brain always active (1st hint of Default Mode Network)

Edward Lee Thorndike, 1874-1949



Student of Cattell & W. James

- ▶ American psychologist, Columbia Univ.
- ▶ Learning theorist
- ▶ Law of effect: positive reinforcement works
- ▶ First use of animals in psychology experiments.
- ▶ 2nd President of the Psychometric Society
- ▶ 1912: President, APA

Shepherd Ivory Franz, 1874-1933: **First neuropsychologist**



Basic research on learning and memory using animals (cats and monkeys).

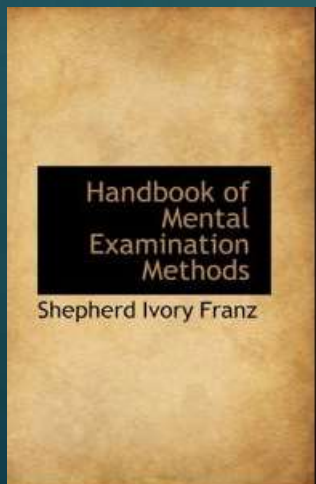
From this research, he is generally recognized as having been the first (1902) to combine experimental brain ablation in animals with systematic behavioral testing

One of first (1907) to implement routine psychological testing of patients in a psychiatric hospital.

1919 textbook detailing tests of tactile sensation, motor coord., praxis, language, attention, memory, VS perception, reasoning & intelligence

Among the first psychologists to address rehabilitation of neurologically damaged patients

Recognized as being the first clinical neuropsychologist.



Pathways leading to Neuroscience

- 1 – 19th century neurology: Investigations of aphasia, alexia, apraxia, amnesia and other disorders by neurologists working in the tradition of the medical case study
- 2 – The mental ability testing movement beginning with the work of Galton and culminating in practical applications in education and the military.
- 3 – The early use of standardized, norm-referenced tests to study clinical populations and a growing recognition of the relevance of psychological methods to medical diagnosis, rehabilitation, and science.
- 4 – Careful experimental studies with animals utilizing ablation techniques to delineate the complexity of brain-behavior relationships.

What is Neuropsychology?

What delineates Neuropsychology from classical 19th century Neurology:

1. Use of experimental psychology methods in both single case and group studies of brain-damaged patients.
2. Use of standardized, repeatable procedures, & norm-referenced tests.
3. Quantification of behavior through the use of scores and summary indexes.
4. Use of various statistical methods, including factor analysis, in test development and in the analysis and reporting of data

Antônio Caetano de Abreu Freire Egas Moniz, 1874-1955



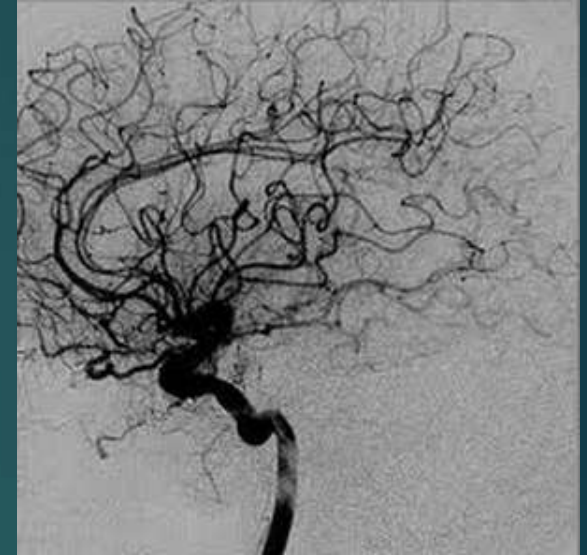
Portuguese neurologist

Invented Cerebral angiography

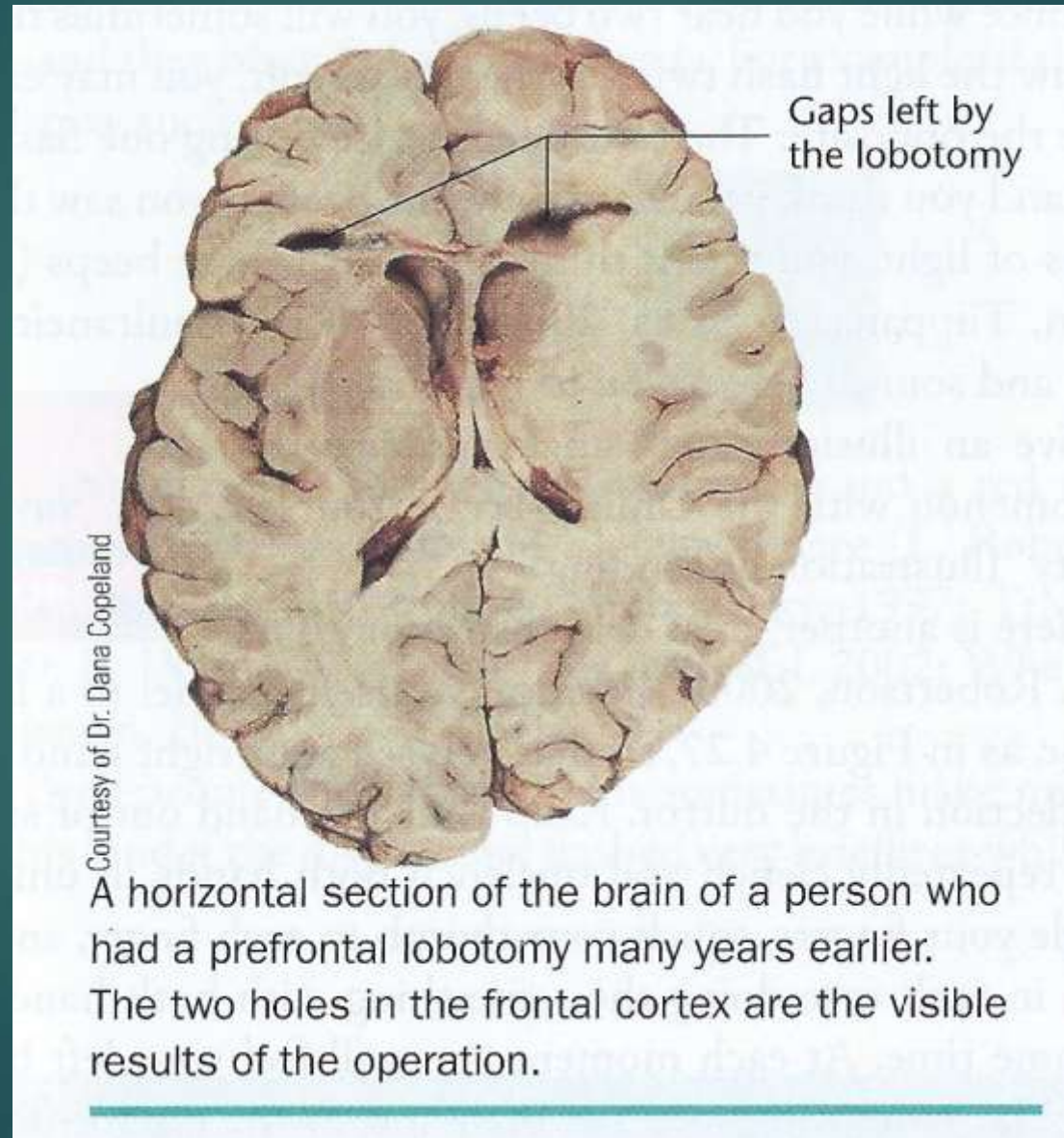
1918: Delegate to the 1918
Paris Peace Conference

1938: first human frontal leucotomy;
27 patients for tx of depression
(reduced depression, but with
significant personality changes)

1949: Only Nobel Prize for Psychiatry



Prefrontal Lobotomy: Only Nobel Prize in Psychiatry



Henry Dale 1875 – 1968: Birth of study of neurotransmitters



- ▶ British physician and pharmacologist
- ▶ Study of ergots and histamines
- ▶ Identified acetylcholine
- ▶ Differentiation of neurons according to what neurotransmitter they release.
- ▶ 1936 The Nobel Prize in Physiology or Medicine: Sir Henry Dale, Otto Loewi for study of acetylcholine as agent in the chemical transmission between neurons (neurotransmission)

Cecile Mugnier Vogt (1875-1962)



First paper at aged 14, on *Drosophila*

Cytoarchitectonics: 200 cortical areas

Neuroanatomy of the Thalamus

Studied Telomeres in her 80s



Oskar & Cecile Vogt

Kaiser Wilhelm Institut für Hirnforschung
was created for them.

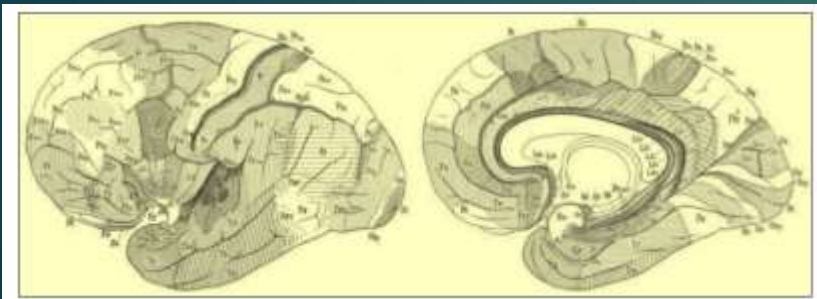
Student of Pierre Marie

Constantin Freiherr von Economo, 1876 -1931



In 1925, his monumental work with Koskinas ("Cytoarchitectonics of the Adult Human Cerebral Cortex") was published. 107 areas

The name "von Economo neurons" or spindle neurons has been given to large bipolar nerve cells identified by von Economo in layer V of the anterior cingulate and fronto-insular cortex



Encephalitis lethargica, 1918 flu: produced Parkinsonism in adults, ADHD in children

Lewis Madison Terman, 1877- 1956



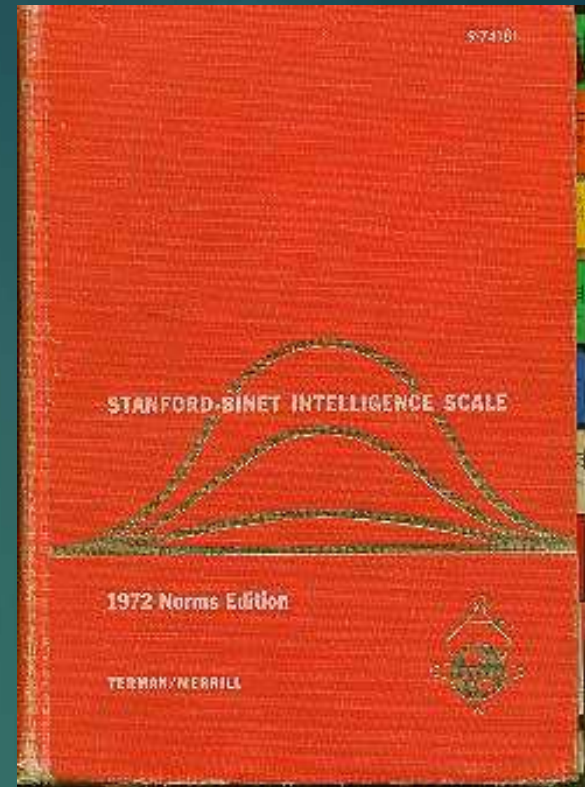
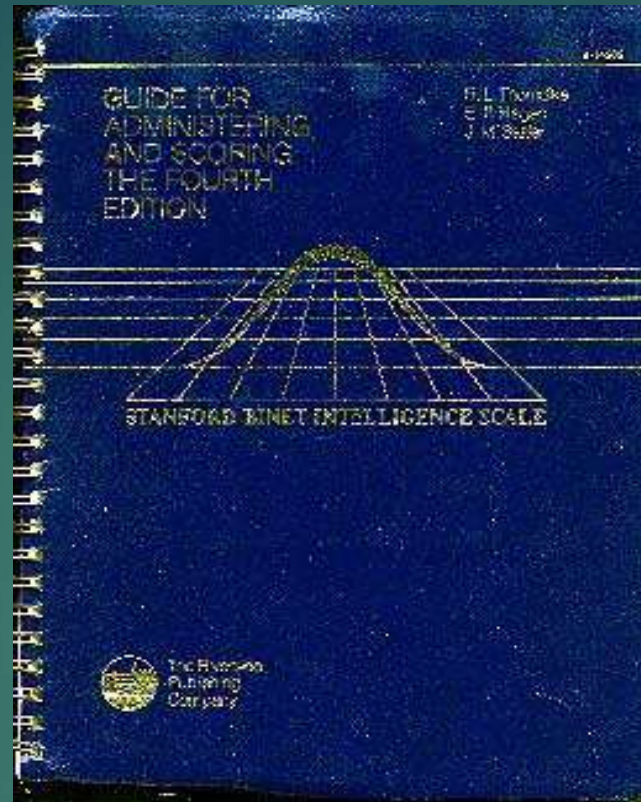
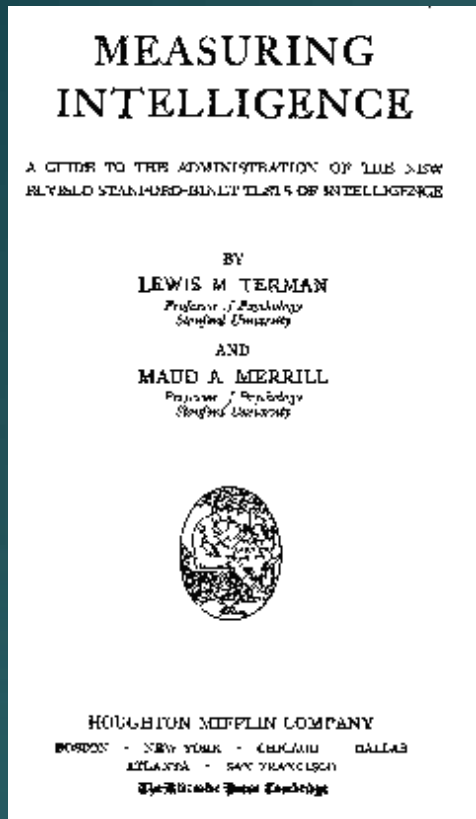
Terman Study of the Gifted: 1921-
Longest longitudinal study in hx

N = 1,528, "Termites"

Genetic Studies of Genius (1925, 1947, 1959)

Student of S. Hall

- ▶ Stanford psychologist Lewis Terman immediately began adapting and supplementing Binet's test with a view to producing an improved version in English.
- ▶ He published his revisions and explanations in 1916 as the Stanford-Binet.
 - ▶ More psychometrically sound
 - ▶ Introduction of the term IQ
 - ▶ Mental Age / Chronological Age = IQ
- ▶ The first mass administration of IQ testing was done with 1.7 million soldiers during World War I.
- ▶ Social Darwinist, Eugenics



The original French Binet-Simon test was revised in 1916 for use in American and renamed the Stanford-Binet. Here we see the Second (1937) Third (1960) and Fourth Editions of the test, which were the leading individual intelligence tests in America for most of the twentieth century.

Kurt Goldstein, 1878-1965



Intensive Case exam method

Inability to think abstractly was basis of most cortical disorders

1948 – Language and Language Disorders

Launched aphasia studies in US

Abstract Attitude (now executive functioning):

Initiation, Shifting set, Accounting for one's own action, Context sensitivity, Grasp whole from the parts, Abstraction and planning, Detaching self from external event



Student of Von Monokow, Wernicke

Samuel T. Orton, 1879-1948



First Description of Learning Disability (after Dejerne):

1925 **Strephosymbolia**:
meaning "twisted symbols" (word blindness, alexia)

Wrong Theory: children "turn off" the right side of the visual areas when learn to read

Dyslexia (now considered a Phonological Dysfunction)

Hermann Rorschach, 1884-1922



Swiss Freudian psychiatrist
and psychoanalyst

Student of Eugen Bleuler

1921: Psychodiagnostik (Inkblot
Test)



Multiple Choice Group Rorschach Test

Hans Gerhard Creutzfeldt, 1885 – 1964



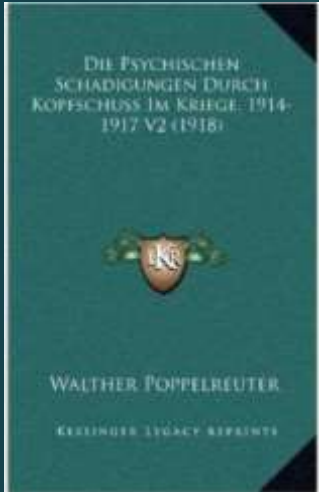
German neuropathologist

First described

- Creutzfeldt-Jakob disease.

Student of Alzheimer

Walther Poppelreuter 1886-1939



▶ German neurologist and psychiatrist. A Nazi.

▶ Neuropsychological damage caused by TBIs during the war 1914/17

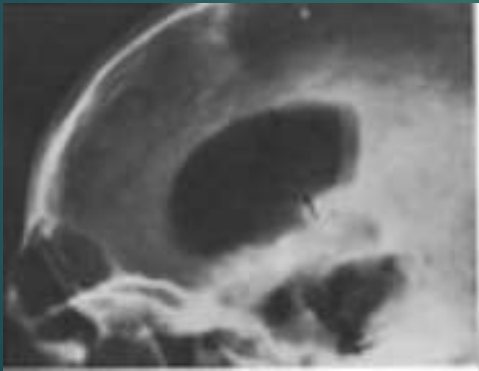
▶ Optic ataxia: difficulties in building, drawing and assembling

▶ Large effects of WWI and WW2 on lesion studies in neuropsychology - all wars were good for science



Overlapping pictures

Walter Dandy, 1886 –1946: **Vascular neurosurgery**



Student & competitor of Cushing

- ▶ American neurosurgeon, Johns Hopkins
- ▶ Achievements:
 - ▶ circulation of cerebrospinal fluid in the brain
 - ▶ surgical treatment of hydrocephalus
 - ▶ Invention of air ventriculography and pneumoencephalography
 - ▶ First clipping of an intracranial aneurysm, which marked the birth of cerebrovascular neurosurgery

James Papez 1883-1958



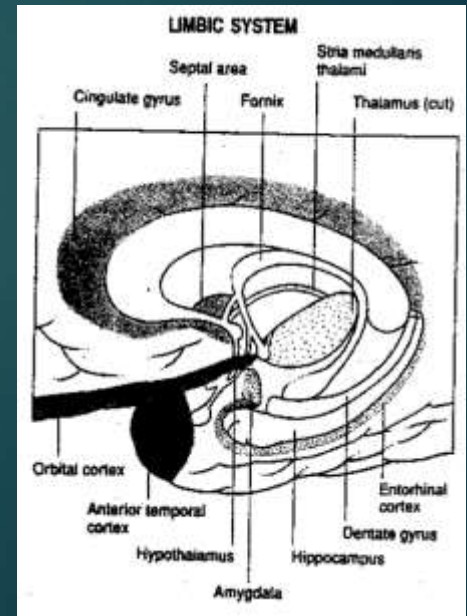
American Neuroanatomist

1936: Limbic Circuit

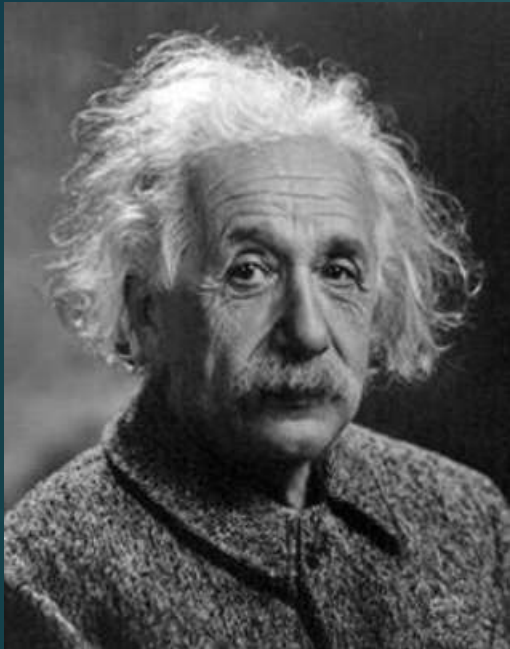
Visceral theory of emotions -
physiological arousal instigates the
experience of emotion



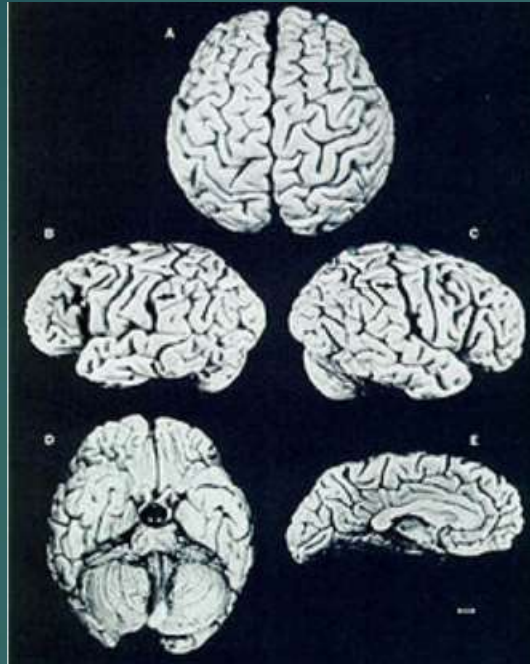
Fig. 12.3. James Papez and his artist wife, Pearl.



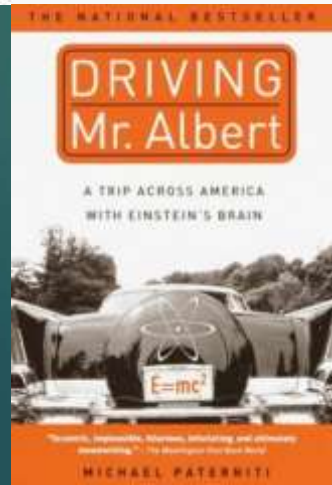
Einstein's Brain



Violin playing;
Ambidextrous



A photograph from 1955 of Einstein's brain.



His physician Thomas Stoltz Harvey kept his brain for 44 years without family permission

No parietal operculum region in the inferior frontal gyrus in the frontal lobe

No lateral sulcus (Sylvian fissure)

Continuous precentral superior and inferior sulci

Inferior parietal lobe was 15% wider than normal

Significantly more glial cells in left inferior parietal

Greater amount of white matter

Ravel's Brain 1932



- ▶ In 1932, composer **Maurice Ravel** (**Bolero fame**) had MVA with brain damage; and also developed primary progressive aphasia, a form of FTD
- ▶ Afflicted by aphasia, amusia and apraxia, (unable to compose, or play piano)

Dr. Ann Adams: Unraveling Bolero

A "The colored, treble parts are embellished with geometric shapes in black and also engraved into the paper to represent the quality of tone of each note. When the modulation finally does occur I use gaudy fluorescent colors to make the few #'s in the piece. The music soon collapses and dies in the final two bars.

I find Bolero an exciting experiment in sound, one which Ravel didn't really consider true 'music'."

B



Musical notation for Bolero, measures 321-340. The notation is arranged in three rows of seven measures each. The notes are color-coded and some are embellished with geometric shapes. The key signature changes from one flat to one sharp between measures 327 and 328.

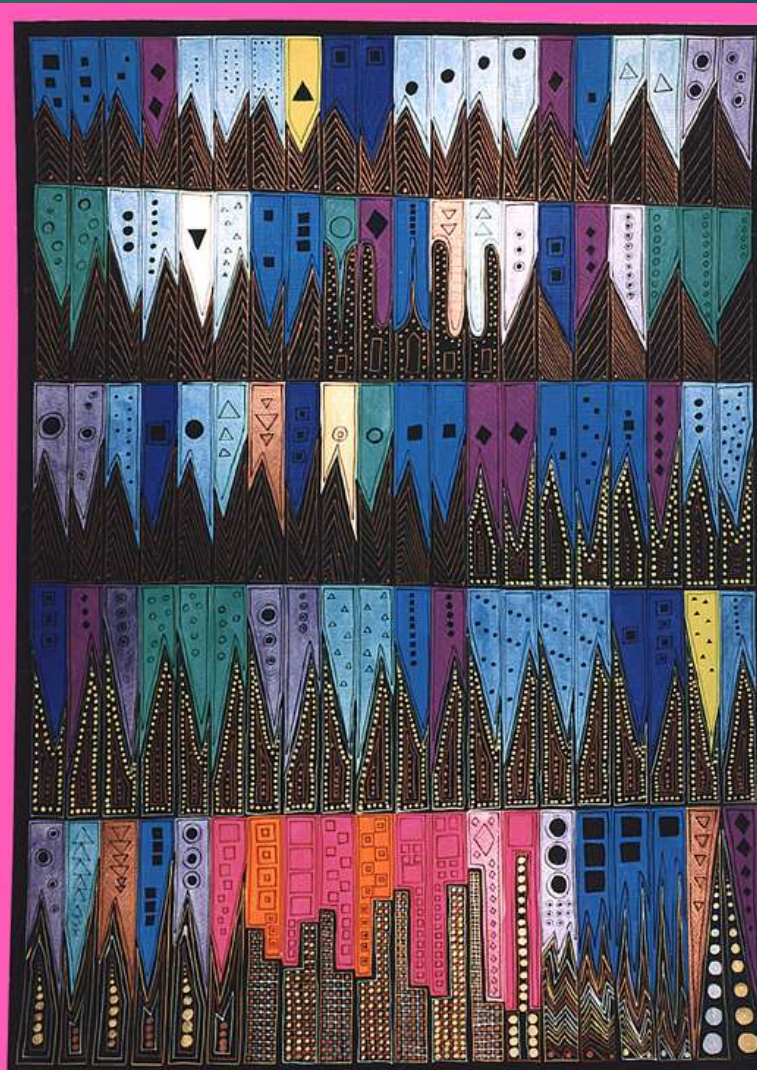
C



Decorative musical notation for Bolero, measures 321-340. The notation is highly stylized, with notes and stems rendered in various colors and geometric patterns. The key signature change is highlighted with a fluorescent color.

Dr. Anne Adams was
obsessed with
Ravel's Bolero;
Both had Primary
Progressive Aphasia

FTD and Art



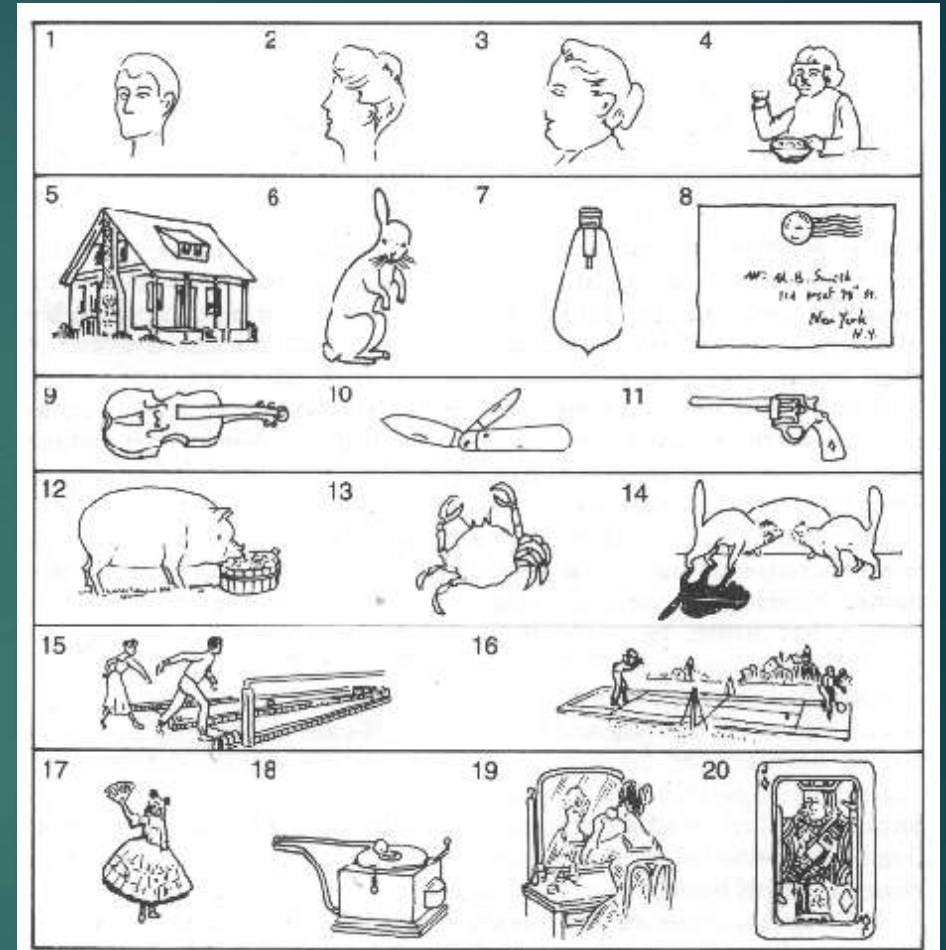
Robert Mearns Yerkes (1876-1956)



1917, WWI Army Alpha and Beta tests, with Goddard & Terman

Eugenics

Founded and directed the Yale Laboratories of Primate Biology (Yerkes National Primate Research Center)



What's Missing?

Group IQ Testing 1917



Administration of the Army Alpha and Beta tests, the first “group tests,” (to be followed in due course by the SAT, LSAT, GRE, etc.); 1.7 million recruits

Friederich H. Lewy (1885—1950)

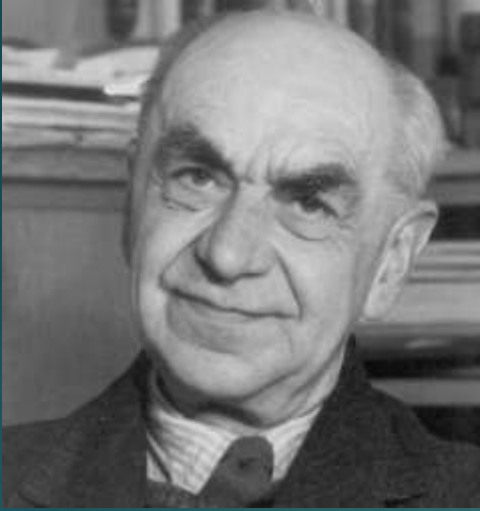


↑
Henry Lewy

Student of Alzheimer

- ▶ In 1912, in Alzheimer's lab, Lewy discovered abnormal protein deposits in the substantia nigra of Parkinsonism pts.
- ▶ Now known as Lewy Bodies
- ▶ Lewy Body Dementia

Sir Frederic Charles Bartlett, 1886- 1969



- ▶ British psychologist
- ▶ First professor of experimental psychology at the University of Cambridge
- ▶ 1932: *Remembering*
- ▶ *War of the Ghosts* memory story

War of the Ghosts: 1st Paragraph memory test

- ▶ One night two young men from Egulac went down to the river to hunt seals and while they were there it became foggy and calm. Then they heard war-cries, and they thought: "Maybe this is a war-party". They escaped to the shore, and hid behind a log. Now canoes came up, and they heard the noise of paddles, and saw one canoe coming up to them. There were five men in the canoe, and they said: "What do you think? We wish to take you along. We are going up the river to make war on the people."
- ▶ One of the young men said, "I have no arrows." "Arrows are in the canoe," they said.
- ▶ "I will not go along. I might be killed. My relatives do not know where I have gone. But you," he said, turning to the other, "may go with them." So one of the young men went, but the other returned home.
- ▶ And the warriors went on up the river to a town on the other side of Kalama. The people came down to the water and they began to fight, and many were killed. But presently the young man heard one of the warriors say, "Quick, let us go home: that Indian has been hit." Now he thought: "Oh, they are ghosts." He did not feel sick, but they said he had been shot.
- ▶ So the canoes went back to Egulac and the young man went ashore to his house and made a fire. And he told everybody and said: "Behold I accompanied the ghosts, and we went to fight. Many of our fellows were killed, and many of those who attacked us were killed. They said I was hit, and I did not feel sick."
- ▶ He told it all, and then he became quiet. When the sun rose he fell down. Something black came out of his mouth. His face became contorted. The people jumped up and cried. He was dead.

Josef Gerstmann, 1887-1969



- ▶ Gerstmann's Syndrome?
 - ▶ **Finger agnosia** (lacking or impaired ability to describe the fingers)
 - ▶ **Agraphia** (lacking or impaired ability to write)
 - ▶ **Right-left disorientation**
 - ▶ **Dysgraphia**
 - ▶ **Dyscalculia/acalculia** (lack of ability to calculate)
- ▶ Disease of dominant Parietal lobe (**angular gyrus**)

Louis Leon Thurstone, 1887 – 1955



- ▶ University of Chicago
- ▶ Pioneer in the fields of psychometrics and psychophysics
- ▶ Responsible for the standardized mean and standard deviation of IQ scores used today
- ▶ 1938: Primary mental abilities
- ▶ 1947: Development of Factor analysis
- ▶ *Thurstone Test of Mental Alertness*
- ▶ His ACE tests were forerunners of SAT

Charlie Doing Statistics: 1970- 2015



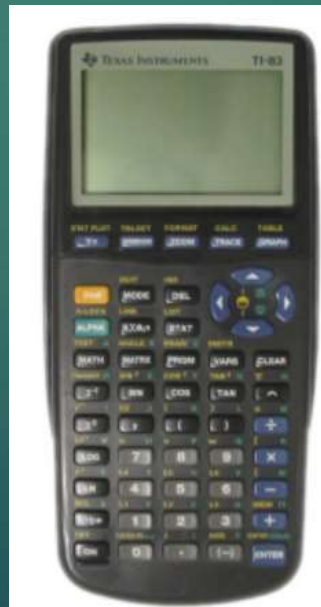
UCB Stat machine, 1970



IBM Punch Card machine & mainframe computer, 1976



IBM PC desktop 1982



Current Stat programs:

R
SPSS
SAS
STATISTICA
Systat



Karl Spenser Lashley, (1890-1958): Equipotentiality



Student of Franz

- Neural basis of memory (engram)
 - Higher-order functions such as learning and memory were not localized;
 - Used training/ablation method that Franz had taught him. He would train a rat to learn a maze and then do ablation
 - Demonstrated via lesion studies that learned behaviors are resistant to brain ablations

-

Lashley

- Behavioral consequences from ablations due to amount (**mass action**), not location, of tissue removed
- Small areas of the brain can take on the function of larger, related areas that have been destroyed.
- He called this phenomenon equipotentiality.
- Challenged the ongoing concept of cortical localization.

Lashley

- Had a profound dampening effect on localization research
- ▶ 1950 *In Search of the Engram*
- 1929 - *Brain Mechanisms and Intelligence* (Study of intelligence and the role of the frontal lobes.)
- Principle of mass action, states that in many types of learning, the cerebral cortex acts as a whole
- He was also racist: “Too bad that the beautiful tropical countries are all populated by negros. Heil Hitler and Apartheid!”

Neural Cartographers: Wilder Penfield, 1891 – 1976 & Theodore Rasmussen 1910-2002

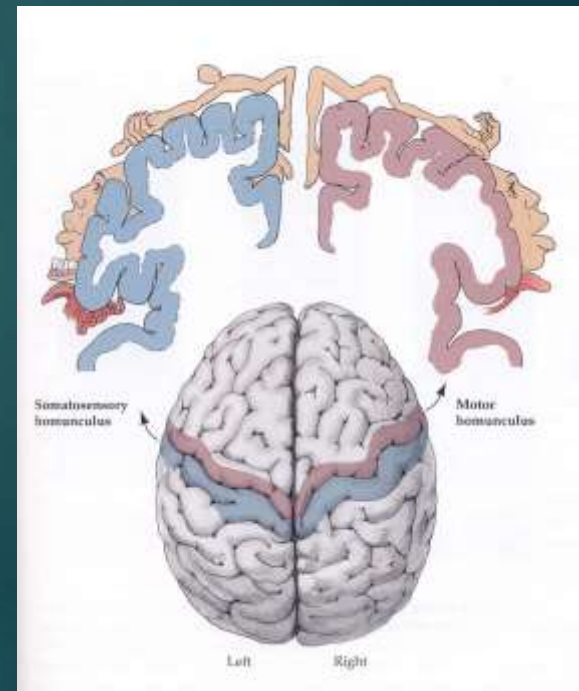


Canadian neurosurgeons; Penfield was one of the greatest neurosurgeons of the 20th century, a student of Cushing, Sherrington, & Cajal; identified oligodendrocytes.

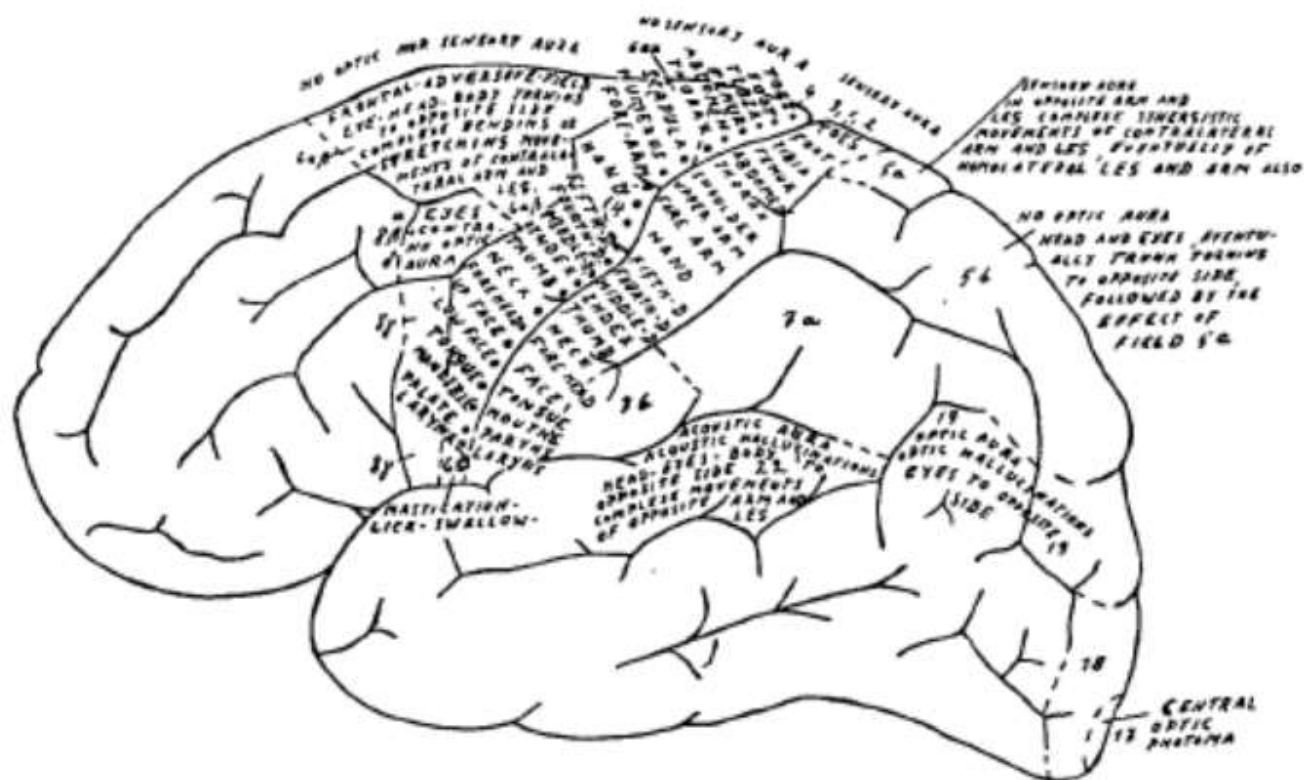
1950: *The Cerebral Cortex of Man*

1957: Description of motor and sensory homunculus

1954: *Epilepsy and the Functional Anatomy of the Human Brain*

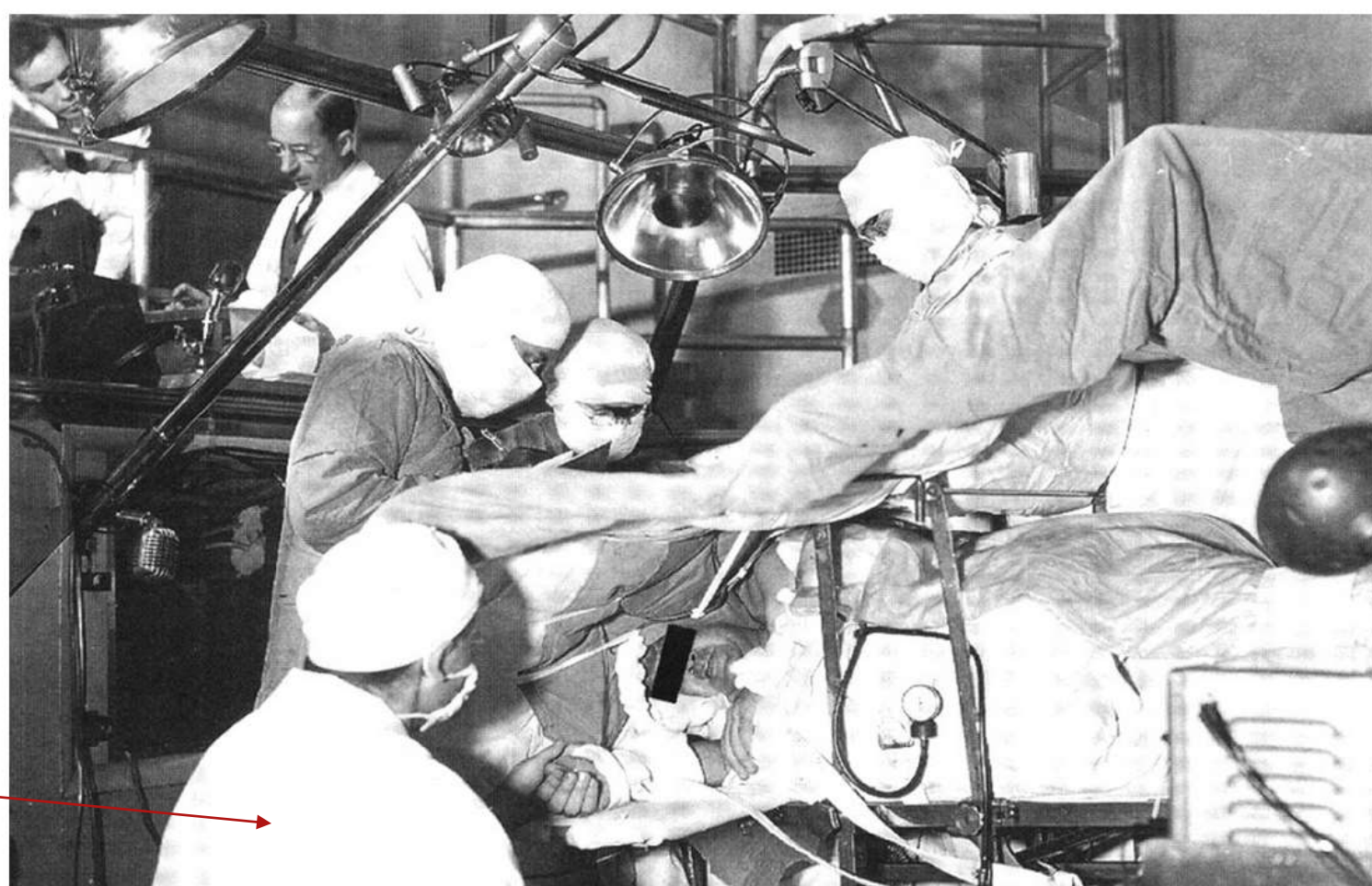


1930: First Functional Map of Human Cortex



First functional map of the human cerebral cortex, outlining the areas of the brain which produce movements and auras. (Foerster & Penfield, 1930)

Penfield & Brenda Milner



Brenda
Milner

The operating theatre at the Montreal Neurological Institute, circa 1958. Wilder Penfield is assisted by Herbert Jasper (upper left, monitoring EEG) and Brenda Milner (lower left).

Larson's version of motor stimulation



"Whoa! That was a good one! Try it, Hobbs — just poke his brain right where my finger is."

Otto Binswanger, 1894 -1929



University Mental Asylum, Jena, Germany

Binswanger's Disease:

Encephalitis Subcorticalis Chronica
Progessiva

A form of multi-infarct dementia caused by damage to small blood vessels & white matter



Students: Hans Berger,
Oskar Vogt, K. Brodmann

A major figure in the existential psychology movement

Leo Kanner, 1894 – 1981: Autism



Leo “Connor”; Austrian Psychiatrist

1943 First to describe Autism; as psychopathology

First child psychiatrist,

Founder of the first academic child psychiatry department at Johns Hopkins University Hospital and his *Child Psychiatry* in 1935 was the first English language textbook to focus on the psychiatric problems of children.

Seminal 1943 paper: "Autistic Disturbances of Affective Contact"

Autism: refrigerator mother theory, rare disorder

Hans Asperger 1906-1980: **Never knew Kanner**



Viennese Pediatrician

1943 Case studies of higher functioning autistic children, “little Professors”

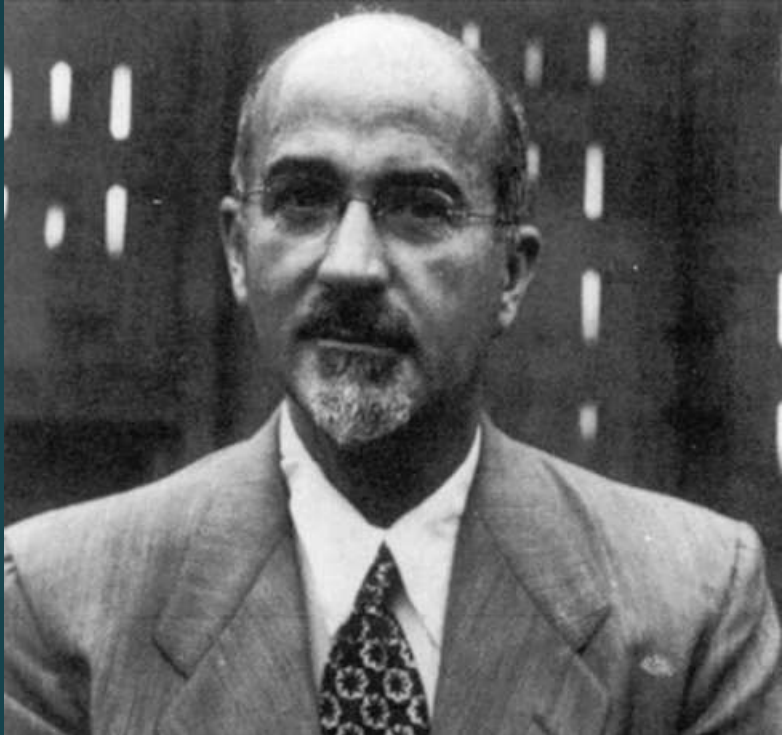
Spectrum disorder in which there is no language delay, but significant social impairment.

1981 Lorna Wing, English autism specialist, names “Asperger Syndrome”

2015: **NeuroTribes: The Legacy of Autism and the Future of Neurodiversity, by Steve Silberman**



Walter Freeman 1895 – 1972

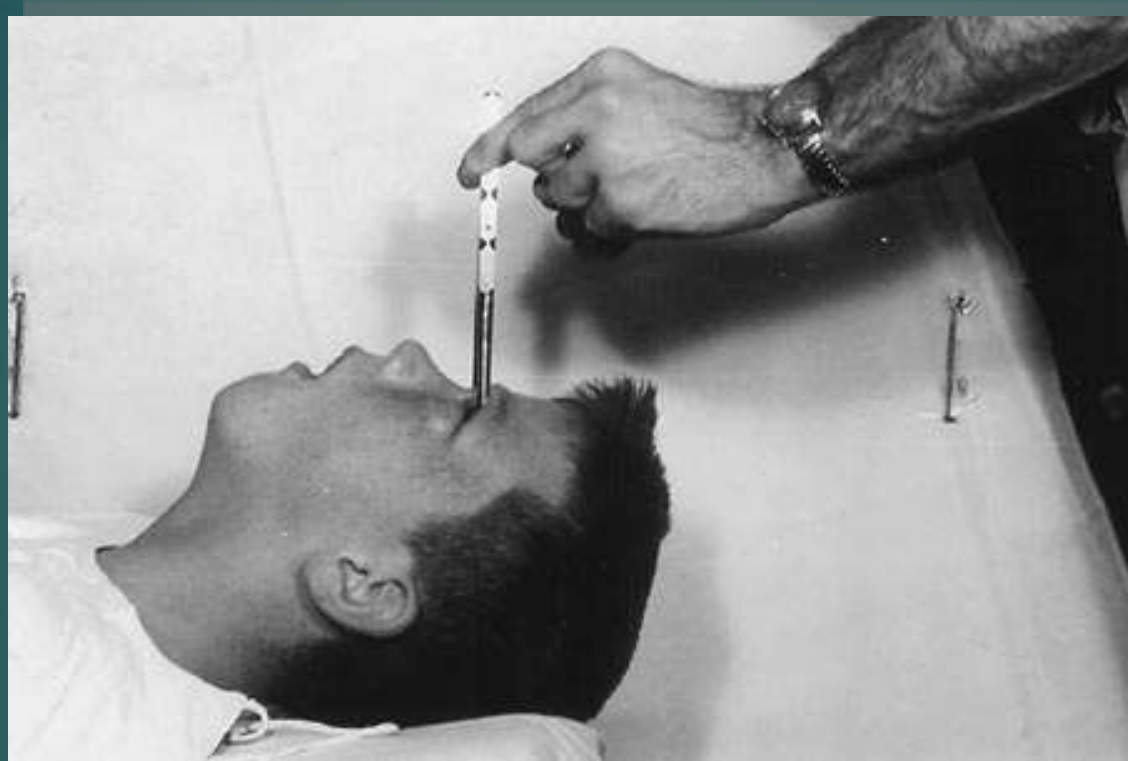


1936: With James W., Watts,
First US Lobotomy

+ 3500 total; Volkswagen van
(nicknamed the Lobotomobile)



Lobectomy: Freeman's Ice pick



Some 2,000 WWII veterans were lobotomized by the government before the first antipsychotic drug, Thorazine, came on the market in the mid-1950s.

Paul Meehl 1920-2003: **Actuarial Judgment always better than clinical judgment**



1954: statistical prediction consistently outperforms clinical judgment

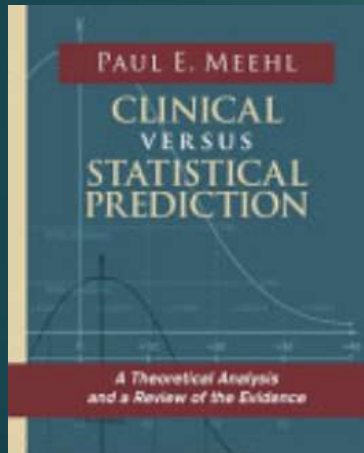
Would not attend case conferences

“...the shadow of the statistician hovers in the background; *always* the actuary will have the final word.”

In 16 of 20 studies, **predictions made by actuarial means were equal to or better than clinical methods**

1986: in 136 studies, data shows that the actuarial method is almost invariably equal to or superior to the clinical method

First to predict that non-psychotic features of schizophrenia were better predictors of outcome

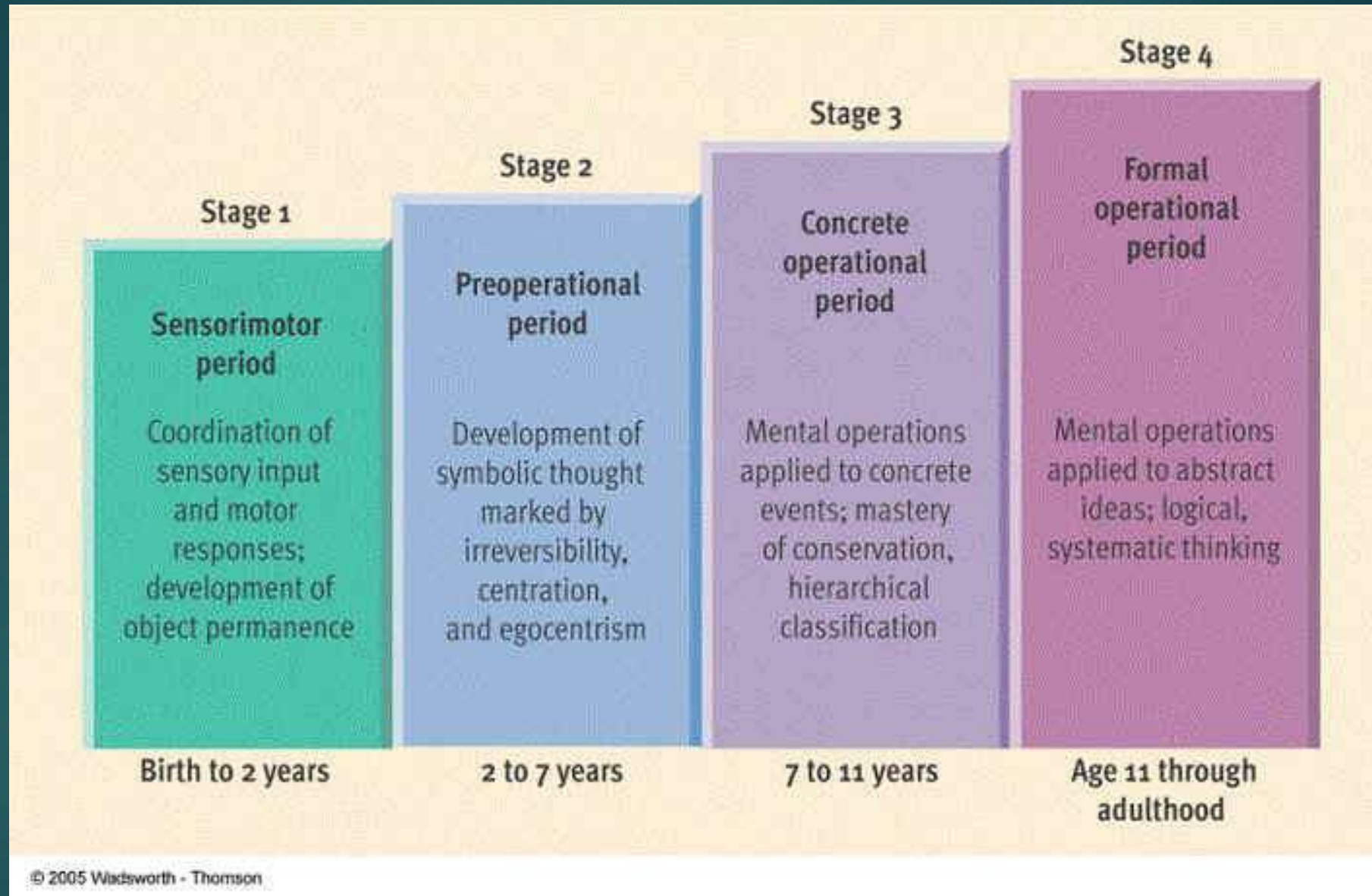


Jean Piaget 1896-1980



- ▶ Student of Binet
- ▶ 1950 “Introduction to Genetic Epistemology”
- ▶ 4 stages of cognitive development





Correlation with brain growth periods

David Wechsler, 1896-1981:

Wechsler Adult Intelligence Scale (WAIS) - 1934



- Subscales “adopted” from the Army Scales
- Produces several scores of intellectual ability rather than Binet’s single scores (VIQ, PIQ, FIQ)
- Evolves into the Wechsler Series of intelligence tests (WAIS, WISC, etc.)

Alfred Strauss, 1897-1957: MBD (ADHD)



- ▶ Second Learning Disability:
- ▶ 1939: Minimal Brain Damage
 - ▶ Aggressiveness
 - ▶ Impulsivity
 - ▶ Distractibility
 - ▶ Hyperactivity

*Psychopathology and Education of the Brain-Injured Children -
Alfred A. Strauss and Laura E. Lehtinen.*

1898 - Bayer Drug Company

BAYER
PHARMACEUTICAL PRODUCTS.

We are now sending to Physicians throughout the United States literature and samples of

ASPIRIN

The substitute for the Salicylates, agreeable of taste, free from unpleasant after-effects.

HEROIN

The Sedative for Coughs,
HEROIN HYDROCHLORIDE
Its water-soluble salt.
You will have call for them. Order a supply from your jobber.

Write for literature to
FARBENFABRIKEN OF ELBERFELD CO.
40 Stone Street, New York,
SOLE AGENTS

- ▶ 1898: **Bayer** registered and marketed diacetylmorphine under the brand name Heroin as a non-addictive cough suppressant medicine
- ▶ 1899: Aspirin by prescription (until 1915)

Heinrich Klüver (1897 -1979) and Paul Bucy (1904-1992)

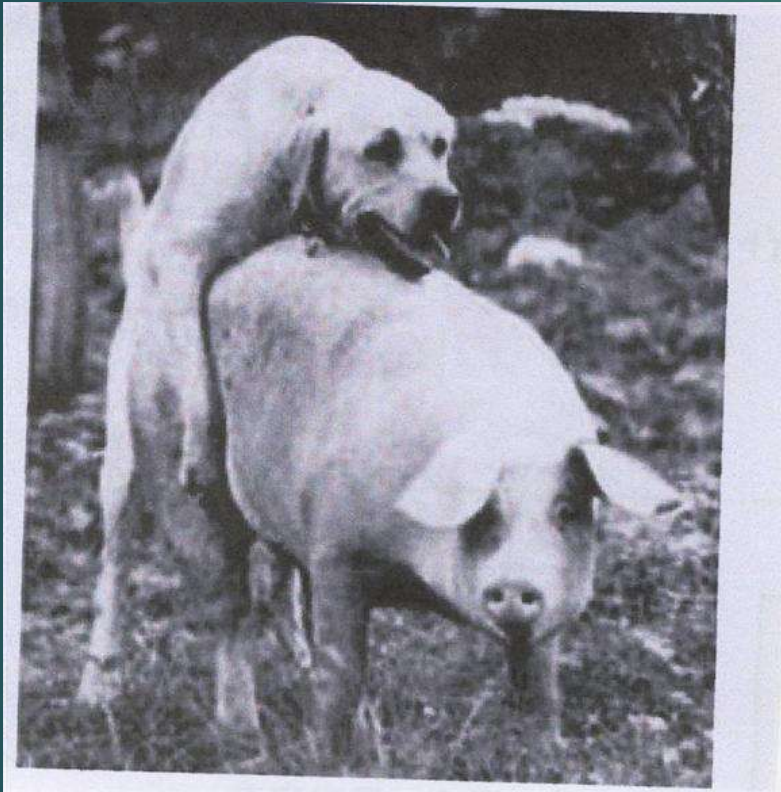


1937: Bilateral Temporal Lobectomy

1939: Klüver-Bucy Syndrome

Klüver was Lashley's student

Kluver-Bucy Syndrome



Indiscriminate sex



Married the Eiffel Tower

Margaret Kennard (1899–1975)



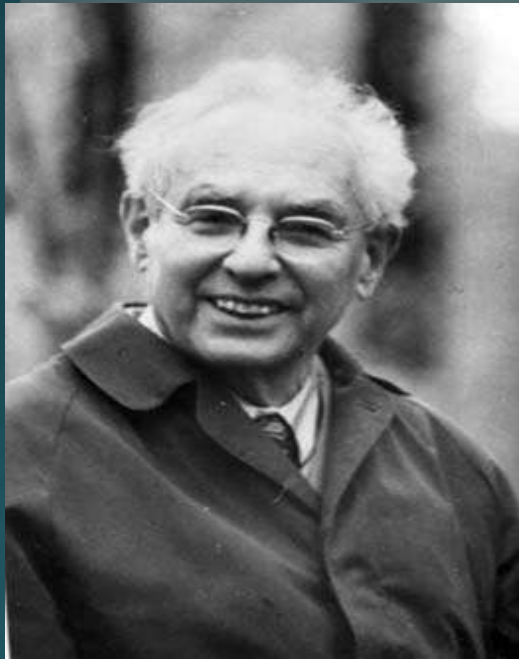
- ▶ Founder of Developmental Neuropsychology
- ▶ Brilliant work in recovery of brain function, but remembered for her eponym.
- ▶ 'Kennard Principle': age-based differences in maturational brain plasticity has been termed the 'Kennard Principle': there is a negative linear relation between age at brain injury and functional outcome. Other things being equal, the younger the lesioned organism, the better the outcome.

Kennard principle is wrong

- ▶ Teuber: evidence shows that it is *not* consistently better to schedule your brain damage earlier rather than later in life.
- ▶ Although the 'Kennard Principle' suffers from over simplicity and obsolescence, it remains alive and well in everyday practice.
- ▶ Belief systems dictate practice, and the idea that a young age immunizes children from neurocognitive deficits may well be hazardous to their proper assessment.

Alexander Romanovich Luria, 1902-1977

Dept. of NP at Moscow University



Founded Russian Neuropsychology

Study of WWII soldiers with TBI

Theory of Functional Systems

His qualitative clinical method compiled by Anne-Lise Christensen

Higher Cortical Functions in Man: one of the seminal books on localization

*The Mind of a Mnemonist:
A Little Book About a Vast Memory, 1968*

TABLE 21-5. Example of tables memorized by S.

6	6	8	0
5	4	3	2
1	6	8	4
7	9	3	5
4	2	3	7
3	8	9	1
1	0	0	2
3	4	5	1
2	7	6	8
1	9	2	6
2	9	6	7
5	5	2	0
x	0	1	x

Note: With only 2 to 3 min study of such a table, S. was able to reproduce it in reverse order, horizontally, or vertically, or to reproduce the diagonals.

Bruno Bettelheim 1903 – 1990: Autism as psychoanalytic disorder

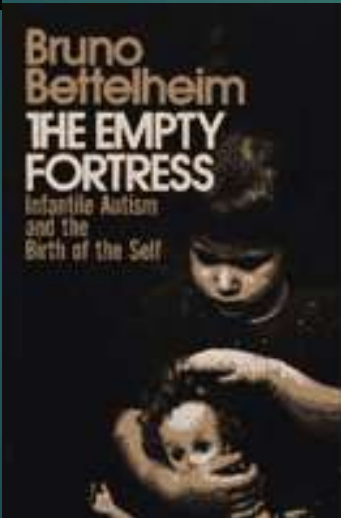


Child Psychologist

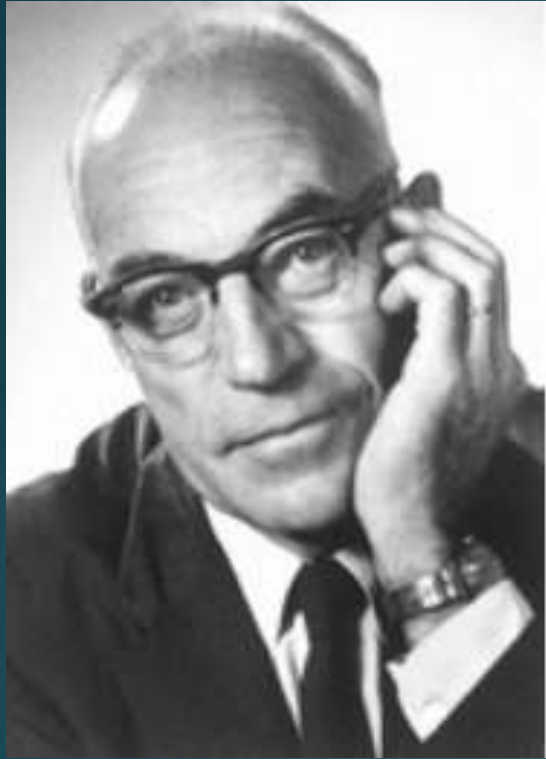
“Brutal” Bettelheim:
"refrigerator mother" theory of autism

Autism is caused not just by bad parenting but by parents “who wish their child did not exist.”

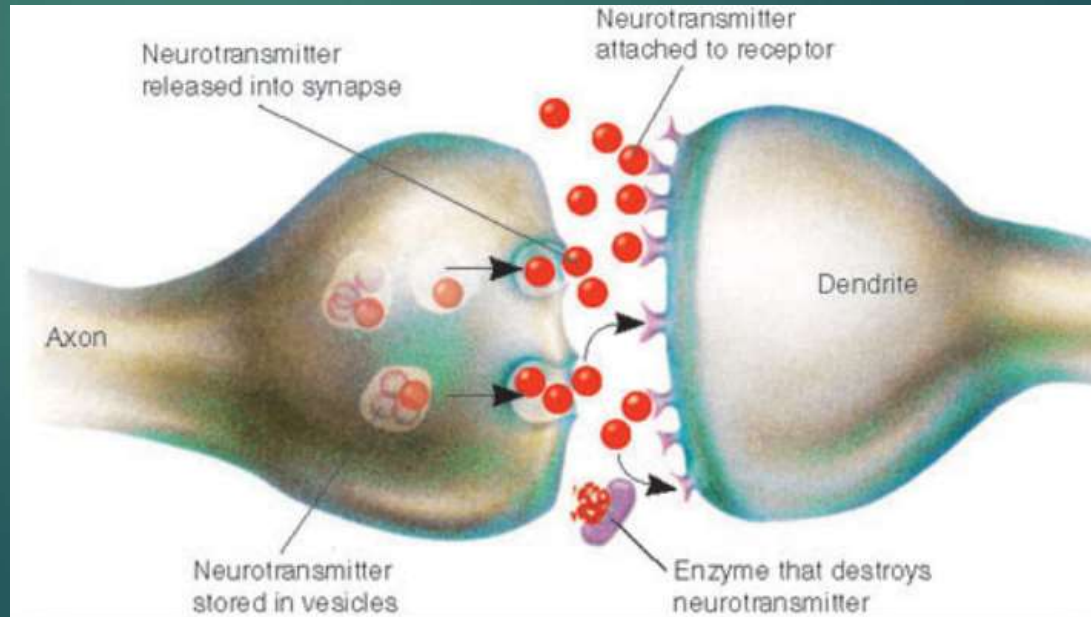
Plastic bag suicide



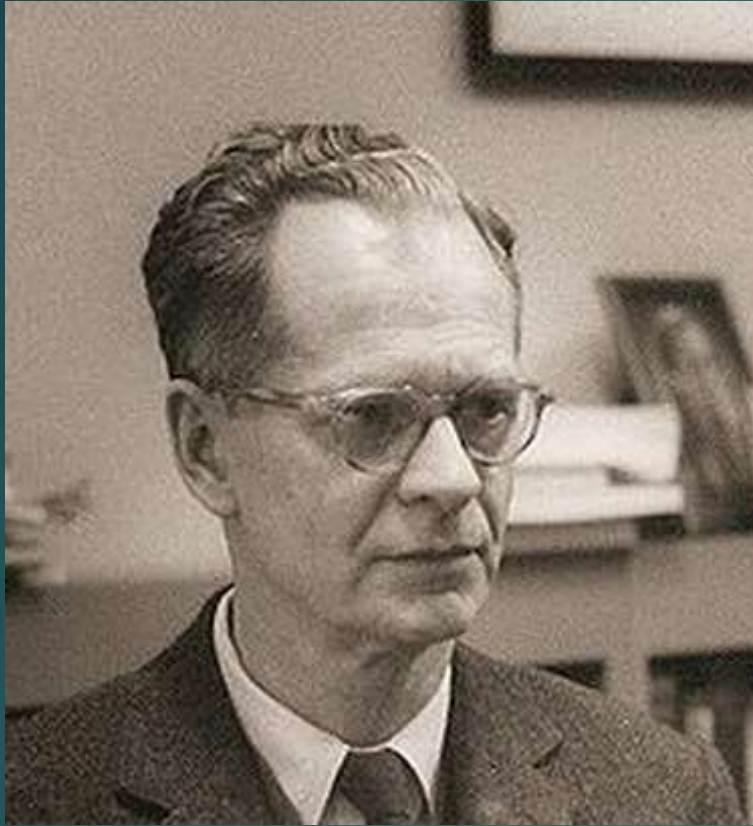
John Carew Eccles, 1903-1997: **The Synapse**



- ▶ 1963 Nobel Prize in Physiology or Medicine for his work on the function of the synapse.
- ▶ Discovered the chemical means by which impulses are communicated or repressed by the nervous system.



B.F. (Burrhus Fredric) Skinner, 1904-1990

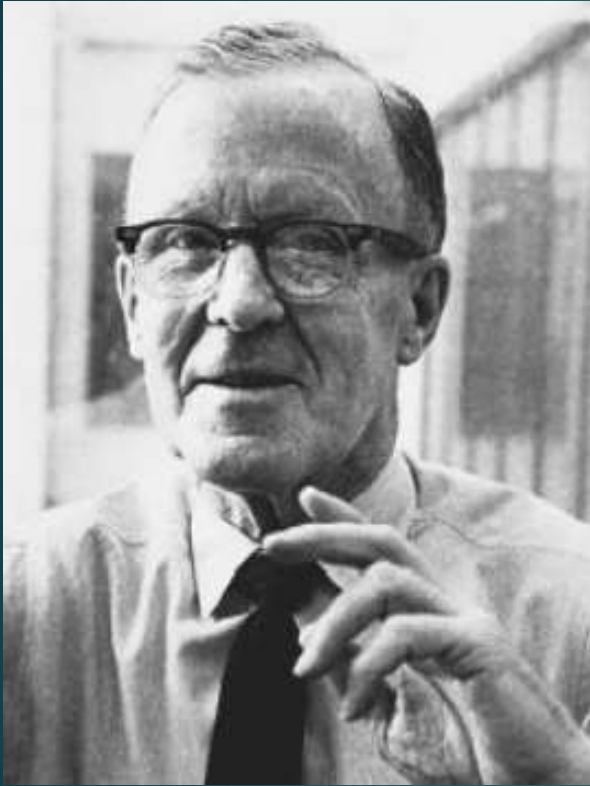


1938: *The Behavior of Organisms*

Theory of operant conditioning: behavior is modified by its antecedents and consequences

Donald Olding Hebb, 1904-1985

The Organization of Behavior: A Neuropsychological Theory, 1949



Animal Labs of McGill Univ.

Student of Penfield

Canadian Psychologist; worked with Penfield & Lashley

One of the fathers of neuropsychology and neural networks (cell assemblies).

First to indicate that the right temporal lobe was involved in visual recognition.

Removal of large parts of the frontal lobe had little effect on intelligence; espoused unification of localization & mass action via regional localization theory

Hebb's Law: Neurons that fire together wire together.

CIA sponsored sensory deprivation experiments

Harry Harlow, 1905-1981



Student of Terman, who recommended he change his surname from Israel to Harlow; “too Jewish”; married one of Terman’s gifted kids

One of first primate labs.

First experimental proof of double dissociation of focal anterior vs posterior lesions

Research on maternal-separation, dependency needs, and social isolation experiments on rhesus monkeys, which demonstrated the importance of care-giving and companionship in social and cognitive development.

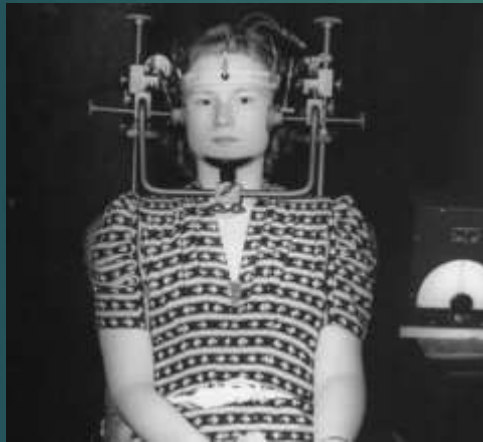
Rearing infant monkeys in isolation chambers for up to 24 months, from which they emerged severely disturbed; factor in rise of animal liberation movement

Ward C. Halstead 1908-1969



Experimental psychologist remembered for his battery

1935 University of Chicago – first full time Lab for studying brain-behavior relationships; observed pts in real life



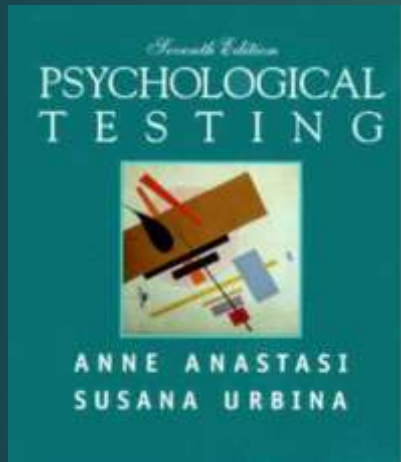
Student of Kluver
& Ralph Reitan's Mentor

1947 - *Brain and Intelligence: A Quantitative Study of the Frontal Lobes*

Halstead-Reitan Neuropsychological Battery: 10 tests that differentiated brain damage

Category test inspired by Kluver's work on decreased generalization in monkeys following ablation; therefore generalization sensitive to brain damage

Anne Anastasi, 1908-2001



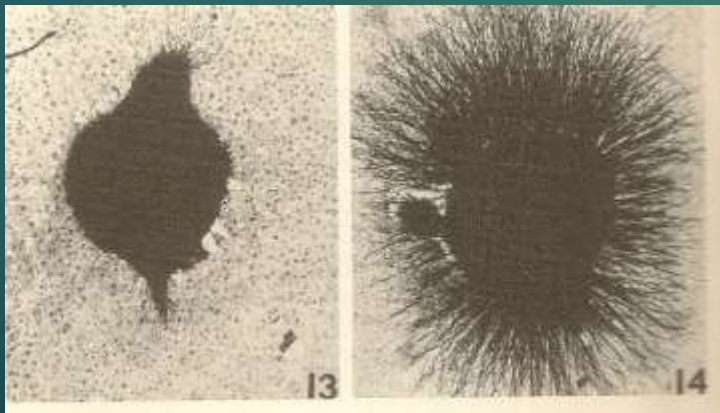
- ▶ American psychologist
- ▶ Best known for her pioneering development of psychometrics.
- ▶ Seminal Work: Psychological Testing (7th Ed)
- ▶ See the person; go beyond test scores; only revealed what the test-taker knows at the time
- ▶ “No intelligence test can be culture free, because human intelligence is not culture free”.
- ▶ Past President, APA

Rita Levi-Montalcini, 1909 - : Brain Growth Factor



- ▶ 1956: Observations of certain cancerous tissues that cause extremely rapid growth of nerve cells lead to discovery of nerve growth factor (NGF)

- ▶ 1986 **Nobel Prize** in Physiology or Medicine for their discovery of Nerve growth factor (NGF)



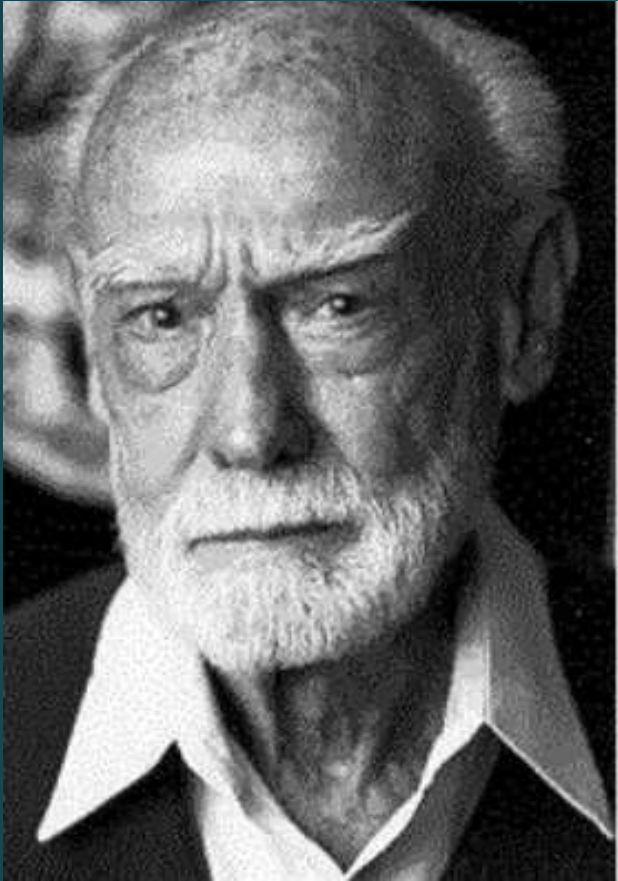
Julius Axelrod, 1912-2004: Neurotransmitters



1970: Nobel Prize:
Neurotransmitters

Storage, release, & inactivation
of catecholamines: epinephrine,
norepinephrine, dopamine

Roger Wolcott Sperry (1913-1994)



1981 Nobel:
Split Brain Surgery

Lateralized Hemispheric Functions

Associate of Lashley

His student: Michael Gazzaniga

Bjorn Sigurdsson 1913-1959: **First neurological slow virus**

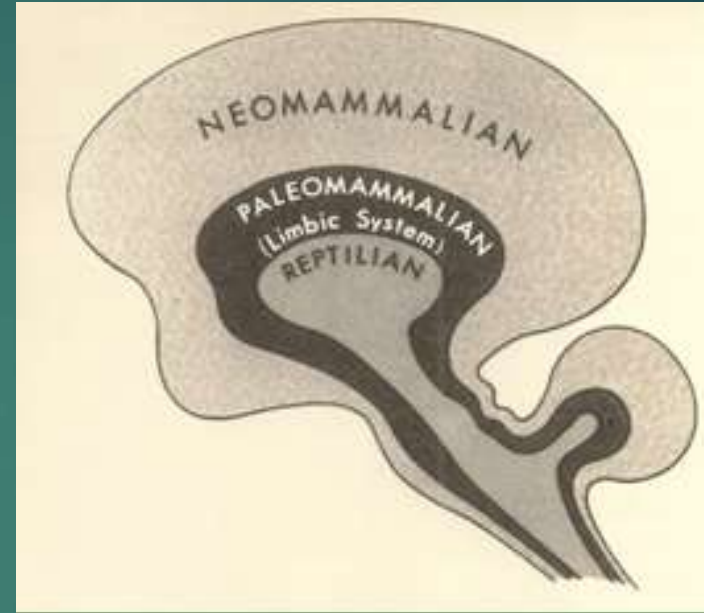


Icelandic physician

Slow virus diseases in sheep including maedi-visna and scrapie.

Similar to HIV and CJD

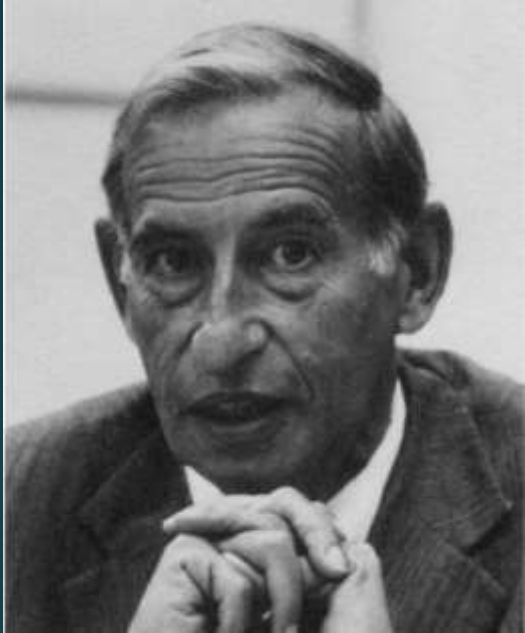
Paul D. McLean 1913-2007: Tripartite Brain



American neuroscientist

Evolutionary triune brain theory proposed that the human brain was in reality three brains in one: the reptilian complex, the limbic system, and the neocortex. No longer accepted

Hans-Lukas Teuber, 1916–1977: Experimental Neuroscience:



MIT: Head of Dept. of
Psychology

- Reanalysis of older German neurological literature
- From case studies to experimental neuropsychology; first use of matched control groups
- 1948 APA paper put NP on map: Spatial organization of visual perception following injury to the brain.

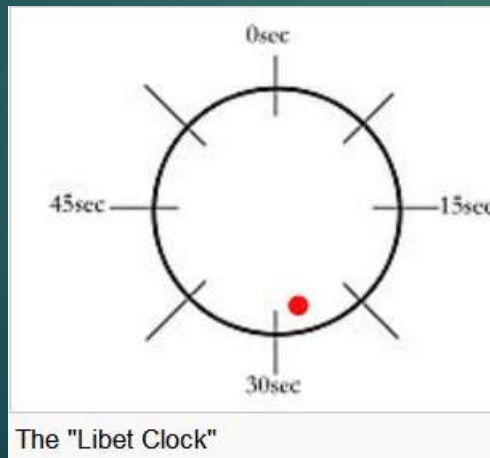
Teuber

- Double Dissociation of function: lesion creates a specific cognitive problem & lesions in other areas do not; Not enough to have normal controls; need other patient groups differing in brain damaged areas
- “Kennard principle” not true
- “Absence of evidence is not evidence of absence”

Benjamin Libet 1916-2007: **Free Will or Free Won't**



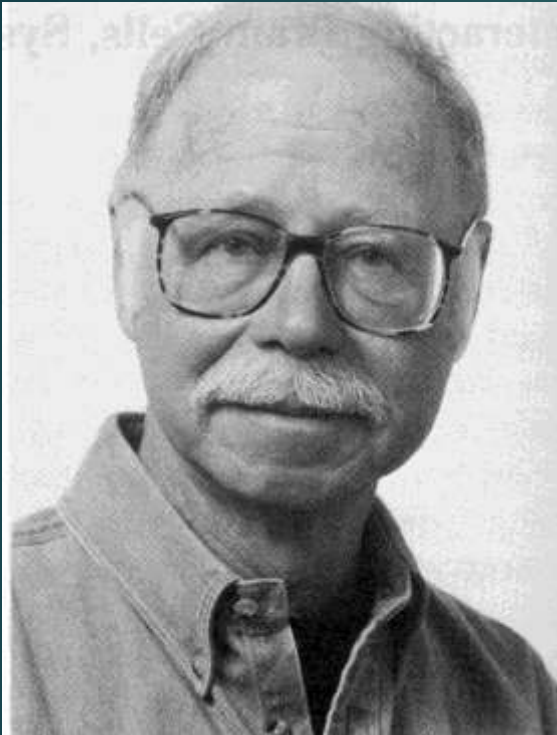
- ▶ 1980s: **Awareness seems to come only after actions have already begun in the brain**
- ▶ The brain activity comes first, then the decision to act, and then finally the action itself. Not only does the decision to act happen after the brain is already getting ready to set off the action, but it comes nearly half a second later.
- ▶ We may not be able to start actions consciously, but we can veto them once they have begun.



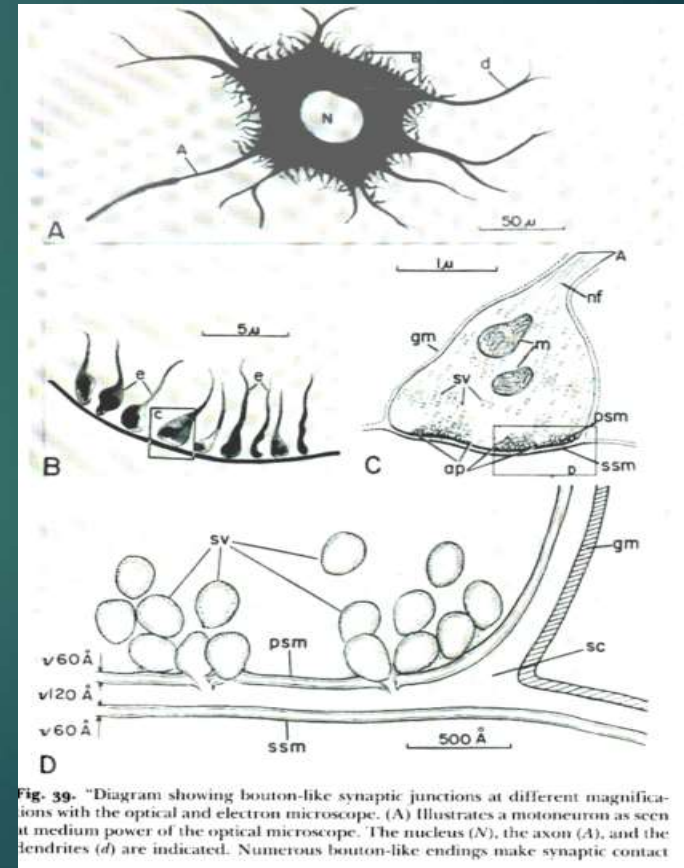
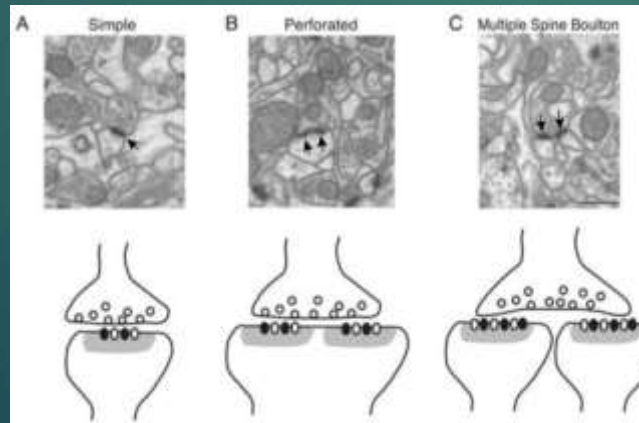
Nonconscious Action: You can only veto

- ▶ Brain registers sensory events immediately. Takes half a second to become conscious of them.
- ▶ Returning a tennis serve:
 - ▶ 0 ms: attention
 - ▶ 70 ms: body memory (BG, parietal)
 - ▶ 250 ms: action plan (premotor)
 - ▶ 355 ms: sending signals to body (motor)
 - ▶ 500 ms: 1st conscious awareness; can veto action

Sanford L. Palay 1918-



First to see synapse under electron microscope

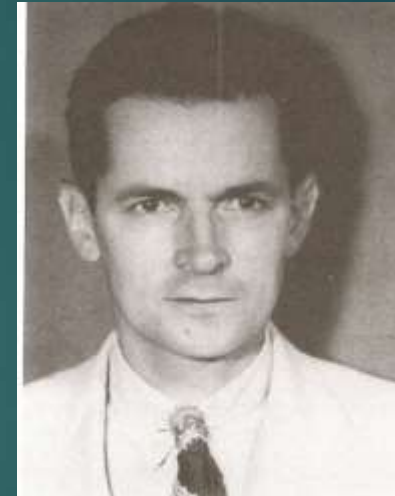


Henry Gustav Molaison, 1926-2008

Unforgettable Amnesiac



Patient H. M.



William Scoville MD

The most important patient in the history of neuroscience.
100 researchers studied him; Brenda Milner & Suzanne Corkin

Brenda Milner, 1918- : Nature of Memory



Student of Hebb, Zangwill,
Penfield

Her students: Suzanne Corkin,
Doreen Kimura

Loss of Recent Memory after Bilateral Hippocampal Lesions - W. Scoville & Brenda Milner J Neurol Neurosurg Psychiatry, (1957):
one of the most cited papers in neuroscience (2500 citations)

1957: Patient H.M.: Medial temporal lobe amnesic syndrome is characterized by an inability to acquire new memories; material-specific nature of amnesia

Studies of seizure lobectomy results

McGill-MIT Axis of collaboration (she & Teuber)

2009: International Balzan Prize for Cognitive Neuroscience

Vernon Benjamin Mountcastle, 1918 - 2015



John Hopkins Univ.

- ▶ Dean of American neurophysiologists
- ▶ Pioneers single-cell recording from mammalian sensory cortex
- ▶ He discovered and characterized the vertical columnar organization of the cerebral cortex in the 1950s
- ▶ **1978 article** “*An organizing principle for cerebral function: the unit model and the distributed system...*” as “the rosetta stone of neuroscience”: first description of distributed functioning
- ▶ **1998: *Perceptual neuroscience: the cerebral cortex***

Oscar A. Parsons, 1920-2000:



Neuropsychology of Alcoholism

Alcoholism is a neurologically based disorder with major neuropsychological deficits

244 published articles;
60 after retirement

Eugene Aserinsky (1921–1998) & Nathaniel Kleitman (1895-1999)



- 1953: Discovers of REM sleep
- Hours spent studying the eyelids of sleeping babies
- REM sleep correlated with dreaming
- Babies in REM 20% of time;
Relation to learning

Ralph Reitan, 1922-2014



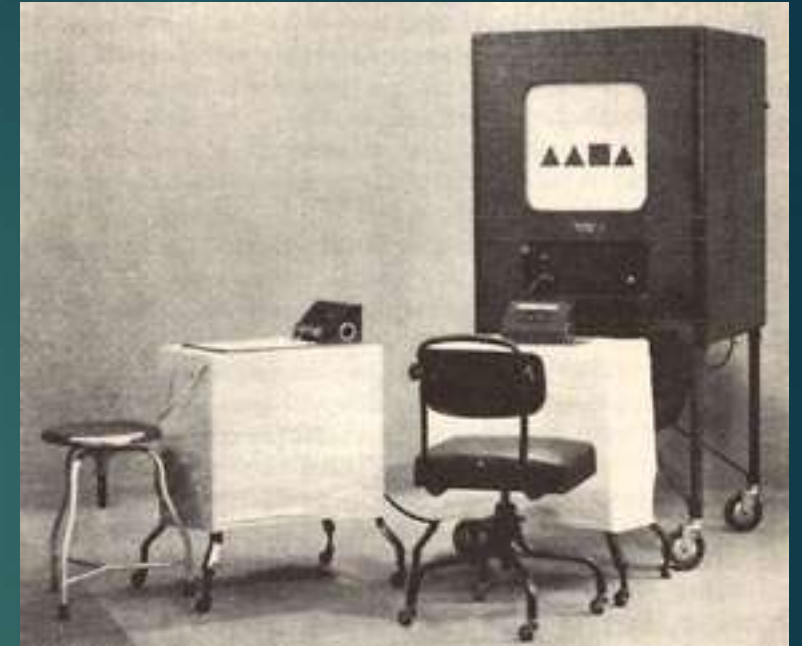
1950 – lab at Univ of Indiana Medical Center

1970 Halstead Reitan Battery: the most widely known NP battery, based on a series of tests devised by Halstead in the 1940's

Father of Clinical Neuropsychology

Student of Halstead & Thurstone

His students: Halgrim Klove, Charles Matthews, James Reed, Manfred Meier, Oscar Parsons, Byron Rourke, Paul Satz, Gerry Goldstein, Igor Grant, Sureyya Dikmen, Ken Adams, and Bob Heaton



SAMPLES OF TESTS...



Psychological Testing 1970: 46 years ago

▶ The 9 classic tests:

▶ WAIS

▶ WMS

▶ Rorschach (Klopfer)

▶ MMPI

▶ TAT

▶ Bender Visual Gestalt

▶ Rotter Incomplete
Sentence Test

▶ House, Tree, Person

▶ Draw a Person

Did not exist:

No cell phones

No internet

No desk top computers or iPads

No laptops

No CT, MRI, or PET

No NP Boards or NP Training
guidelines

No psychometrists

The 10 most commonly used tests in 1976

- 1.) Wechsler Intelligence Scale for Children (WISC)
- 2.) Bender Visual-Motor Gestalt Test
- 3.) Wechsler Adult Intelligence Scale (WAIS)
- 4.) Minnesota Multiphasic Personality Inventory (MMPI)
- 5.) Rorschach Ink Blot Test
- 6.) Thematic Apperception Test (TAT)
- 7.) Sentence Completion
- 8.) Goodenough Draw-A-Person Test
- 9.) House-Tree-Person Test
- 10.) Stanford-Binet Intelligence Scale

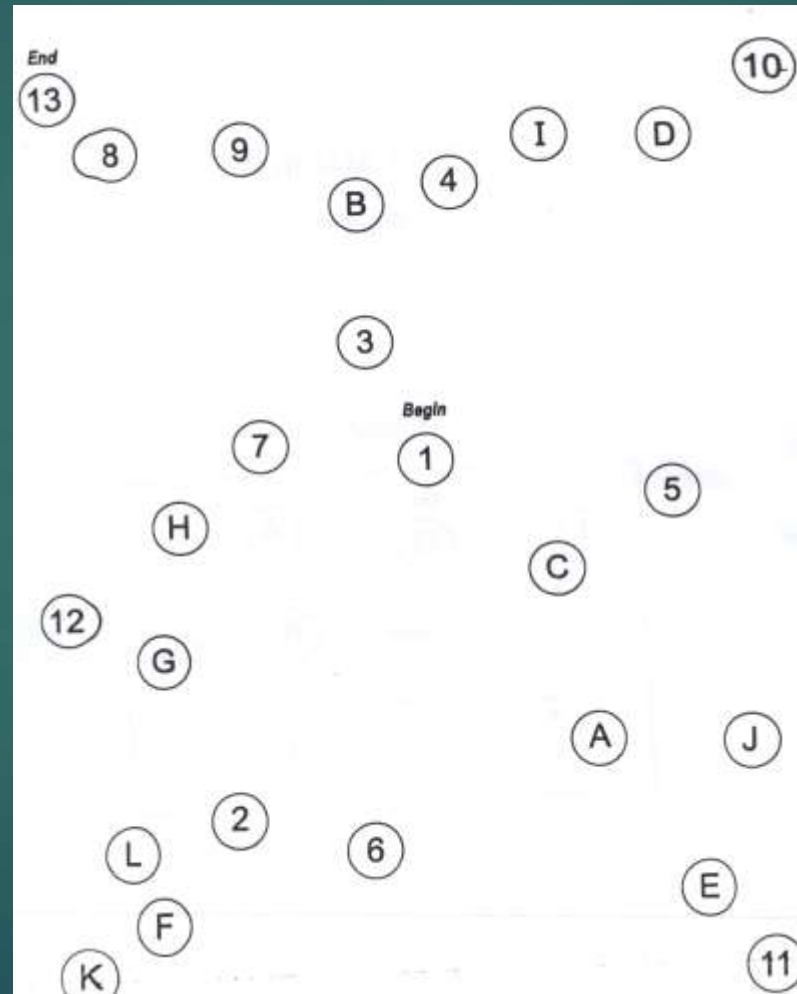
From Brown & McGuire, 1976

San Francisco NP Service: 2009 Adult Tests

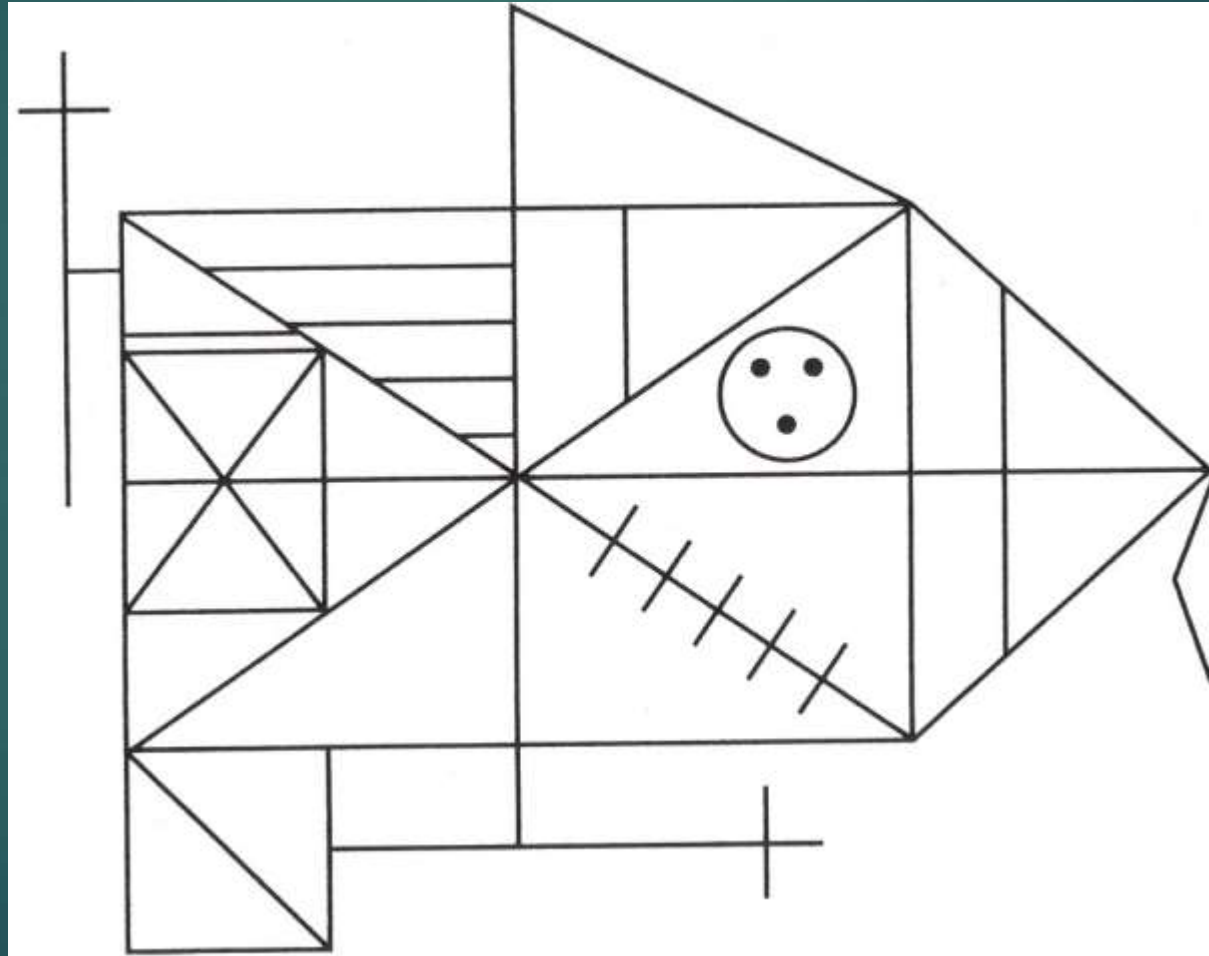
- ▶ Cognistat
 - ▶ MOCA
 - ▶ IFS: INECO Frontal Screening
 - ▶ RBANS
 - ▶ Word Memory Test: WMT
 - ▶ NVWMT: NonVerbal WMT
 - ▶ Dot Counting Test
 - ▶ b Test
 - ▶ Rey 15 Item Test
 - ▶ Rey Word Recognition
 - ▶ ROCF Recognition
 - ▶ Warrington Recognition
 - ▶ TOMM
 - ▶ Woodcock Johnson III
 - ▶ Bateria III
 - ▶ WAIS IV
 - ▶ WASI – II
 - ▶ WIAT
 - ▶ Wechsler Test of Adult Reading
 - ▶ Stroop Color Naming Test
 - ▶ PASAT
 - ▶ WRAT-4, PIAT-R,
- Halstead Reitan Battery:
 - Booklet Category
 - Trailmaking
 - Finger Tapping Test
 - Grip Strength
 - Tactual Performance Test
 - Seashore Rhythm Test
 - Speech Sounds Perception Test
 - Grooved Pegboard
 - Purdue Pegboard
 - California Verbal Learning Test 2
 - Wechsler Memory Scale IV
 - AVLT
 - Hopkins VLT
 - Test of Nonverbal Intelligence-3
 - Neuropsychological Assessment Battery (NAB)
 - Boston Naming Test
 - COWAT Fluency
 - Animal Naming
 - Action Fluency
 - Boston Diagnostic Aphasia Exam
 - IVA CPT
 - Dementia Rating Scales
 - Leiter
 - Luria-Nebraska (LNNB)
- Clock Drawing
 - Rey Complex Figure
 - Benton-Visual Retention
 - Beery-VMI
 - Face Recognition Test
 - Hooper Visual Integration
 - Judgment Line Orientation
 - Wisconsin Card Sorting Test
 - Category Test
 - Iowa Gambling Task
 - DKEFS
 - Raven's Progressive Matrices
 - NIH Examiner
 - Heaton Norms
 - PHQ9
 - GDS
 - MCMII-3
 - MMPI-2-RF
 - PAI
 - RIT (R-PAS system)
 - NEO-PI-R
 - 16 PF
 - Computerized administration & scoring for many

Neuropsychological Testing Measures

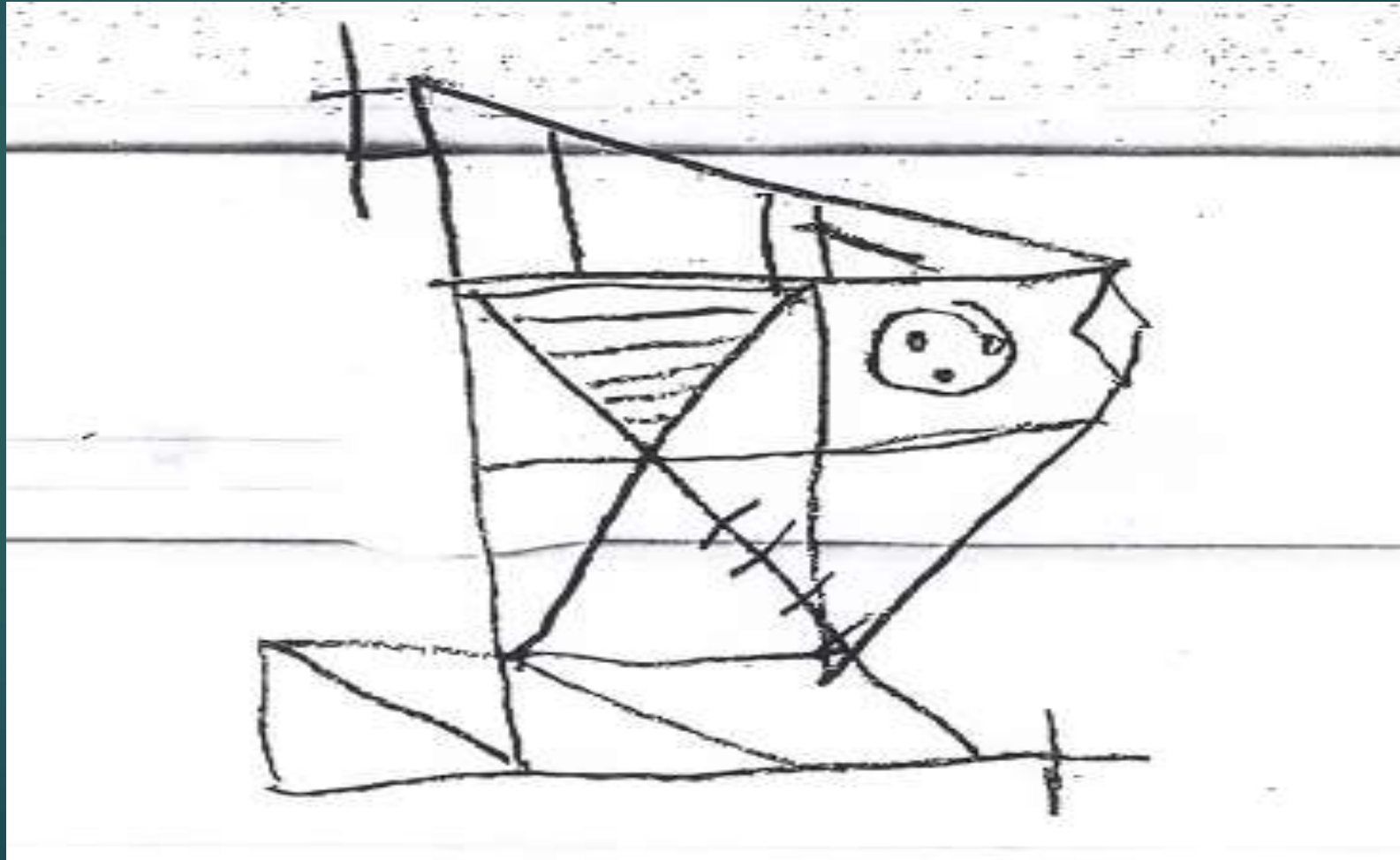
Trail Making Test - B



Rey Complex Figure



Rey Complex Figure Example



California Verbal Learning Test II

I'm going to read a list of words to you. Listen carefully, because when I'm through, I want you to tell me as many of the words as you can. You can say them in any order, just say as many of them as you can. Are you ready?

Read List A at an even pace, taking slightly longer than one second per word, so the entire list takes 18 to 20 seconds. Then say: **Go ahead.**

I'm going to read the same list again. Like before, tell me as many of the words as you can, in any order. Be sure to also say words from the list that you told me the first time.

I'm going to read the same list again. Like before, tell me as many of the words as you can, in any order, including words from the list you've said before.

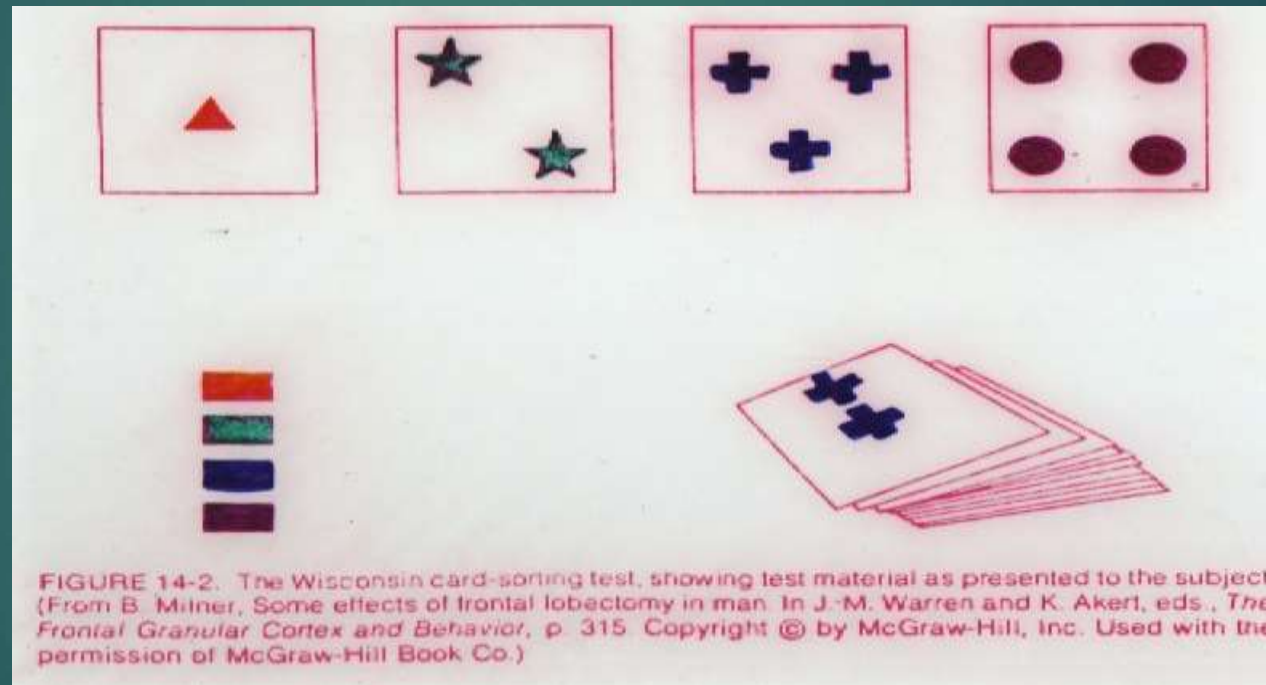
I'm going to read the same list one more time. Like before, tell me as many of the words as you can, in any order, including words from the list you've said before.

Record all responses verbatim, in the order recalled. Prompt only once (e.g., Anything else?) at the end of each free and cued recall trial (i.e., after 15 seconds with no response or when the examinee says he/she cannot remember more words).

	Trial 1		Trial 2		Trial 3		Trial 4		Trial 5	
		Resp Type		Resp Type		Resp Type		Resp Type		Resp Type
	1		1		1		1		1	
	2		2		2		2		2	
List A	3		3		3		3		3	
truck	4		4		4		4		4	
spinach	5		5		5		5		5	
giraffe	6		6		6		6		6	
bookcase	7		7		7		7		7	
onion	8		8		8		8		8	
motorcycle	9		9		9		9		9	
cabinet	10		10		10		10		10	
zebra	11		11		11		11		11	
subway	12		12		12		12		12	
lamp	13		13		13		13		13	
celery	14		14		14		14		14	
cow	15		15		15		15		15	
desk	16		16		16		16		16	
boat	17		17		17		17		17	
squirrel	18		18		18		18		18	
cabbage	19		19		19		19		19	
	20		20		20		20		20	
	Total Correct	C <input type="checkbox"/>	Total Correct	C <input type="checkbox"/>	Total Correct	C <input type="checkbox"/>	Total Correct	C <input type="checkbox"/>	Total Correct	C <input type="checkbox"/>
	Total Repetitions	R <input type="checkbox"/>	Total Repetitions	R <input type="checkbox"/>	Total Repetitions	R <input type="checkbox"/>	Total Repetitions	R <input type="checkbox"/>	Total Repetitions	R <input type="checkbox"/>
	Total Intrusions	I <input type="checkbox"/>	Total Intrusions	I <input type="checkbox"/>	Total Intrusions	I <input type="checkbox"/>	Total Intrusions	I <input type="checkbox"/>	Total Intrusions	I <input type="checkbox"/>

WCST: Wisconsin Card Sort Test

The Gold Standard for Executive Functioning

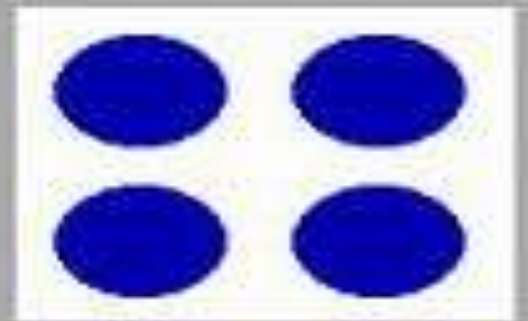
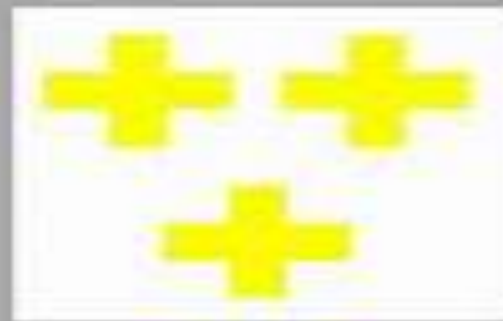


Opinion: Nonverbal executive function tests are superior to verbal tests in predicting real world independence capability.

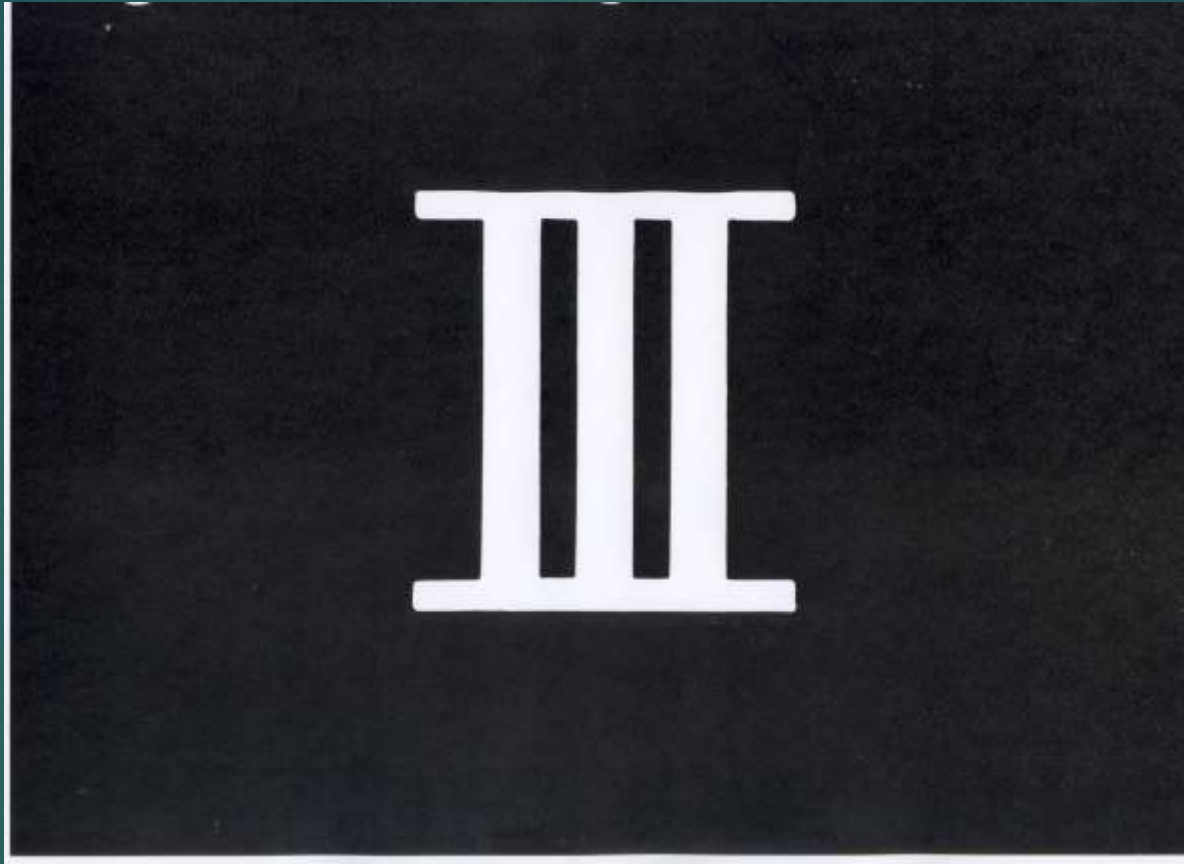
WCST



RIGHT

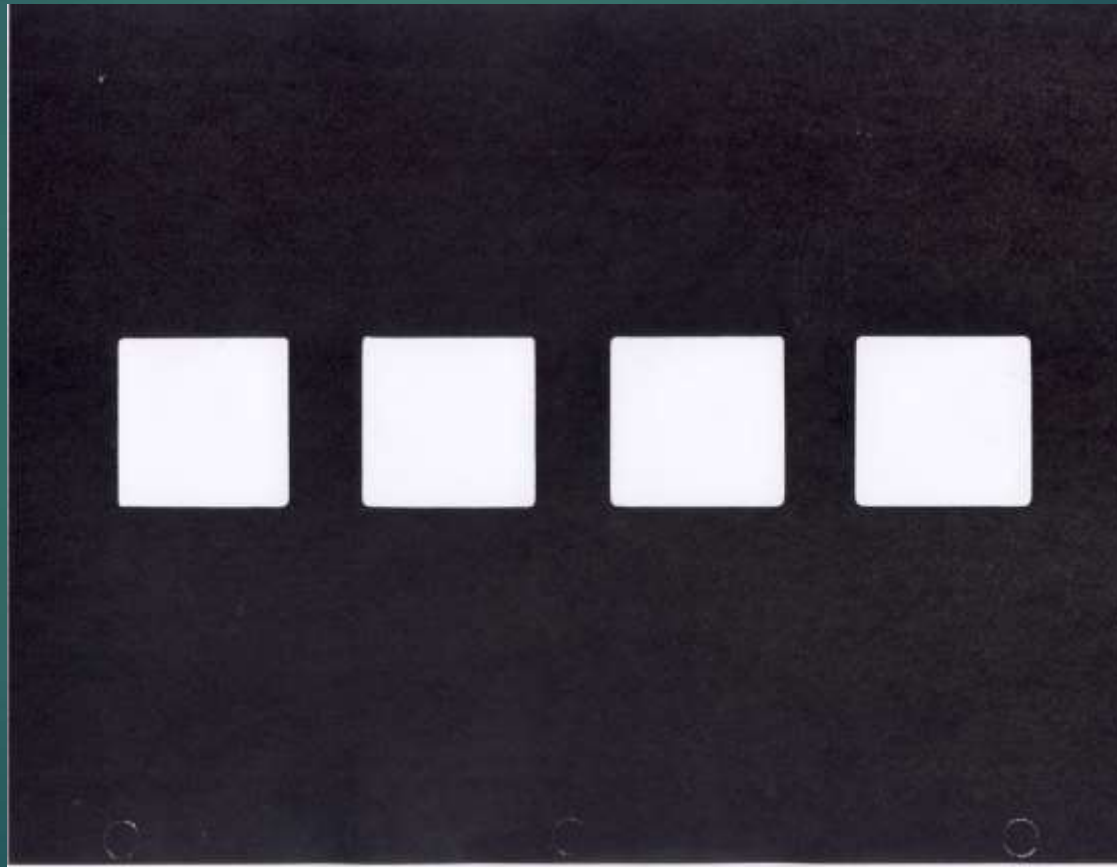


Category Test: I

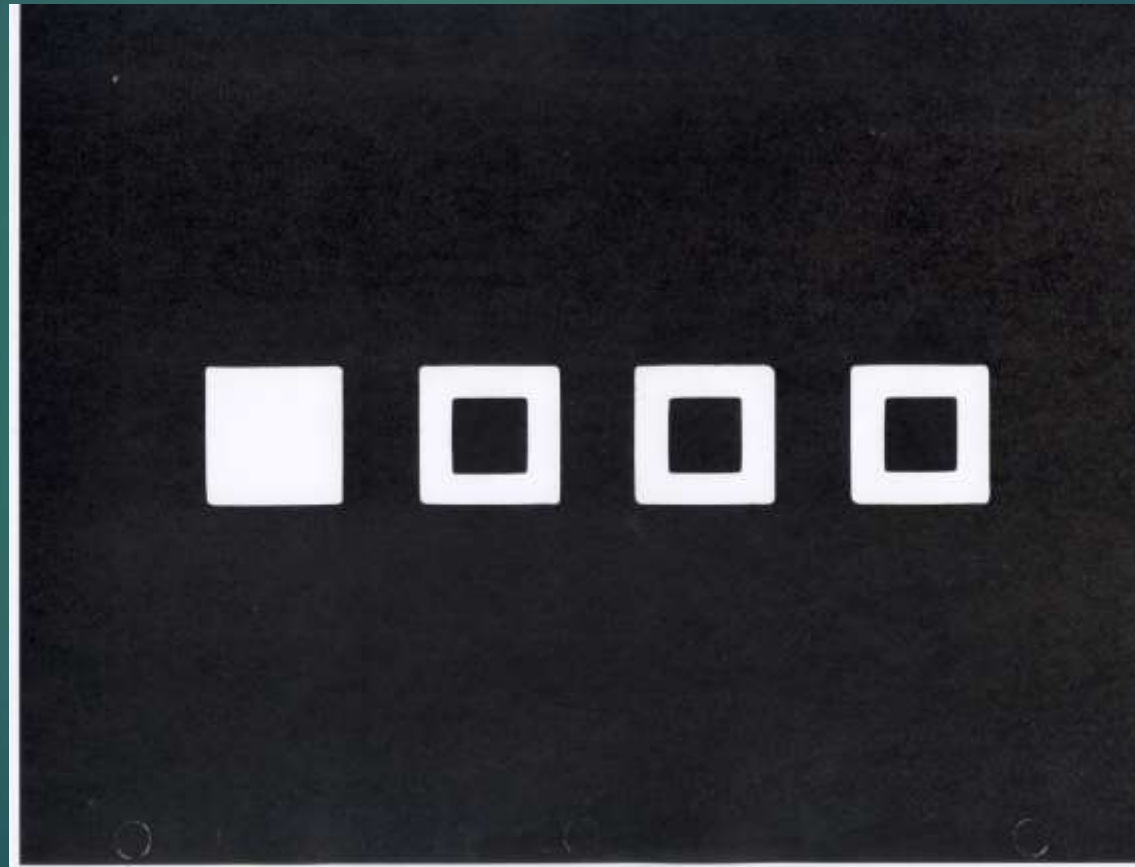


Correct answer is 1-2-3-4

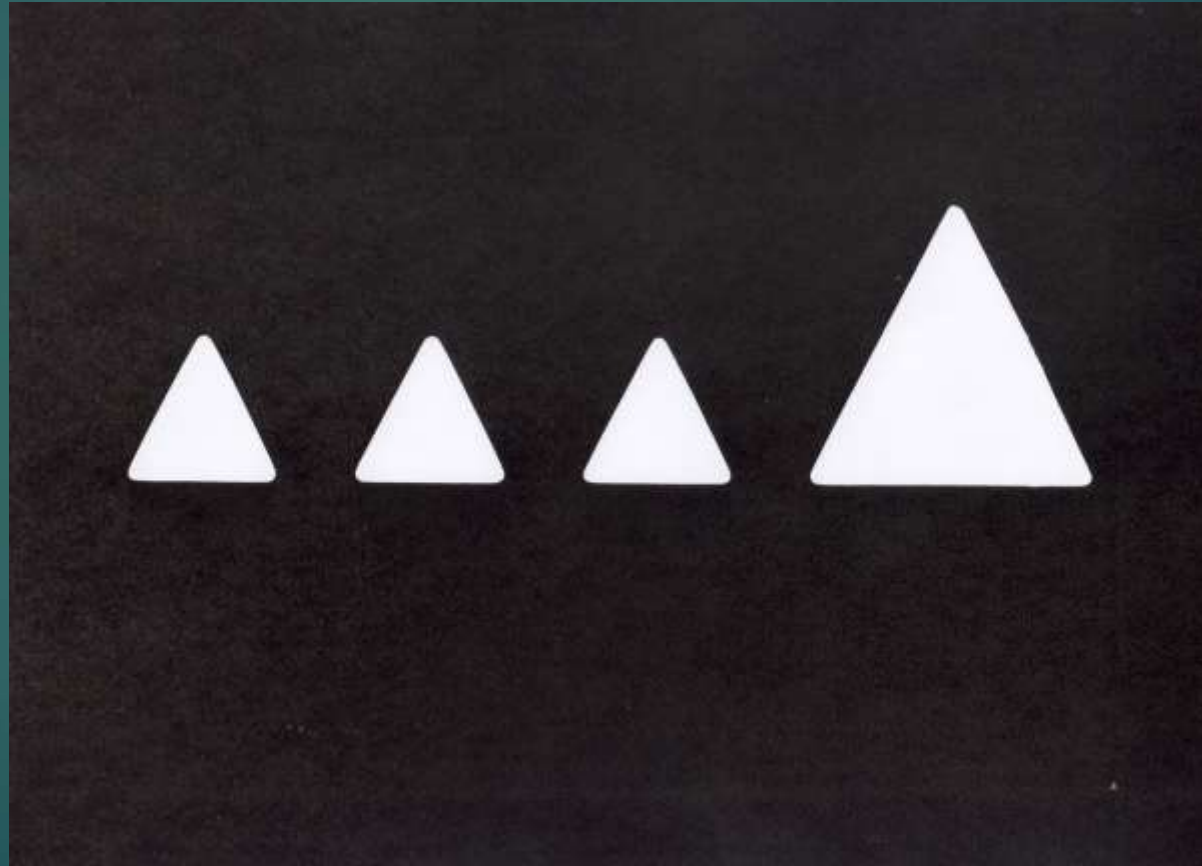
Category Test: II



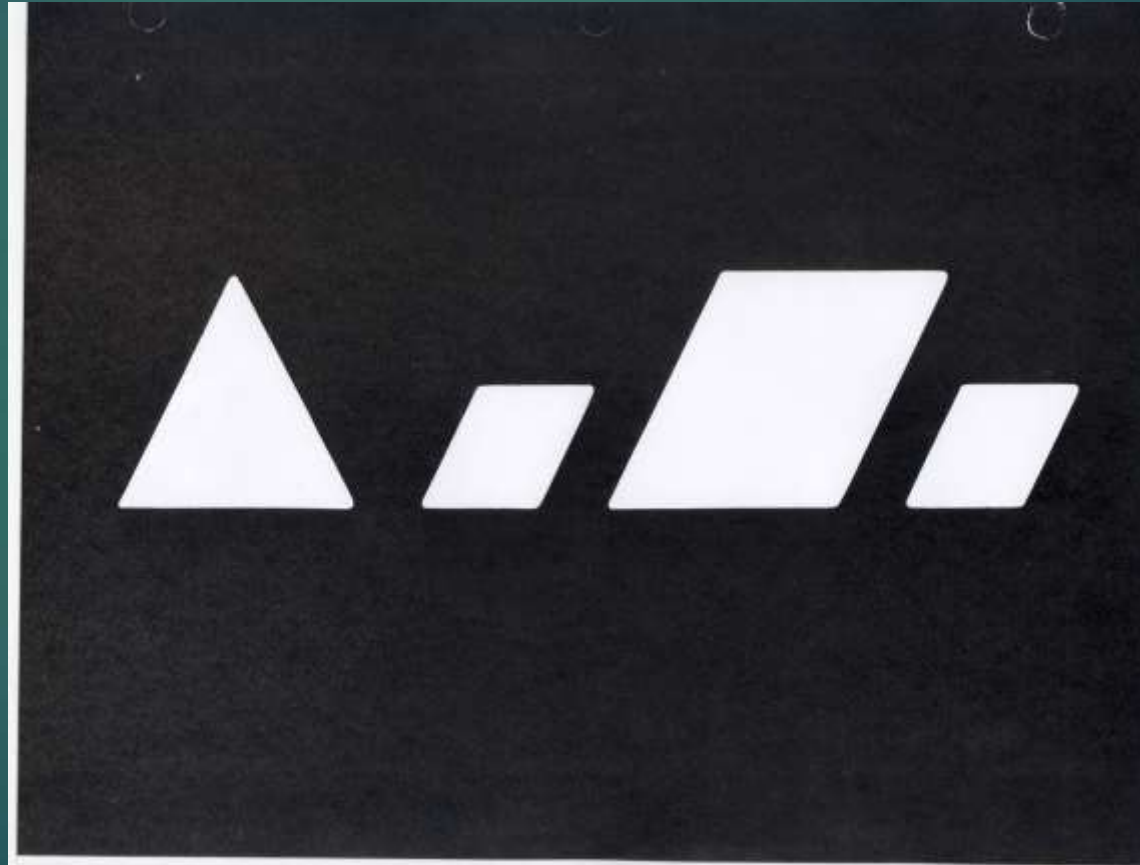
Category Test: III



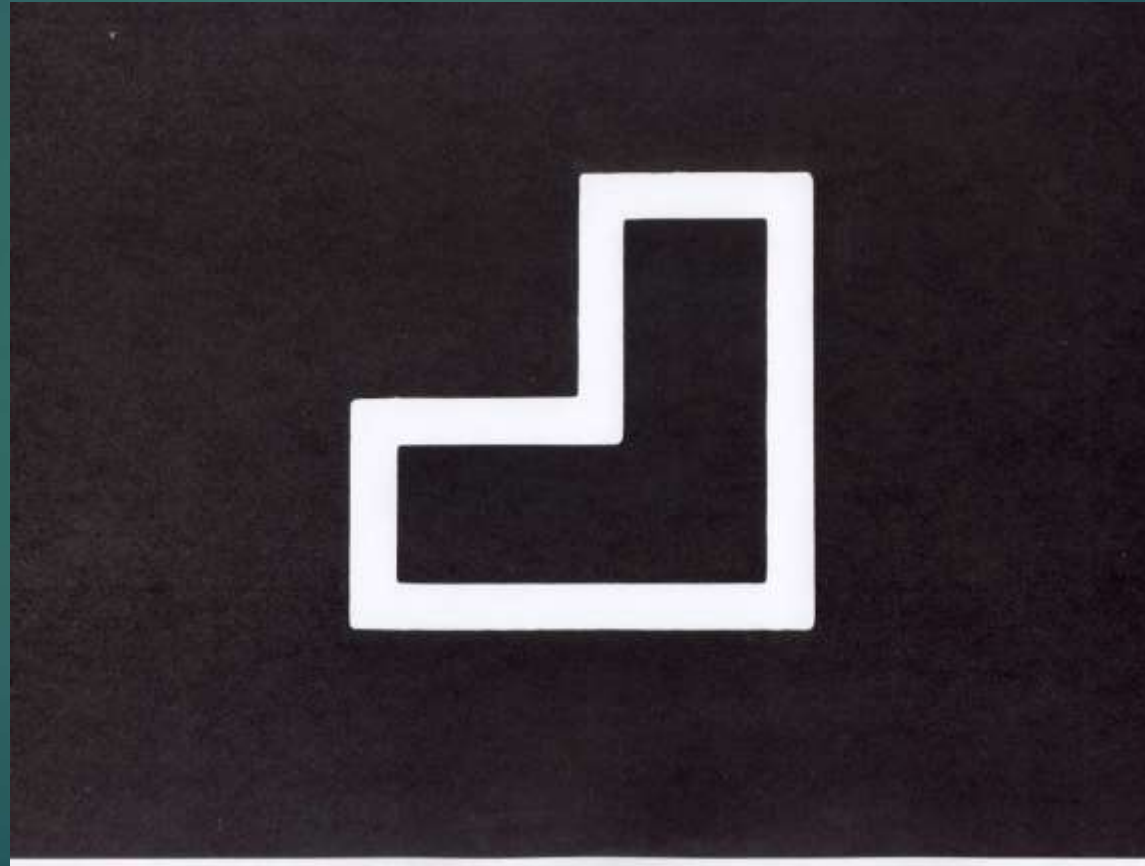
Category Test: III



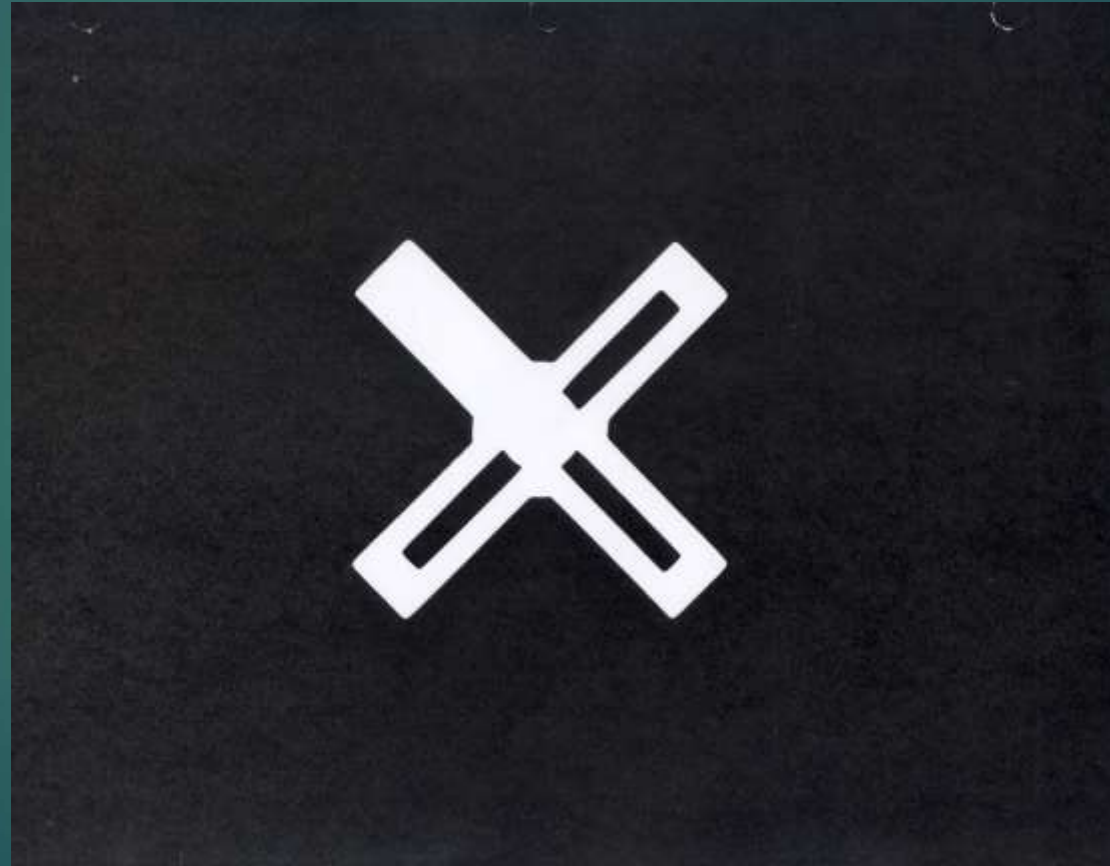
Category Test: III



Category Test: IV



Category Test: IV



Please read color of print not word

red white **green** **brown**

green **red** **brown** white

white **brown** **green** **red**

red **white** **green** **brown**

brown **green** **white** **red**

white **brown** **red** **green**

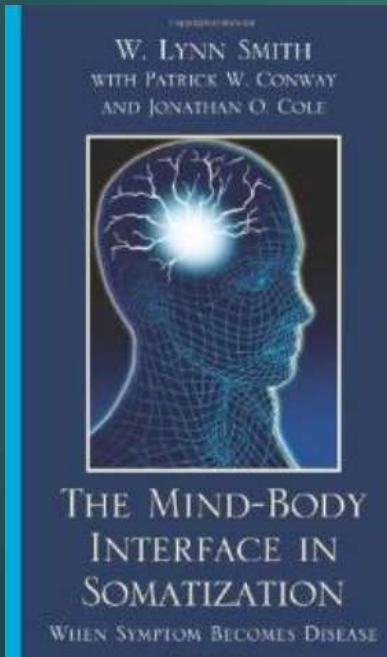
green **white** **brown** **red**

red **brown** **green** **white**

W. Lynn Smith, 1923–2008



- ▶ University of Denver, the University of Colorado Health Sciences Center and the University of North Dakota.
- ▶ Somatization, pain and psychosomatic illnesses
- ▶ 1976-77, 1st elected President, NAN



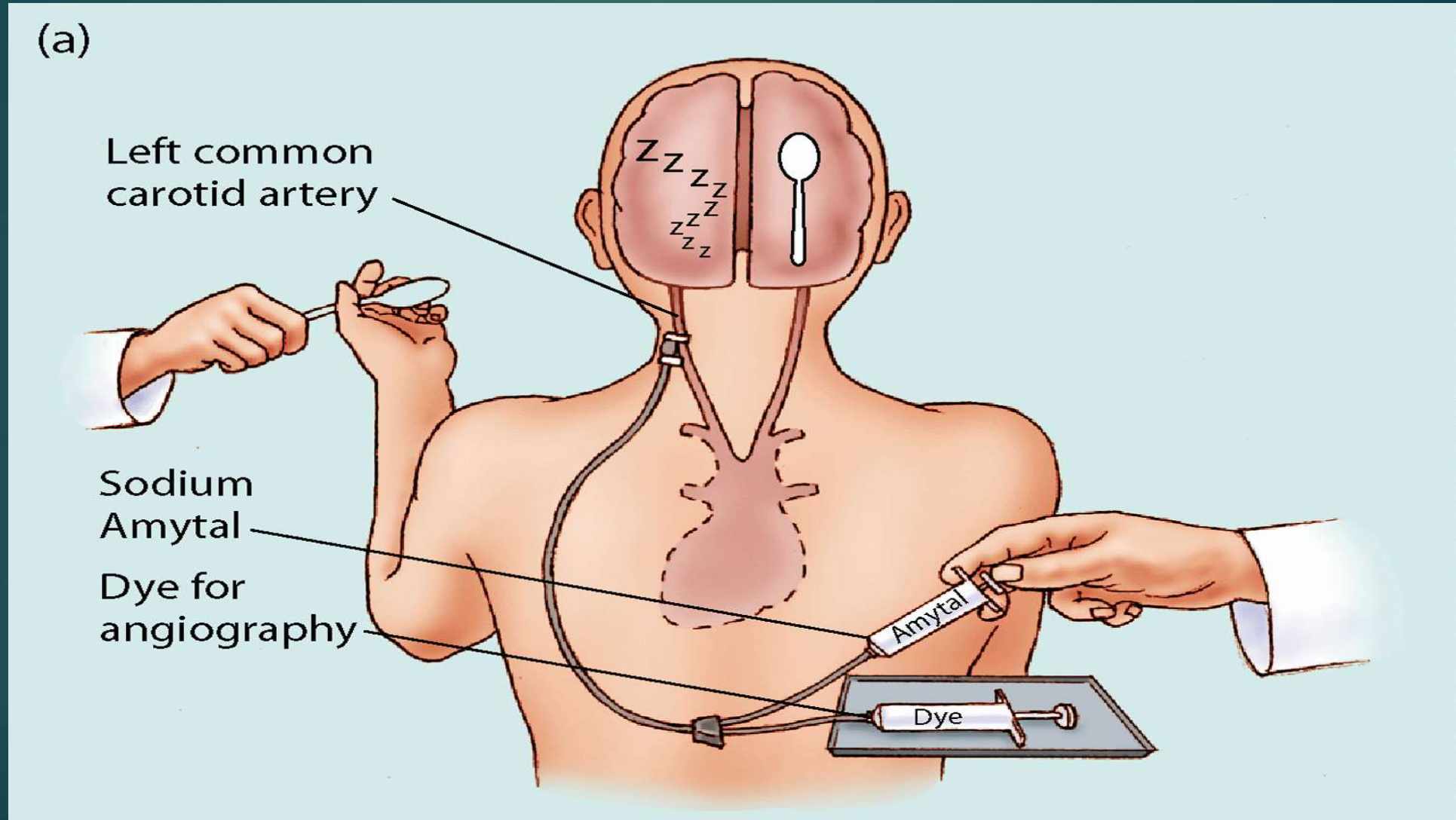
Juhn Atsushi Wada, 1924 -



- ▶ University of British Columbia: Japanese Canadian neurologist
- ▶ Epilepsy
- ▶ Wada Test for cerebral hemispheric dominance of language function.
- ▶ Now being replaced by MRI

WADA procedure of separate hemispheric functioning

Injection of sodium amytal (a barbituate), into one and then the other carotid artery temporarily (5-10min) puts half the brain to sleep allowing neurologists to assess function in the awake hemisphere



Elizabeth Warrington, 1931 -



Student of Zangwill

- National Hospital, London
- Warrington Recognition Test
- Single Case Analysis: case K.F., No WM (1 digit only), ok LTM
- Semantic Organization in the brain
- First to describe semantic dementia
- 2003: Past President, INS

Edith Freund Kaplan, 1924-2009:

Clinical Neuropsychology



Students: Dean Delis, Joel Kramer,
Donald Stuss

Boston VAMC, Director of NP service

Studies of normal praxis, pivotal case study of a patient with a human disconnection syndrome

Originator of Boston Process Approach: highlights the importance of cognitive strategies and error pattern analysis in clinical evaluation.

Boston Diagnostic Aphasia Exam, Boston Naming Test, D-KEFS, CVLT, Microcog, WAIS-R NI, WISC III-NI, Baycrest Assessment

Cofounder ABCN

1979: Past President, INS

Torsten Wiesel 1924- & David Hubel, 1926-:
Visual Processing; Nobel Prize, 1981



Discoveries that individual neurons in the visual area of the brain are selective for many stimulus dimensions: orientation, direction of movement, spatial and temporal frequency, and contrast.

Norman Geschwind, 1926 – 1984: Behavioral Neurology



Behavioral Neurology

Aphasia subtyping
Cerebral Lateralization,
Disconnection Syndromes

Epilepsy & religious experience

1965: “Disconnexion Syndromes in Animals and Man.”

1972: Past President, INS

Students: Goodglass, Kaplan, M. Albert

Father of modern behavioral neurology

Endel Tulving, 1927 -: Human Memory



Human Memory:

Episodic Memory,

Encoding Specificity,

Retrieval Cues

Frontal mechanisms in memory processing

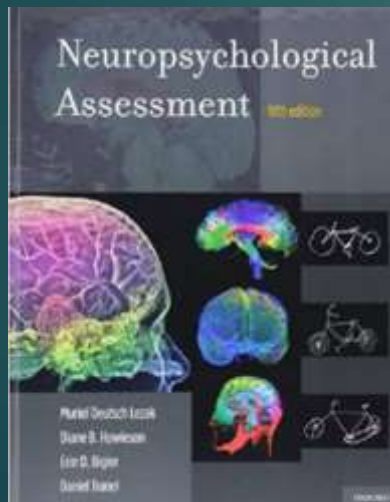
Muriel Deutsch Lezak, 1927- : **The Bible of Neuropsychology**



Oregon Health and Sciences University.

Assessment and rehabilitation of brain injury

1976: *Neuropsychological Assessment* (now 5th ed.); when it came out, only “organicity” measures or full batteries



1987: Past President, INS

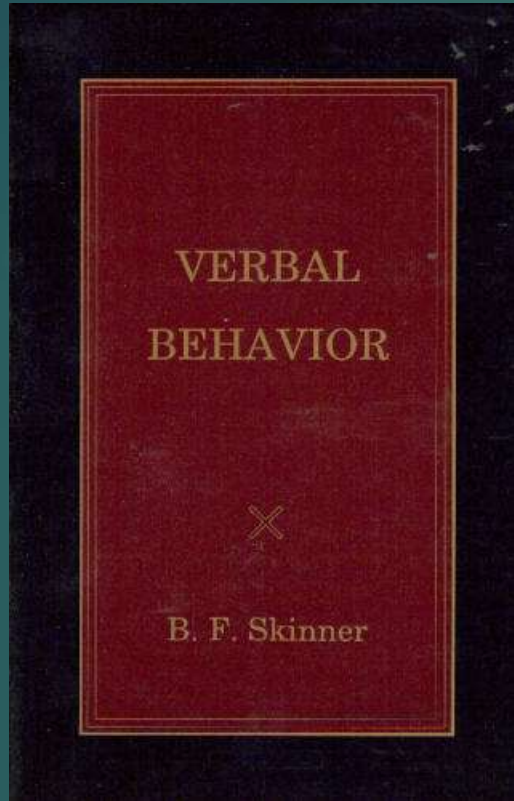
Noam Chomsky 1928-



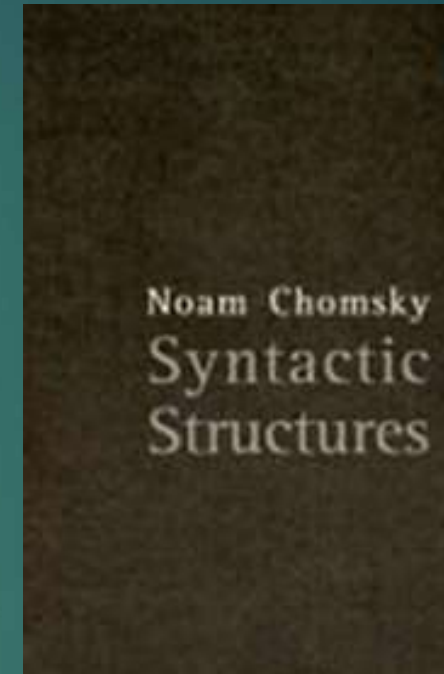
1957 “Syntactic Structures”

- ▶ Father of modern linguistics; at MIT
- ▶ An innate set of linguistic principles shared by all humans known as “innate universal grammar”
- ▶ Greatest political dissident of the left despite being rejected by the mainstream media in the USA.
- ▶ Most cited source of any living scholar in this order: Marx, Lenin, Shakespeare, Aristotle, the Bible, Plato, Freud, Chomsky
- ▶

1957: Skinner vs. Chomsky on Language



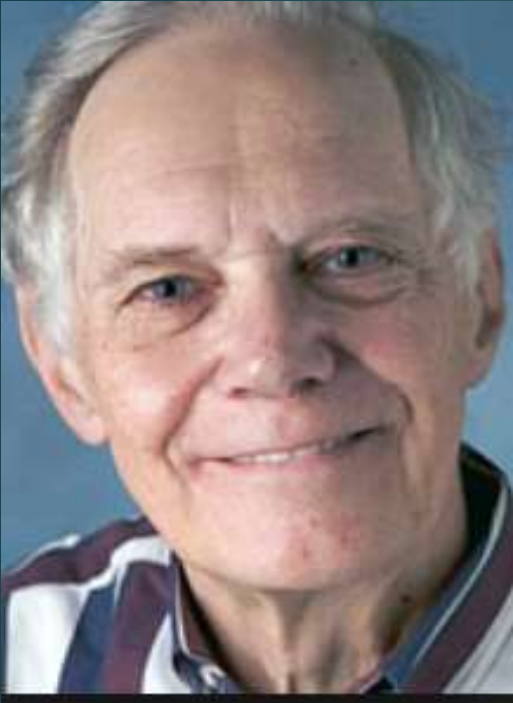
Language is conditioned response
to reinforcement



Transformational grammar

"Colorless green ideas sleep furiously."

Ulric Neisser, 1928 - 2012



- ▶ “Father of Cognitive Psychology”
- ▶ 1967 *Cognitive Psychology* (an attack on behaviorist psychological paradigms)
- ▶ Main tenet of cognitive psychology is that mental activity (i.e. cognition) is information processing.
- ▶ Studies of memory, especially memory for life events and in natural settings;
- ▶ Memory is, largely, reconstructed and not a snap shot of the moment:
John Dean’s Watergate case study
- ▶ Flashbulb memories & Challenger explosion: they eventually become erroneous
- ▶ Importance of ecological validity

John Exner, 1928 – 2006

The Rorschach: A Comprehensive System



Exner system of scoring was the standard method in psychology for interpreting the Rorschach inkblot test.

Now: **Rorschach Performance Assessment System® (R-PAS®)**



Alas, alas...

You Tube [Browse](#) [Upload](#)

Take the official Rorschach Ink Blot test to see if you are crazy

[architectus777](#) 397 videos



If you are a writer or student, you must check out Master Edit in the d

0:04 / 9:05 360p

Eric Kandel, 1929-

In Search of Memory



Aplysia Californica



2000 Nobel Prize: on the **physiological basis of memory storage in neuron (LTP)**

Joaquin Fuster 1930-



UCLA's Semel Institute for
Neuroscience and Human Behavior

- ▶ 1 of 1st **microelectrode methods for single-unit recording**
- ▶ Demonstrated a reversible deficit in delayed-response behavior by mild cooling of the prefrontal cortex
- ▶ Describes the first “working memory cells” (in prefrontal lobe) ever found in the primate brain
- ▶ 1980 he publishes foundational text *The Prefrontal Cortex: temporal organization function*

Fuster - Neural networks

- ▶ Physiological dynamics of working memory: all three forms of memory--that is, short-term memory, working memory, and long-term memory--share the same cortical networks
- ▶ *Cortex and Mind*: foundational text on brain networks; all cognitive functions are based on neural transactions within and between neuronal networks of cognitive representation which he calls *cognits* (now connectivity networks)

Marcel Kinsbourne, 1931 -

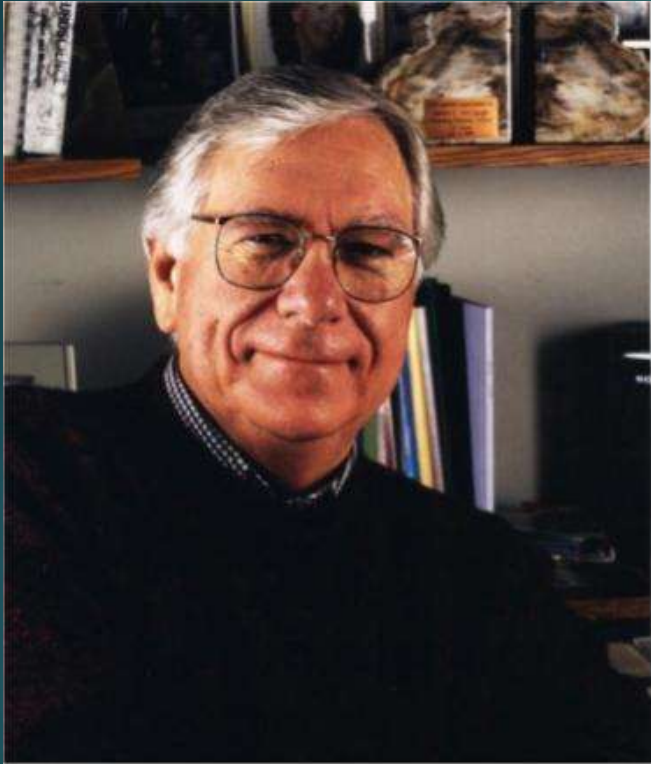


- ▶ Pediatric neurologist and cognitive neuroscientist
- ▶ Early pioneer in the study of brain lateralization.
- ▶ Cognitive neuroscience view of regional specialization: functions not attributed to one specific brain location, but claims that neural networks are either recruited or inhibited on the basis of competing task demands
- ▶ Dual task methodology for functional cerebral distance: balance a dowel rod while repeating sentences (both regional close in left hemisphere task) and found that balancing time decreased for the right finger (controlled by left hemisphere) but not the left finger

Kinsbourne 2

- ▶ Developmental Invariance of Cerebral Lateralization
- ▶ Hemispatial, not unilateral, neglect; a gradient across space; **left hemisphere-mediated rightward orientation bias**
- ▶ Left Hemisphere Specialization for Positive Emotion, detail, approach;
- ▶ Right Hemisphere Specialization for Negative Emotions, relationships, context, whole picture
- ▶ 1976: Past President, INS

James L. McGaugh, 1931- : role of amygdala in memory

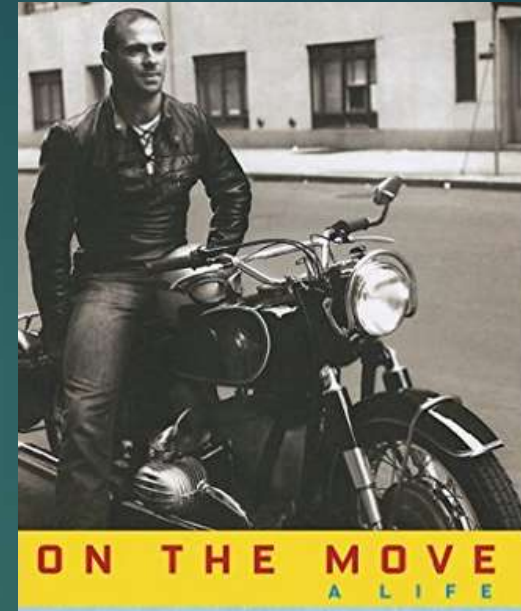
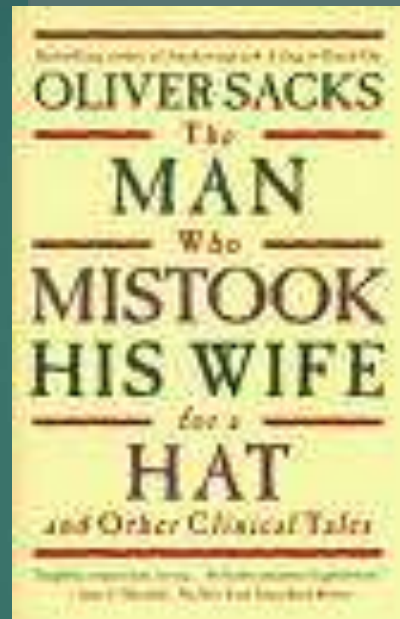
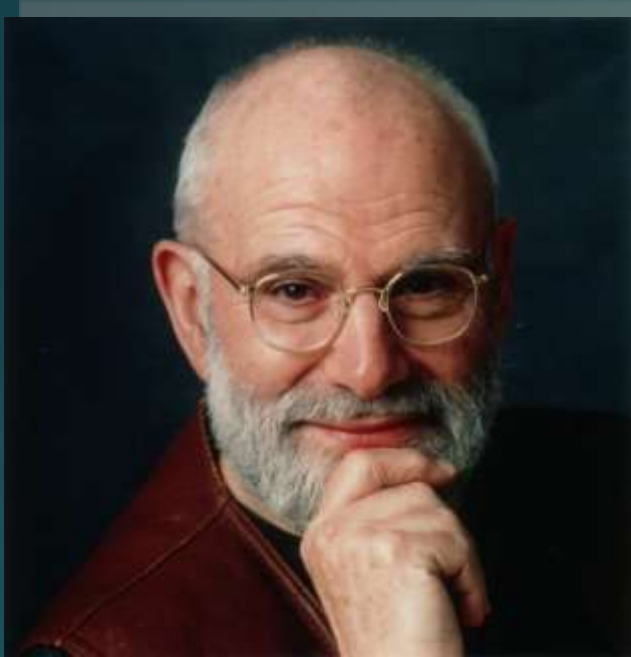


Memory is first malleable, then gets more permanent

Memory Consolidation: Basolateral region of the amygdaloid complex (BLA)

Hyperemesis: Superior Autobiographical Memory

Oliver Sacks, 1933 –
Hughlings Jackson of 20th century



Humanist Neurology

Rodolfo Llinás, 1934 - : MEG

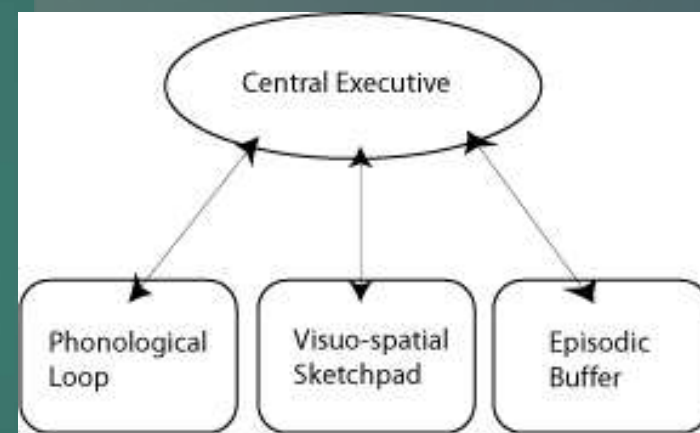


- ▶ Physiology of the cerebellum, the thalamus, thalamocortical dysrhythmia
- ▶
- ▶ Pioneering work on the:
 - ▶ inferior olive,
 - ▶ squid giant synapse
 - ▶ magnetoencephalography (MEG).

Alan Baddeley 1934-



1975: Working Memory Model



Paul Ekman, 1934- : Emotions



Ekman - Basic Emotions exist because there are universal facial expressions



Ekman - pioneered research using facial expressions in cultures across the world and boiled it down to six universally recognized emotions.

The 6 Basic Emotions

Anger
Disgust
Fear
Happiness
Sadness
Surprise

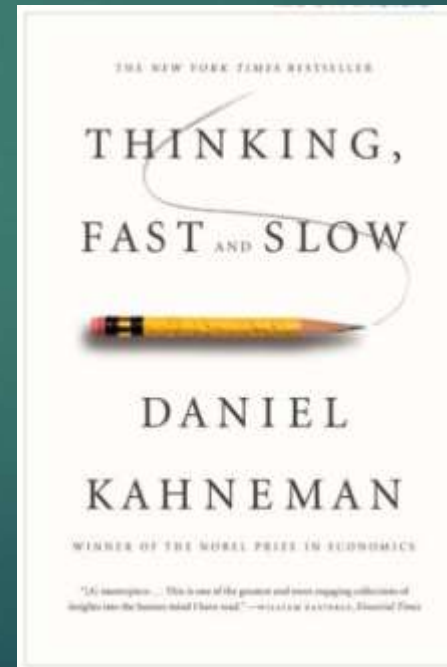
Daniel Kahneman, 1934 -



Israeli-American psychologist notable for his work on the **psychology of judgment and decision-making**, as well as **behavioral economics**

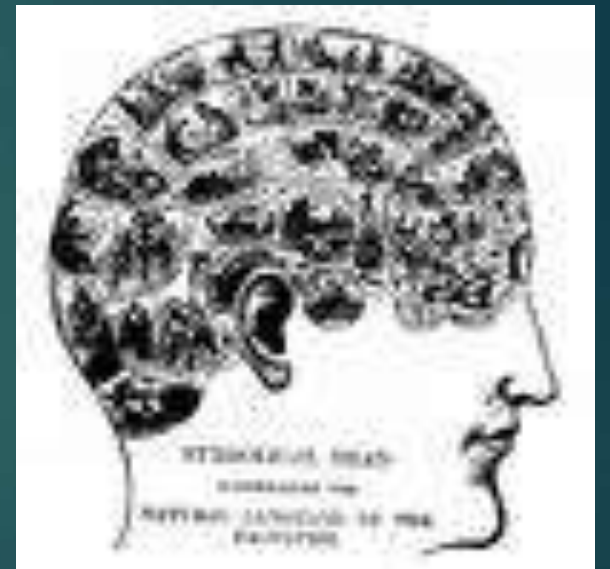
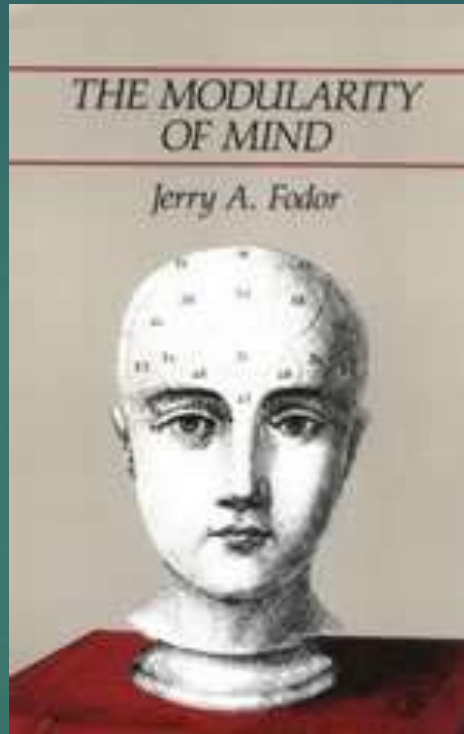
Awarded the **2002 Nobel Memorial Prize in Economic Sciences**

Challenges the assumption of human rationality prevailing in modern economic theory.



System 1: Hot (Go) System/Default	System 2: Cool (Know) System
Emotional	Cognitive
Stereotypic	Calculating
Automatic	Effortful
Frequent	Infrequent
Reflexive	Reflective (deliberative, logical)
Nonconscious	Conscious
Fast	Slow
Amygdala & Ventral Striatum	Prefrontal
Develops Early	Develops Later
Accentuated by Stress	Attenuated by Stress
Stimulus Control	Self-Control

Jerry Fodor, 1935 -: Evolutionary Modularity of Mind



Premier theorist of mind and cognitive scientist.

Has articulated a new form of “functionalism” and has advocated a “modularity” view of the mind, harkening back to Gall and the faculties of phrenology. Also Language of thought hypothesis (thought has syntax)

Giacomo Rizzolatti 1937-



1992: describes mirror neurons
In area F5 of monkey premotor
cortex

- ▶ Mirror neurons are a type of brain cell that respond equally when we perform an action and when we witness someone else perform the same action.
- ▶ “Read” other people's minds and feel empathy for them
- ▶ Parieto-frontal mechanism is the only mechanism that allows understanding others' actions from the inside, giving the observing individual a "first-person" grasp of other individuals' motor goals and intentions

Patricia Goldman-Rakic, 1937-2003



Married to Pasko Rakic

NIMH, Yale U

First to discover and fully describe the circuitry of the prefrontal cortex and its relationship to working memory

Her methods employed to study the sensory cortices could be adapted to the prefrontal cortical areas, revealing the circuit basis for higher cognitive function

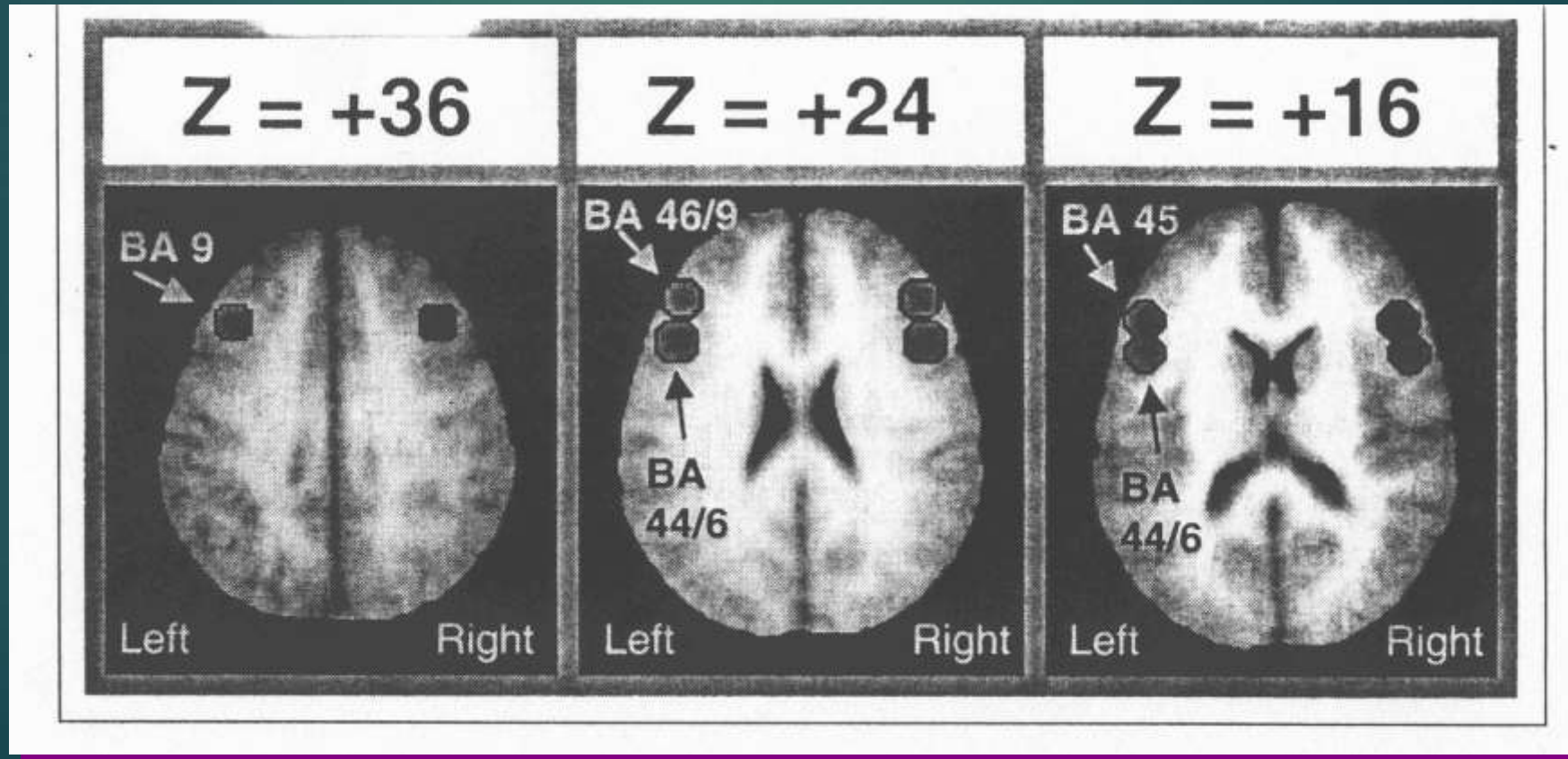
Pioneered the first studies of dopamine influences on prefrontal cortical function

Cellular basis of working memory

Founder of the *Cerebral Cortex Journal*

Working Memory: Neuroanatomy

Area 46 & 9: Spatial location WM -- where
Area 45: Visual feature WM -- what
Area 44: Linguistic WM



WM & Stereotype Threat

- ▶ Stereotype threat is a disruptive concern that occurs when people know that if they perform poorly, they will confirm a negative self-relevant stereotype
- ▶ In response to this threat, people underperform compared with their potential, thereby confirming the stereotype
- ▶ When older adults (60+) are confronted with negative stereotypes about age-related cognitive declines, they underperform on memory tests
- ▶ Neuroanatomy: choking up due to amygdala (threat detection) interfering with WM in prefrontal cortex; people who do not choke up have appropriate disconnect between amygdala and PFC
- ▶ Treatment: writing/journaling for 5 minutes about feelings or worries before test (B+ vs B-)

Suzanne Corkin, 1937-



- ▶ MIT: Professor of Behavioral Neuroscience
- ▶ Best known for her investigation of the famous amnesic patient, H.M., whom she met in 1962 and studied until his death in 2008.
- ▶ 2013: *Permanent Present Tense*



Student of Milner, Teuber

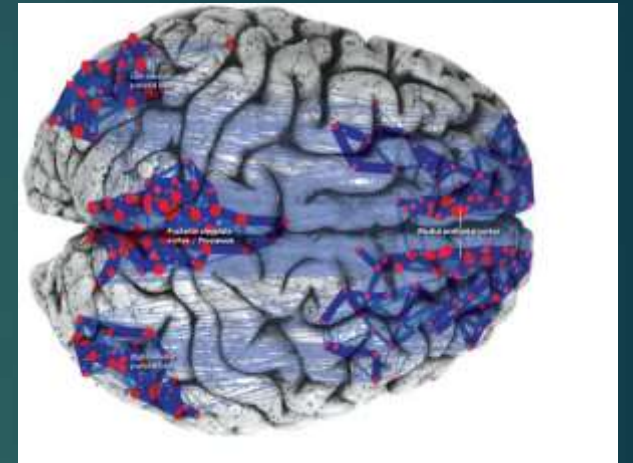
Marcus Raichle, 1937-



- ▶ Nature of functional brain imaging signals arising from PET and fMRI
- ▶ 1988 landmark study (Nature) on methodology of FMRI research
- ▶ 2001 -Task-induced activity decreases in functional brain images (physiological baseline)
This has led to the concept of a default mode network of brain function

Marcus Raichle: Default Mode Network, 2001

- ▶ Marcus Raichle coined "default-mode" in 2001
- ▶ A distributed network that is active when the brain is resting and that powers down during focused mental tasks.
- ▶ The network, which includes the medial prefrontal cortex, the posterior cingular cortex/precuneus, and the lateral parietal cortex
- ▶ Activates during daydreaming, self-referential thought, and during some kinds of memory retrieval.
- ▶ Killed by Alzheimer's disease



Kenneth M. Heilman, MD 1938-



Clinical Neuropsychology:
5th Ed with Edward Valenstein

1982: Past President, INS

Student of Norman Geschwind

Univ. of Florida: Behavioral neurologist

Hemispheric discoveries:

Hemispatial Neglect: right hemisphere is dominant for attending to both sides of space

Prosody: right hemisphere

Praxis: Skilled movement, such as tool use, is controlled by a left hemisphere modular network where the parietal lobe contains the representations of the spatial trajectories (input praxicons), & the frontal lobe transforms this into motor codes (output praxicons).

ANS: control by right parietal lobe

Mechanical klg: left hemisphere (loss = conceptual apraxia)

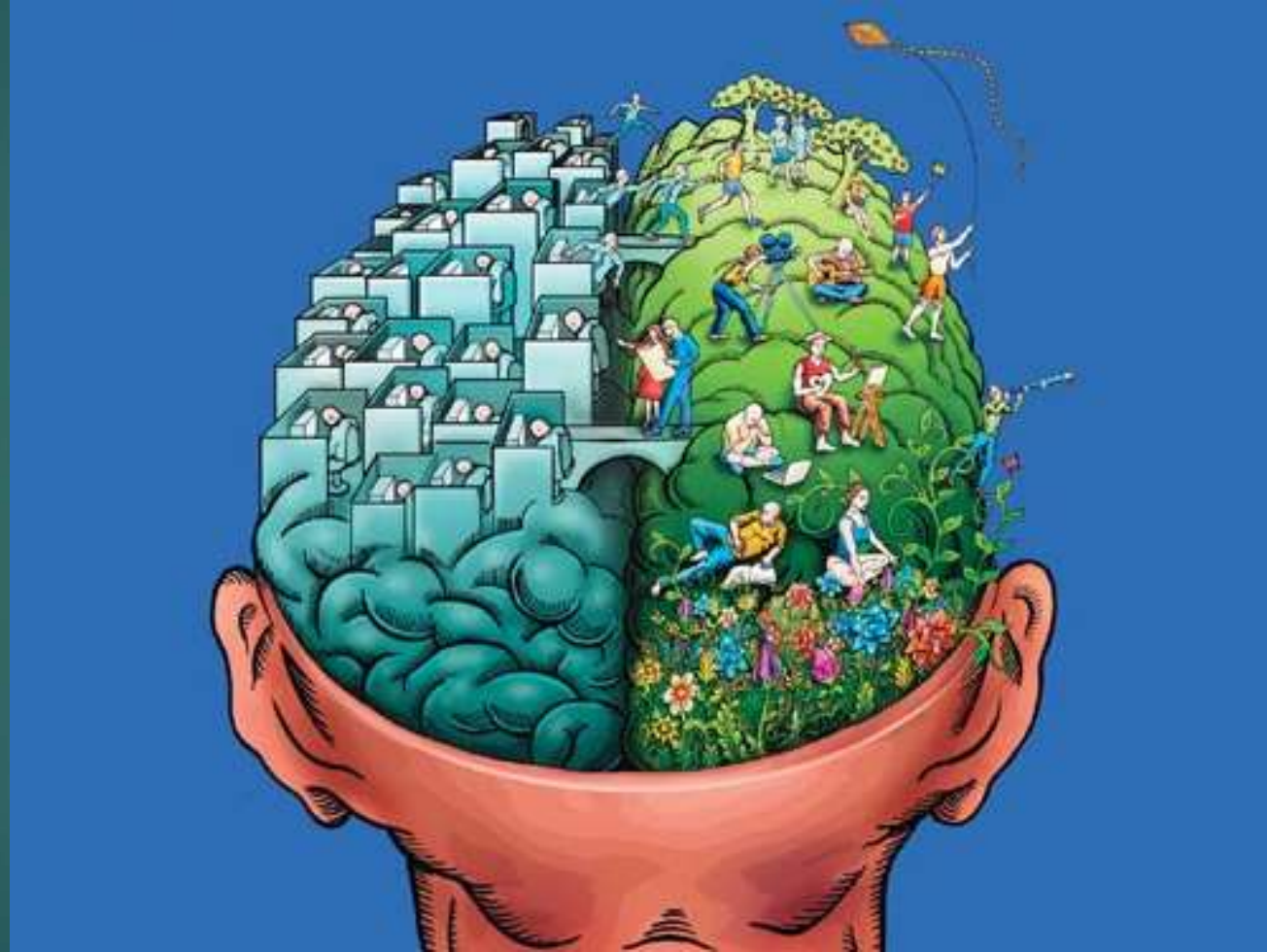
Deftness: left hemisphere controls deftness (precise) movements of both hands.

Dominant Left vs. Minor Right circa 1890

▶ Dominant Left:
language,
reason,
logic,
masculine

Minor Right:
animality,
intuition,
feminine,
instinct,
criminal tendencies,
female impulsivity,
mental disease

Modern Popular theories: Right vs. Left Hemisphere



Michael Gazzaniga, 1939-: Cognitive Neuroscience



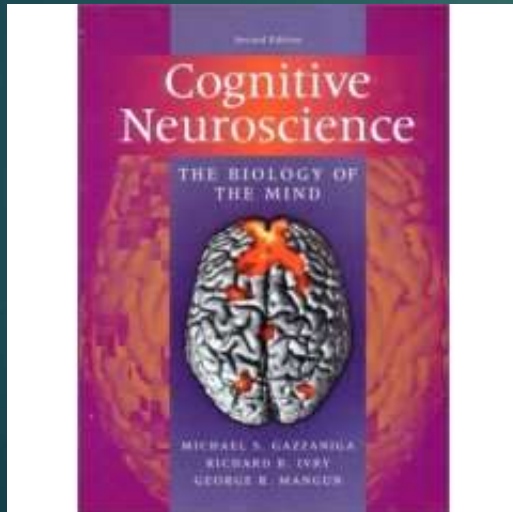
Cognitive Neuroscientist

Journal of Cognitive Neuroscience

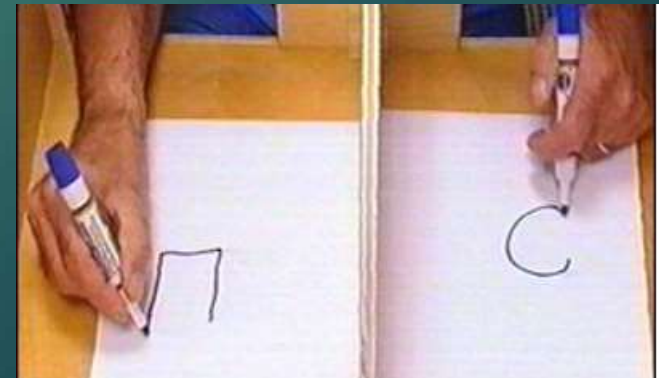
Gazzaniga, Ivry and Mangun coined the term “cognitive neuroscience” in the late 1970s to describe the study of “how the brain enables the mind.”

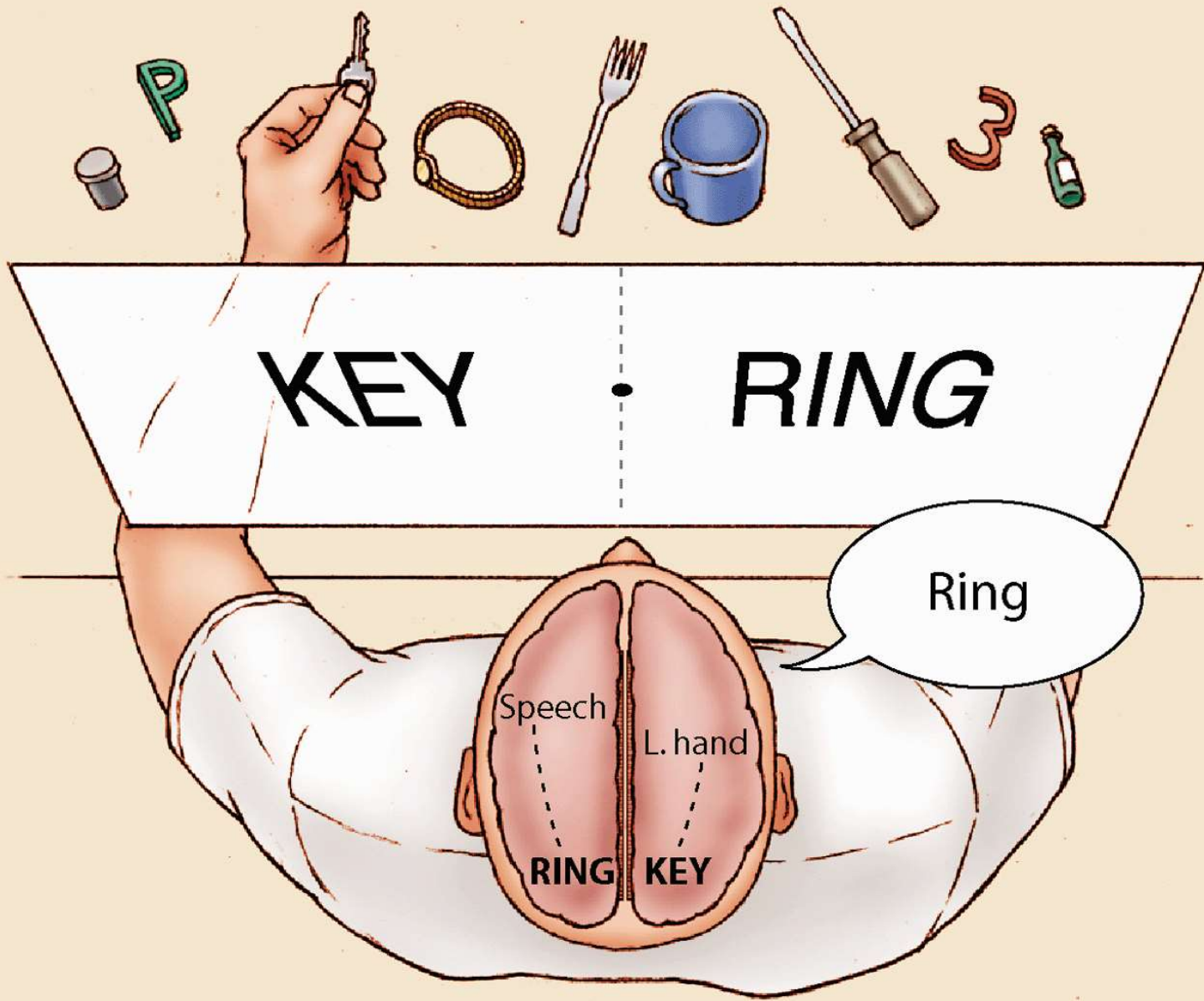
Split Brain & Hemispheric lateralization

Law and Neuroscience Project



Sperry's protégé





Left vs. Right Hemisphere circa 2000

▶ Right:

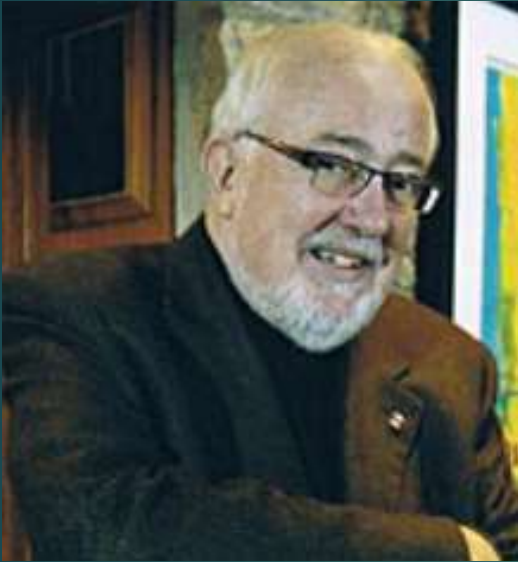
- ▶ Spatial processing
- ▶ Emotional interpretation
- ▶ Face recognition
- ▶ Mental Rotation
- ▶ Melody Recognition
- ▶ Appositional thought (Street Test)

• Left:

- Linear temporal processing
- Language
- Propositional thought (Similarities)

Be Careful! i.e. Bogen 1970 research that Indians are right brained.

Byron P. Rourke, 1939-2011



- ▶ Developmental Neuropsychology: North America's preeminent child-clinic neuropsychologist
- ▶ University of Windsor professor of psychology;
- ▶ One of the first child neuropsychology assessment laboratories in North America
- ▶ First to identify nonverbal learning disabilities (NVLD)
- ▶ *Nonverbal Learning Disabilities: The Syndrome and the Model*, Byron P. Rourke, 1989
- ▶ *Practice of Child Clinical Neuropsychology: An Introduction*

John O'Keefe, 1939- **Hippocampal GPS**



Student of Hebb

2014 Nobel in Physiology:

Place cells in the Hippocampus & discovery that they show, by the timing of their action potentials, a specific kind of temporal coding in the form of theta phase precession

Place cells spike at different phases relative to theta rhythm oscillations; create a positioning system in the brain

Functional role of the hippocampus as a cognitive map for spatial memory function

Joseph Altman & Fernando Nottebohm, 1940 - :



Joseph Altman



Fernando Nottebohm



Fred Gage

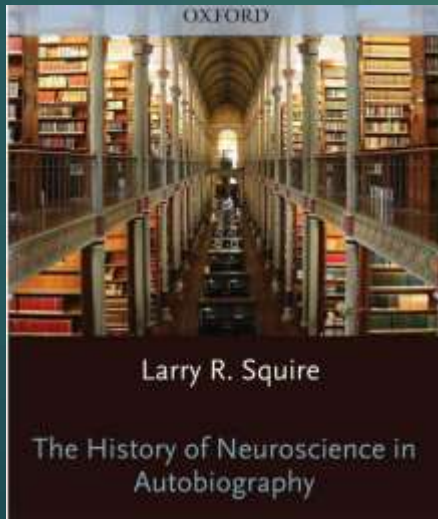
- ▶ In 1965, Joseph Altman discovered adult neurogenesis with Gopal Das at MIT in adult rats, cats, and guinea pigs. Tritiated thymidine autoradiography to label the cells; subventricular zone and in the dentate gyrus. Their results were largely ignored.
- ▶ In the mid 1970s and the early 1980s, Michael Kaplan found them in rats. Career ruined.
- ▶ In 1980s, Fernando Nottebohm: new neurons in adult canaries, in song learning
- ▶ Fred Gage: proof in rats & humans (cancer patients).

Larry R. Squire, 1941 - : Multiple Memory Systems



UCSD

Student
of Teuber



Organization and structure of mammalian memory: human memory impairment, identified the anatomy of the medial temporal lobe memory system, pioneered distinction between declarative & nondeclarative memory, conscious and unconscious memory systems, and standard account of memory consolidation

Pioneered the brain-based distinction between declarative and procedural memory, introducing these terms into neuroscience in 1980.

480 research publications

Books:

The History of Neuroscience In Autobiography (editor) (8 vols);
Memory and Brain;

Memory: From Mind to Molecules with Eric Kandel; *Fundamental Neuroscience* (4th Ed.)

Dean Delis & Joel Kramer



Professor of Psychiatry, UCSD



Professor of Neuropsychology
Director of Neuropsychology
UCSF Memory & Aging Clinic

Corroboration with Edith Kaplan

CVLT-2

WAIS-R NI

CVLT-C

WISC-III as a Process Instrument

D-KEFS

Examiner Battery

Donald Stuss: **Frontal Lobes**

Ontario Brain Institute & University of Toronto



1990: *Principles of Frontal Lobe Function*

Functions of Frontal Lobe

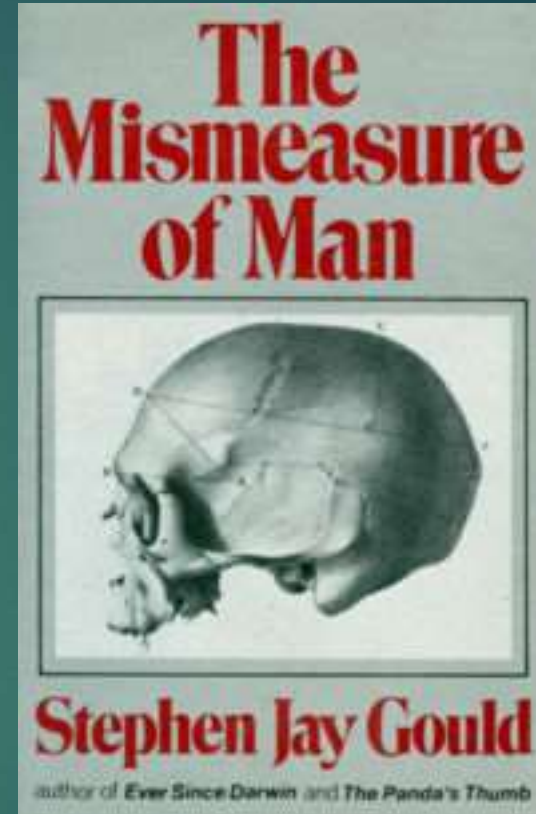
Anterior attentional processes

Emotion, and different aspects of theory of mind.

458 journal articles

1994: Past President, INS

Stephen Gould 1941-2002

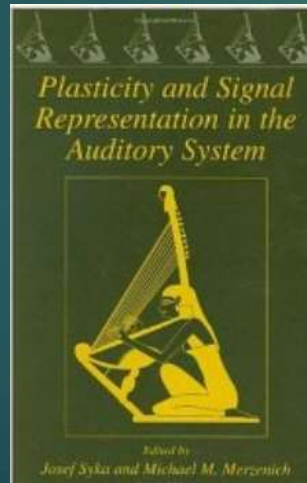


Stephen Gould's 1981 book re-opened questions about **the meaning of intelligence tests.**

Michael M. Merzenich, 1942 -



- ▶ Neuroscientist, UCSF
- ▶ Refined sensory cortex maps using dense micro-electrode mapping techniques.
- ▶ Multiple somatotopic maps of the body in the postcentral sulcus, and multiple tonotopic maps of the acoustic inputs in the superior temporal plane.
- ▶ Cochlear implant development
- ▶ Neuroplasticity
- ▶ Founder, Posit Science
- ▶ 100 patents



Brain hates a vacuum: Finger removal & arm deafferentation

- ▶ Michael Merzenich, UCSF, 1984:
- ▶ Microelectrodes to map sensory cortex:
 - ▶ mapped hand in monkey, removed a finger;
 - ▶ months later, brain map for missing finger was gone & replaced by maps for 2 adjacent fingers
- ▶ First evidence of brain reorganization: neuroplasticity

- ▶ Tim Pons, 1991: first proof that neurons in face map invaded area of missing arm map; 14 mm of arm map reorganized to process sensory input from face
- ▶ Lead to Ramachandran's 1992 work on phantom limbs: brain hallucinates a missing limb

Blind use visual areas of brain for tactile processing

- ▶ Congenitally blind reading Braille: activation of primary visual area from tactile sensation = radical reorganization of brain
- ▶ Tactile processing pathways usually linked in the secondary somatosensory area are rerouted in blind subjects to the ventral occipital cortical regions originally reserved for visual shape discrimination.
- ▶ Used TMS to prove causal link.

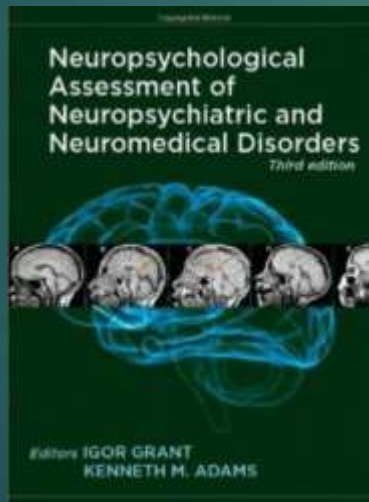
Igor Grant, 1942 -



UCSD: American psychiatrist

Director of the HIV Neurobehavioral Research Center (HNRC), California NeuroAIDS Tissue Network (CNTN), UC Center for Medicinal Cannabis Research (CMCR), CNS HIV Antiretroviral Therapy Effects Research (CHARTER)

Founding Editor of JINS & and founding co-editor of the journal AIDS and Behavior.



Neuropsychology of HIV

Neuropsychological Assessment of Neuropsychiatric and Neuromedical Disorders

2007: Past President, INS

Collaborator: R. Heaton

Stanley B. Prusiner, 1942 -



1997: [Nobel Prize for discovery of Prions](#)

Prions as infectious agents in several brain diseases that cause neurocognitive disorders in humans and animals.

Antonio Damasio, 1944 -



Descartes' Error: Emotion, Reason, and the Human Brain

Student of Geschwind

Neurobiology, especially neural systems which subserve emotion & decision-making, memory, language and consciousness.

"Gage Matrix": prefrontal damage, intact cognition, compromised emotional reactions (Somatic Marker hypothesis)

Not Cogito ergo sum, but experience/emotion precedes thought

Role of insula, ventromedial prefrontal cortex and amygdala in emotions

Misread Phineas Gage

OFC Tumor:

Is Mr. Spock's rationality the ideal

- ▶ 1982: Pt. E.: model father, corporate manager, 97%tile IQ
- ▶ Then behavior change; considered a "malingerer"; fired from job, wife divorced him.
- ▶ He walked into neurologist Antonio Damasio's office: bilateral mOFC tumor diagnosed & removed
- ▶ No emotional reaction (no GSR) to scenes of mutilation
- ▶ Now: pathological indecision: Use of blue or black pen, where to park
- ▶ Discovery: human decision making requires emotions to function correctly
- ▶ Damasio's Somatic Marker Theory: Iowa Gambling Test

Elizabeth Loftus, 1944- : Trauma and Memory



Memory is Malleable



Marsel Mesulam, 1945 -



Student of Norman Geschwind

- ▶ Leading behavioral neurologist
- ▶ *Principles of Behavioral and Cognitive Neurology.*
- ▶ Functional imaging of neurocognitive networks and on the pathophysiology of focal dementias
- ▶ Primary Progressive Aphasia.

Charles J. Golden, c 1946-



Luria Nebraska Neuropsychological Battery, 1987:
Quantification of Luria's qualitative method

Anne-Lise Christensen refused to collaborate

CJV: 1st LNNB computerized scoring program

1980-81, Past President, NAN

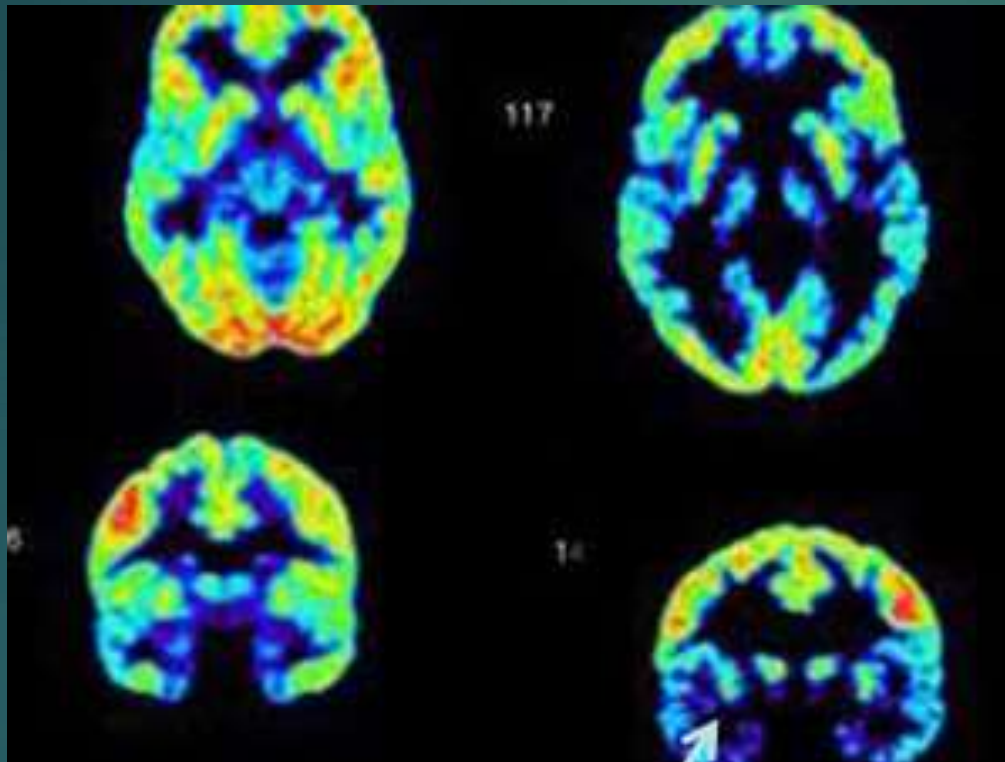
James Fallon, 1947 -



- ▶ Neuroscientist: adult stem cells, chemical neuroanatomy and circuitry, higher brain functions, and brain imaging.
- ▶ Fallon, who himself has the neurological and genetic correlates of psychopathy has been categorized as a "pro-social psychopath", an assessment with which he concurs.
- ▶ 2013: *The Psychopath Inside*: *A Neuroscientist's Personal Journey into the Dark Side of the Brain*

Cousin of Lizzy Bordon & 7 other murders

Brains of James Fallon PhD and son: Thwarted Sociopathy



Right: Low Orbital Frontal
Activation in Fallon

Fallon's brain (on the right) has dark patches in the orbital cortex. This is the area that Fallon says is involved with ethical behavior, moral decision-making and impulse control. The normal scan on the left is his son's. His is on right.

Fallon on Psychopathy: Combination of Factors

- 1 – Low Orbital Frontal activation pattern
- 2 - MAO-A gene (monoamine oxidase A):
high-aggression variant (low Serotonin),
Warrior gene
- 3 – Mother transmission to son
(X chromosome), too little Serotonin:
higher rates among males
- 3 – History of childhood abuse or
seeing lots of traumatic violence

Robert Sapolsky, 1947-



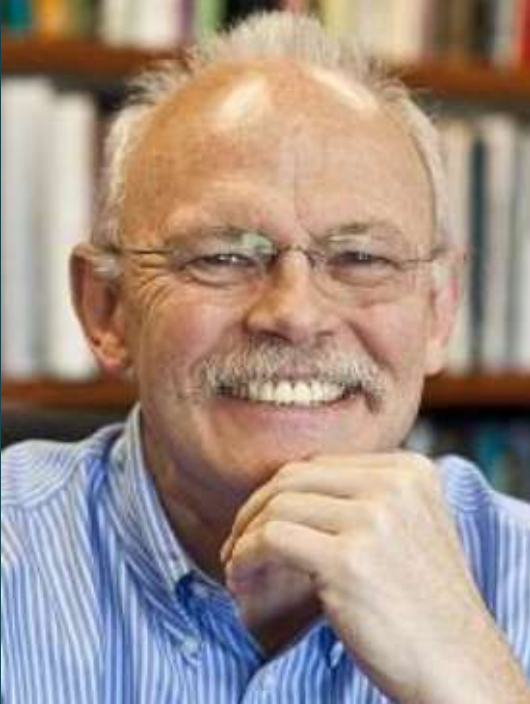
Neuroendocrinologist, professor of biology, neuroscience, and neurosurgery at Stanford University

1994: [Stress and Neuronal Degeneration](#)

1994: [Why Zebras Don't Get Ulcers](#)

[Best lecturer in world](#)

James Lloyd "Jay" McClelland, 1948 - : Neural Networks



- ▶ Stanford Univ.
- ▶ 1986: *Parallel Distributed Processing*
- ▶ Statistical learning and Parallel Distributed Processing applying connectionist models (or neural networks) to explain cognitive phenomena such as spoken word recognition and visual word recognition
- ▶ McClelland is to a large extent responsible for the "connectionist revolution" of the 1980s, which saw a large increase in scientific interest for connectionism (mental or behavioral phenomena as the emergent processes of interconnected neural networks)

Russell A. Barkley, 1949 -



Clinical professor of psychiatry
Medical Univ. of South Carolina

ADHD

1990: *Attention Deficit Hyperactivity Disorder*

2010: *Attention Deficit Hyperactivity Disorder in Adults*

2012: *Executive Functions*

Bruce L. Miller, MD, 1949 - : Frontal Temporal Dementia



UCSF Memory & Aging Clinic

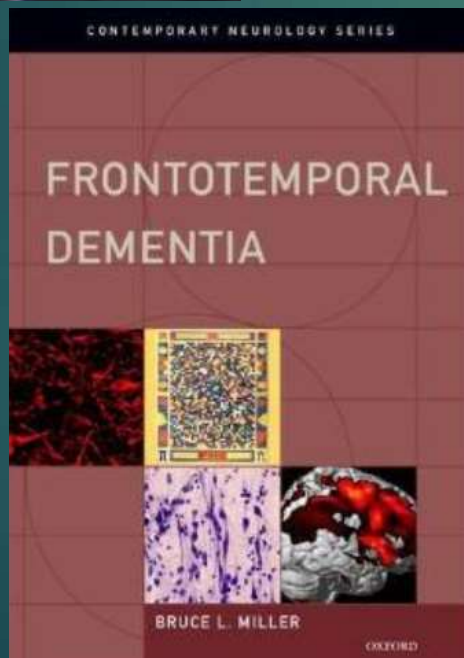
Frontal Temporal Dementia (FTD)
Tauopathies

2006: *The Human Frontal Lobes:
Functions and Disorders*

eds Bruce L. Miller, Jeffrey L. Cummings

2011: *The Behavioral Neurology of Dementia*

2013: *Frontotemporal Dementia*



Joseph E. LeDoux, 1949 -



Professor of neuroscience and psychology at
New York University

The Emotional Brain, esp. especially the
mechanisms of threat assessment (fear).

1996: The Emotional Brain

2002: Synaptic Self

*2009: Post-traumatic Stress Disorder: Basic
Science and Clinical Practice, co-Editor*

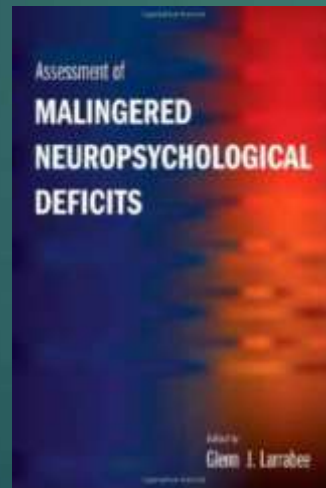
*2015: Anxious: Using the Brain to
Understand & Treat Fear and Anxiety*

A singer and guitarist in the science-themed
rock band The Amygdaloids.

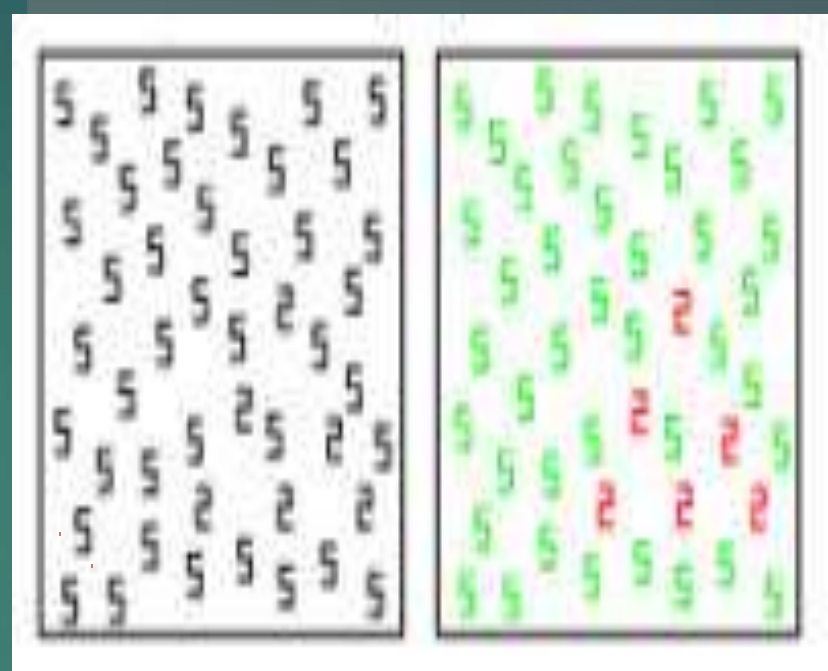
Glenn J. Larrabee, 1950 - : **Symptom Validity Testing**



- ▶ Independent practice of clinical neuropsychology, with an emphasis in forensic neuropsychology
- ▶ *Malingered Neuropsychological Deficits*
- ▶ *Continuous Visual Memory Test* co-author, with Dr. Donald E. Trahan
- ▶ Editor, *Assessment of Malingered Neuropsychological Deficits*



Vilayanur S. Ramachandran, 1951 - : **Weird Syndromes**

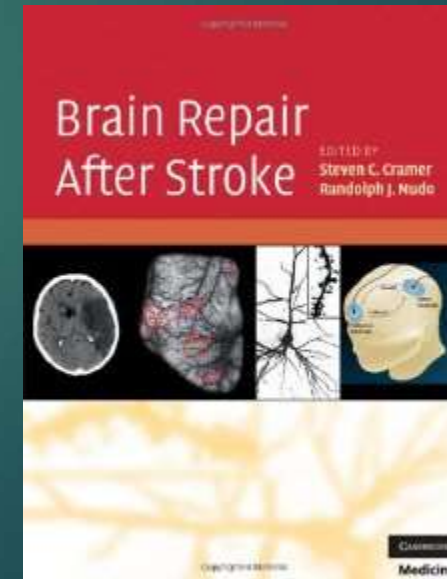


1994:

- **Neuroplasticity of the adult human brain;**
- **Phantom Limb, Capgras Syndrome,**
- **Synesthesia (neural cross-wiring),**
- **Apotemnophilia (desired self amputations)** (a neurological disorder caused by damage to the right parietal lobe; unresponsivity to tactile stimulation of limb areas)

Randolph Nudo, 1953 -

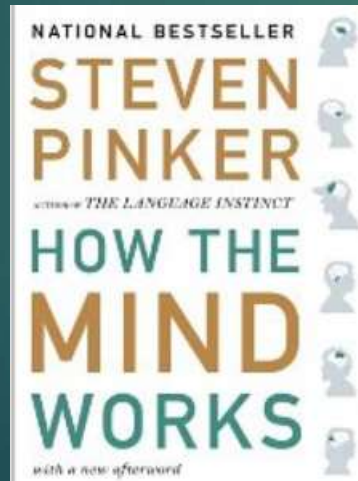
- ▶ Rehabilitation of stroke
- ▶ Neuroplasticity
- ▶ Size of motor representation of the fingers depends on experience:
- ▶ MRI shows that hand representation expands as result of performing complex finger tasks
- ▶ Most notable in Braille readers and string instrument musicians



Steven Pinker, 1954 -



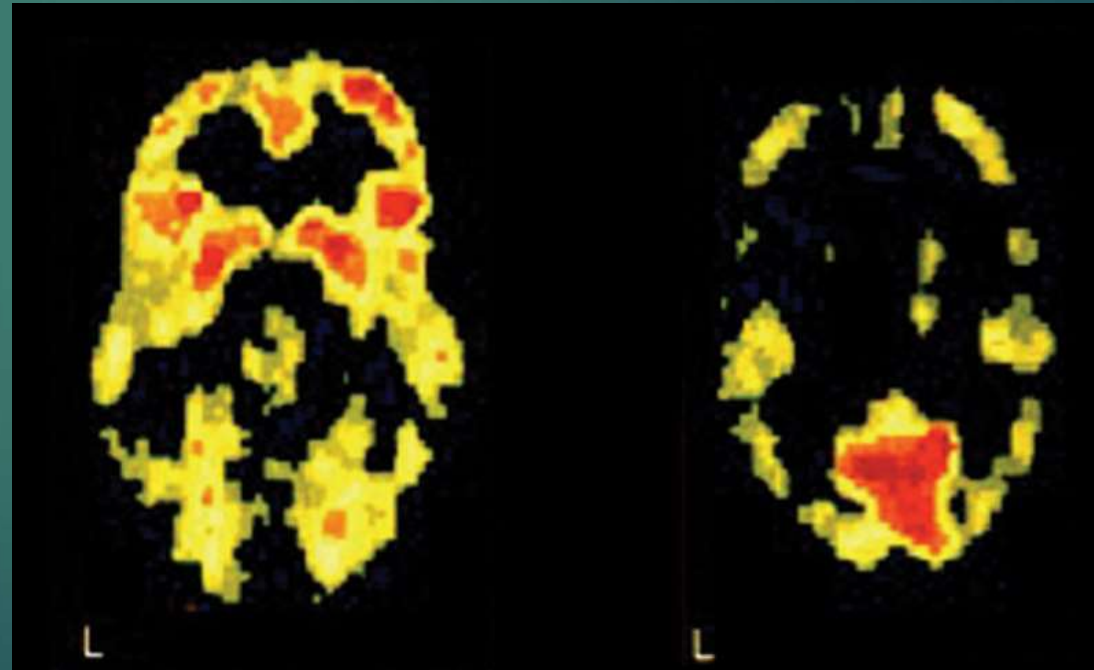
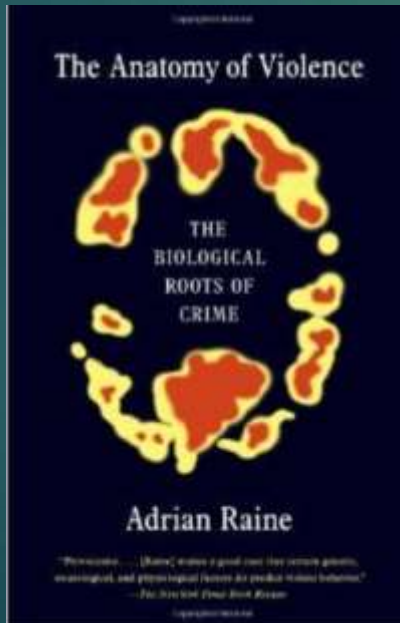
- ▶ Steven Pinker's books articulate a computational model of mind that also integrates insights from evolutionary psychology.



Adrian Raine, 1954 -



▶ 2014: Neurobiology of violence

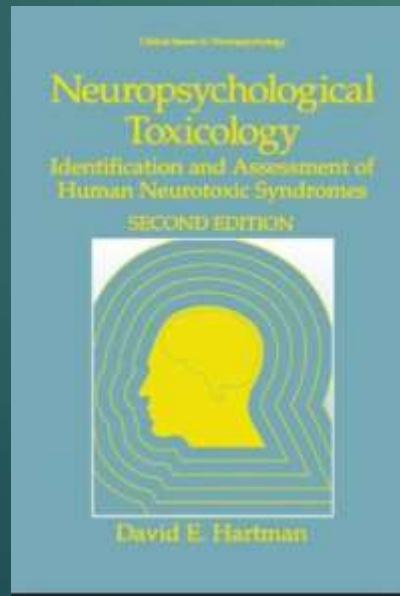


Murderer: no
Prefrontal activation

David Hartman, 1955 -



- ▶ Forensic neuropsychologist
- ▶ Neurotoxicology



Larry J. Seidman, 1957-



Beth Israel Deaconess Medical Center
Director, Neuropsychology Laboratory,
Professor of Psychology, Department of Psychiatry,
Harvard Medical School

Neuropsychology of schizophrenia and attention deficit/hyperactivity disorder (ADHD)

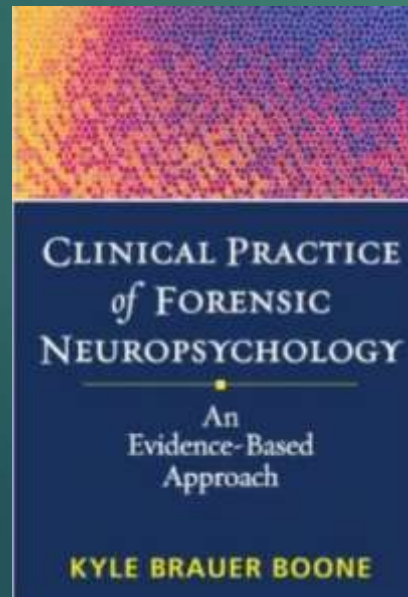
1983: extensive review of the world literature (1920-1982) evaluating brain dysfunction **in schizophrenia (1st frontal lobe deficit hypothesis & presence of cognitive deficits)**; core is dysfunctional network in an attentional network involving the frontal lobe, limbic system, and sub-cortical areas

Social Neuroscience: Brain, Mind, and Society - 2015

Kyle Brauer Boone, 1957 - : Symptom Validity



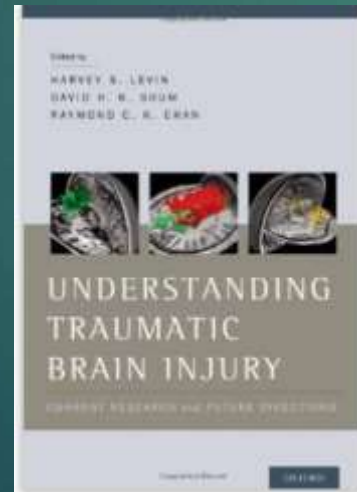
- ▶ UCLA School of Medicine
- ▶ Feigned Cognitive Impairment: Symptom Validity measures
- ▶ Forensic NP



Harvey E. Levin, 1960 -



- ▶ Baylor College of Medicine
- ▶ Neuropsychologist
- ▶ Traumatic Brain Injury
- ▶ 1989: Past President, INS



Student of Benton

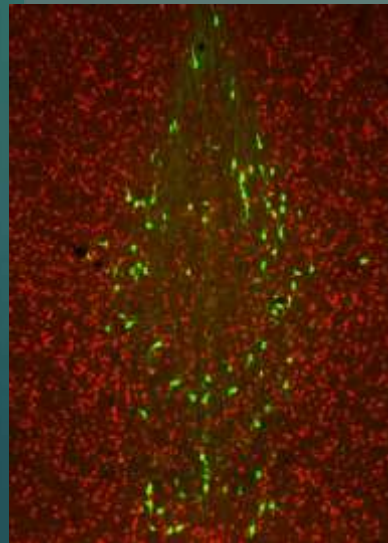
Elizabeth Gould, 1962 -



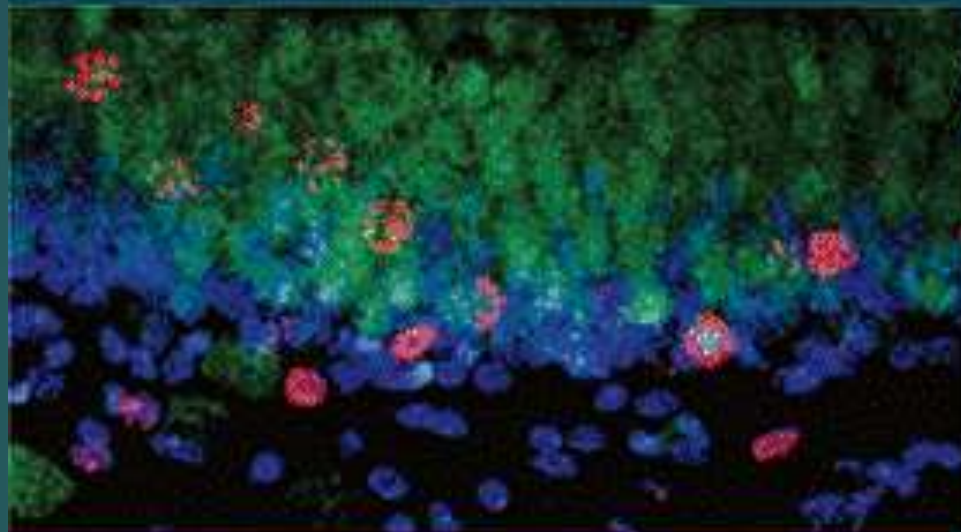
American neuroscientist

Professor of psychology at
Princeton University's
Department of Psychology

1998: Adult neurogenesis in the
hippocampus and olfactory bulb
of rats, marmosets and macaque
monkeys.

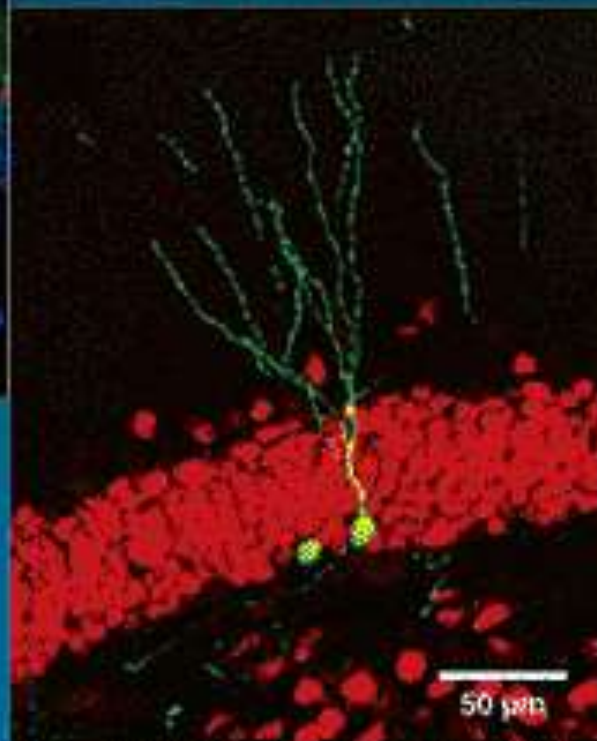


Neurogenesis in the Hippocampus

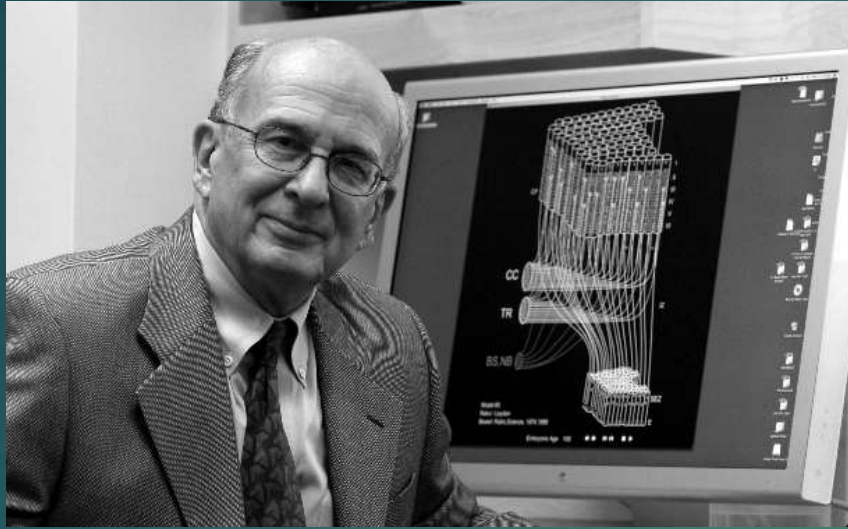


Adult rat brains spawn new cells (red) in the hippocampus

After 4 weeks new cells (green) appear functional



Pasko Rakic, 1933 - *“Read my lips – no new neurons.”*”



- ▶ Pasko Rakic, Professor of Neurobiology and Neurology, Yale Univ.
- ▶ Brain Development
- ▶ 1985 - “Limits of Neurogenesis in Primates”: No new neurons are born in the adult mammalian brain
- ▶ First description of neurogenesis in the subventricular zone
- ▶ 2008 Kavli Prize in Neuroscience: brain development

Michael McCrea, 1965 - : mTBI



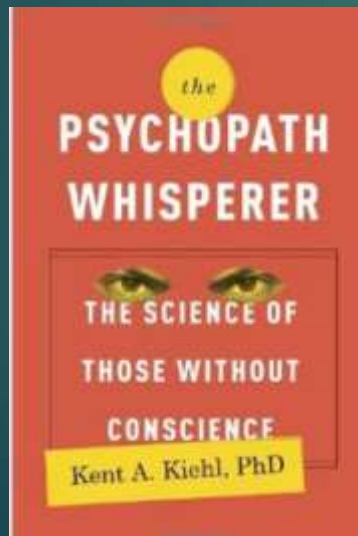
- ▶ Medical College of Wisconsin, *Director of Brain Injury Research*
- ▶ Acute and chronic effects of mild traumatic brain injury (TBI)
- ▶ 2007: *Mild Traumatic Brain Injury and Postconcussion Syndrome*
- ▶ mTBI: normal within a month
- ▶ PCS: majority psychiatric

Paul Green: **Symptom Validity Assessment**



- ▶ Dr. David Hartman described the work of Dr. Green as “the largest body of research on effort in the history of the profession”
- ▶ Symptom Validity Measures:
 - ▶ WMT (Word Memory Test)
 - ▶ MSVT (Medical Symptom Validity Test)
 - ▶ NV-MSVT (Nonverbal Medical Symptom Validity Test)
 - ▶ EPT (Emotional Perception Test)
 - ▶ MCI (Memory Complaints Inventory)
 - ▶ RSPT (Road Sign Perception Test)
 - ▶ AST (Alberta Smell Test)
 - ▶ SRT (Story Recall Test)

Kent Kiehl, 1970 - & his 1100 Psychopaths



Kiehl on Psychopaths

- ▶ Psychopathy: Score of 30 of 40 on Hare's Psychopathy Checklist-Revised (PCL-R) (normals score 4)
- ▶ Psychopaths typically exhibit impulsivity, poor planning, little insight and an utter absence of guilt or empathy.
- ▶ Psychopaths have impairment in the paralimbic system (ACC, Orbital F, Amygdala don't activate).
- ▶ Limbic system is not engaged during moral or emotional trigger

William Seeley, 1971-



Student of Bruce Miller

- ▶ American neurologist and Associate Professor of Neurology at the UCSF
- ▶ Frontal Temporal Dementia
- ▶ Connectivity Networks
- ▶ Selective Vulnerability Research Laboratory: regional vulnerability in dementia (why particular dementias target specific neuronal populations)

Lera Boroditsky, 1976 - : Language Shapes Thought



- ▶ She has discovered empirical examples of cross-linguistic differences in thought and perception that stem from syntactic or lexical differences between languages.
- ▶ Versus Chomsky: Counters the notion that human cognition is largely universal and independent of language and culture.

Languages divide up the world of color differently, and as a result speakers of English, Russian, Korean, Himba, Tarahumara and Greek differ in their ability to perceptually discriminate colors. Different languages encourage different kinds of cognitive expertise in their speakers

Fluoxetine (Prozac), 1987



- Used by 40 million people
- SSRI: Selective Serotonin Reuptake Inhibitor
- 2014: serotonin transporter knockout mice; no depressive behavior

Optogenetics, 1971:

Walther Stoeckenius and Dieter Oesterhelt,



- ▶ By inserting opsin genes into neurons; act as miniature solar panels, enabling the cells to convert illumination into electrical signals. Can use flashes of light to trigger firing by specific neurons on command. Use light to determine the precise role of those neurons in freely moving animals.



- ▶ The discovery of channelrhodopsin2 (ChR2) from the unicellular alga *Chlamydomonas reinhardtii* was the starting point for the optogenetic approach. When transfected into mammalian cells and activated by blue light ChR2 acts as an inwardly rectifying cation channel, thus depolarizing the cells

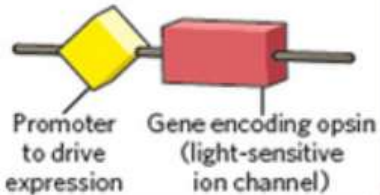
Controlling the Brain with Light

SIX STEPS TO OPTOGENETICS

With optogenetic techniques, researchers can modulate the activity of targeted neurons using light.

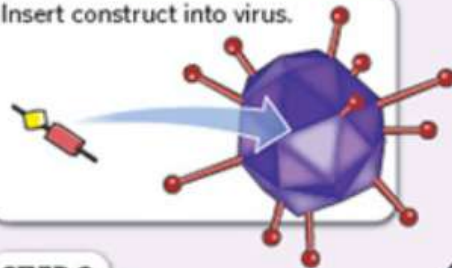
STEP 1

Piece together genetic construct.



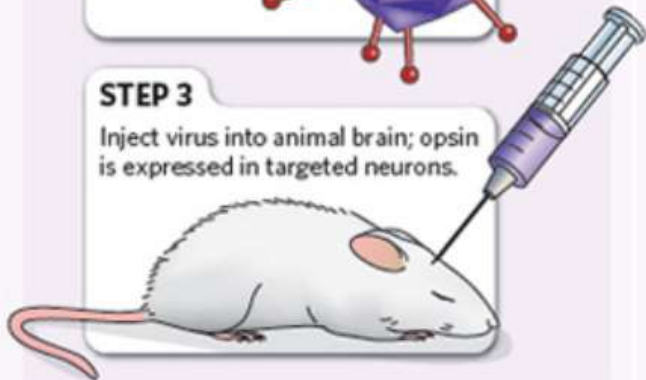
STEP 2

Insert construct into virus.



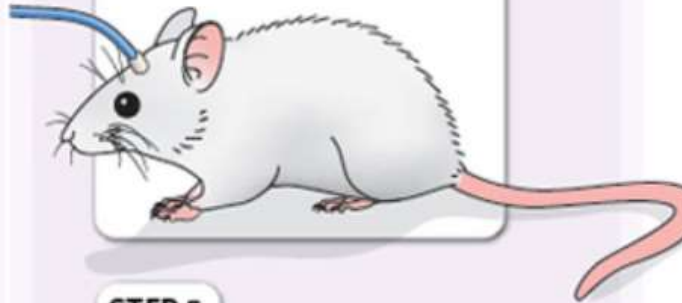
STEP 3

Inject virus into animal brain; opsin is expressed in targeted neurons.



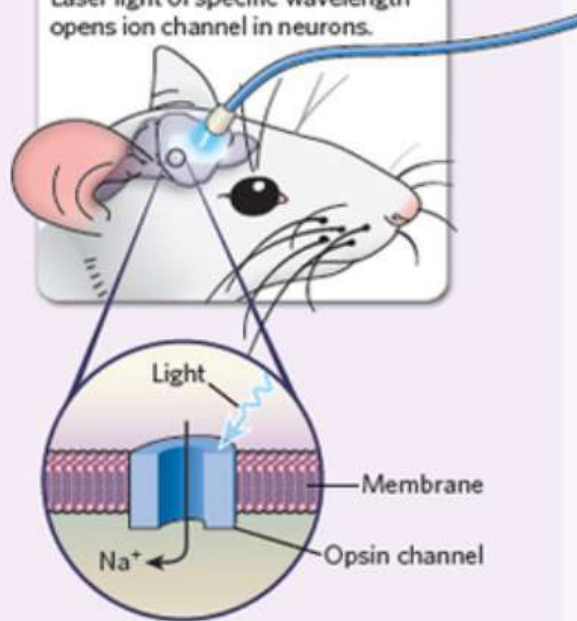
STEP 4

Insert 'optrode', fibre-optic cable plus electrode.



STEP 5

Laser light of specific wavelength opens ion channel in neurons.



Turn On: ChR2 activates the cells with blue light by depolarization,

Turn Off: NpHR inactivates the cells with yellow light by hyperpolarization of the cells

Neuropsychological Assessment Battery, ~2003

Robert A. Stern, PhD, Travis White, PhD



Delis–Kaplan Executive Function System (D–KEFS)



The Latest: PARiConnect, no more kits

Introducing the future of assessment...

PARiConnect™

Assessment at the speed of life™

←

→

— Launching January 2, 2013 —

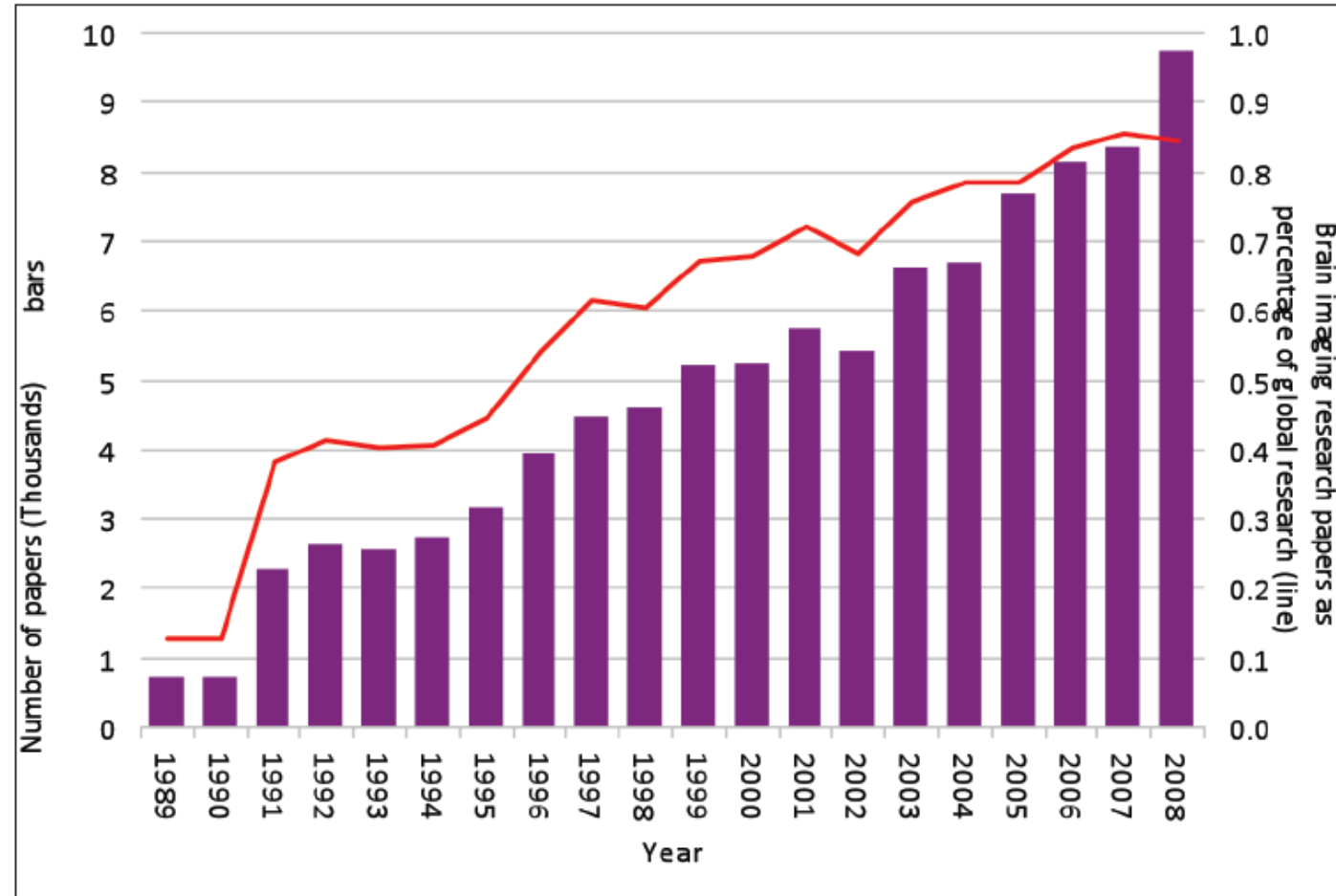


Imaging The Living Brain

- ▶ Computed Tomography (CT)
- ▶ Magnetic Resonance Imaging (MRI)
- ▶ Positron Emission Tomography (PET)
- ▶ Functional MRI (fMRI)
- ▶ Electroencephalography (EEG)
- ▶ Magnetoencephalography (MEG)
- ▶ Magnetic Field Correlation (MFC)

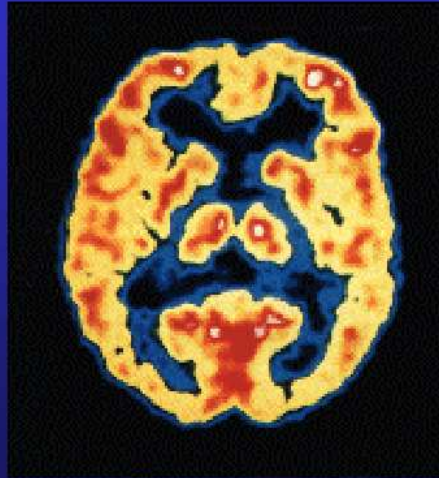
Number of neuroimaging papers: 1989-2008

Figure 1 Number of brain imaging papers and as percentage of all research papers, 1989-2008

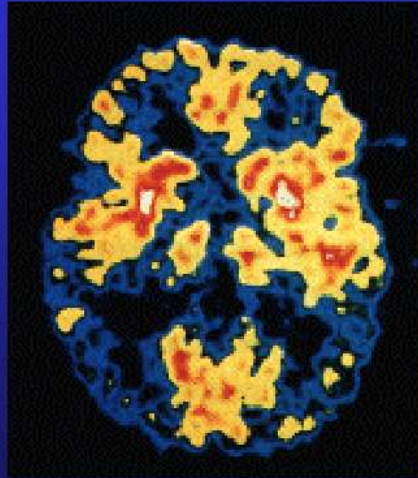


Birth of Cognitive Neuroscience

Brain Metabolism in Alzheimer's Disease: PET Scan



Normal Brain



Alzheimer's Disease

Cognitive Psychology

strengths: cognitive

Neuroimaging

strengths: normal brains, spatial resolution

Neurology

strengths: mechanisms, causation

Computerized Tomography (CT)

- Early technique to examine brain structure (1974)
- Special X-ray images region from different angles
- Computerized processing to reconstruct cross-section

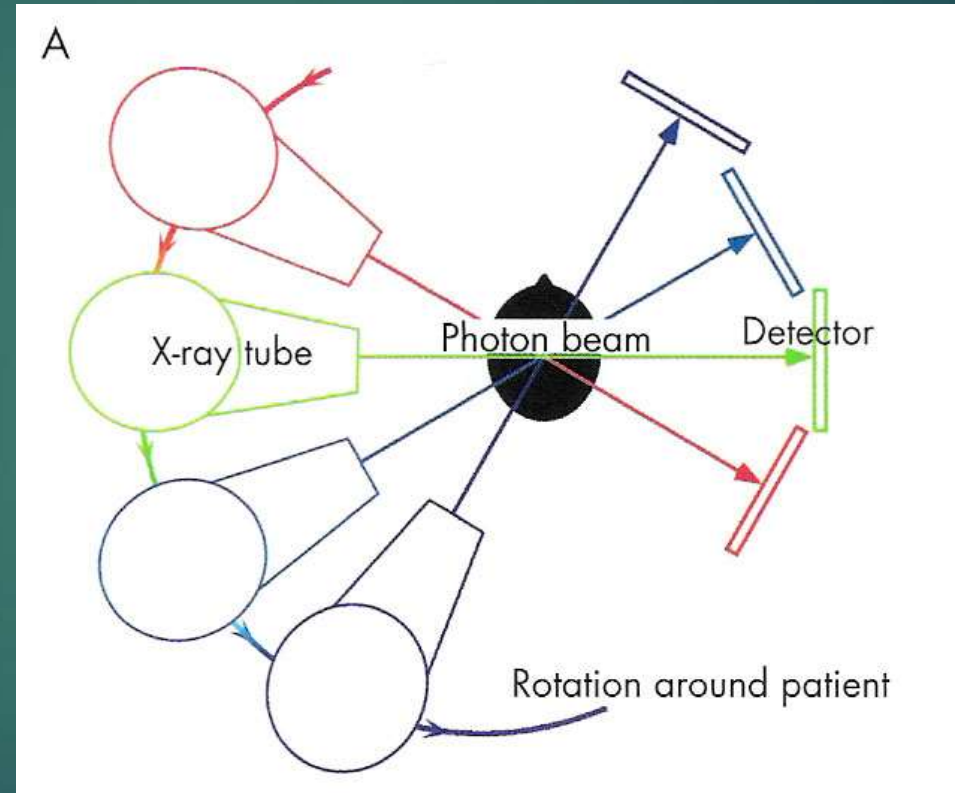
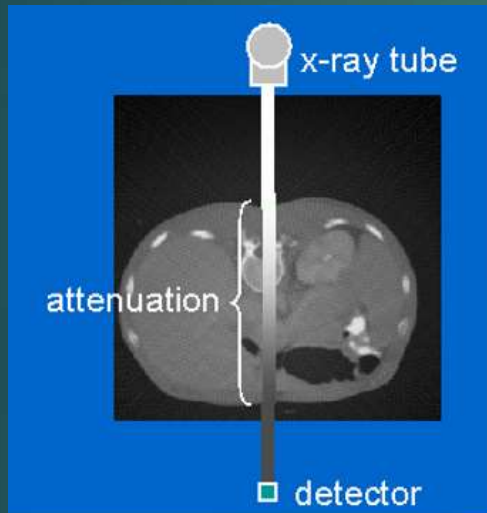


www.radiologyinfo.org

CT was invented in 1972 by British engineer Godfrey Hounsfield of EMI Laboratories, England and by South Africa-born physicist Allan Cormack of Tufts University,

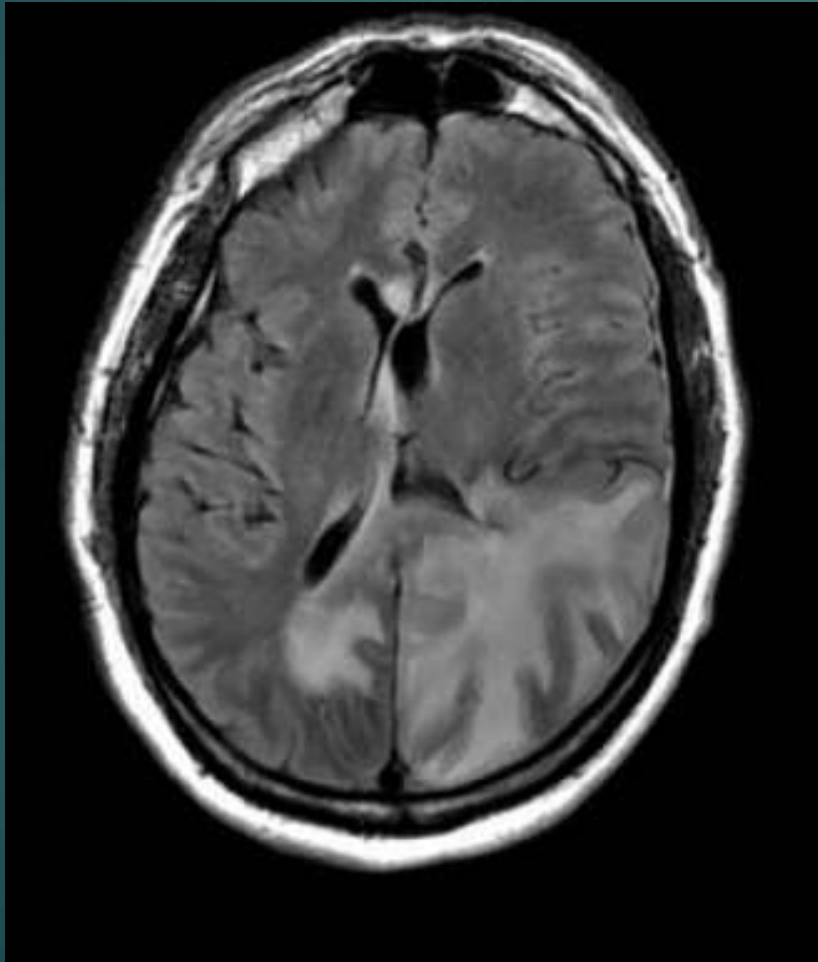
Computed Tomography

Based upon X-rays and attenuation

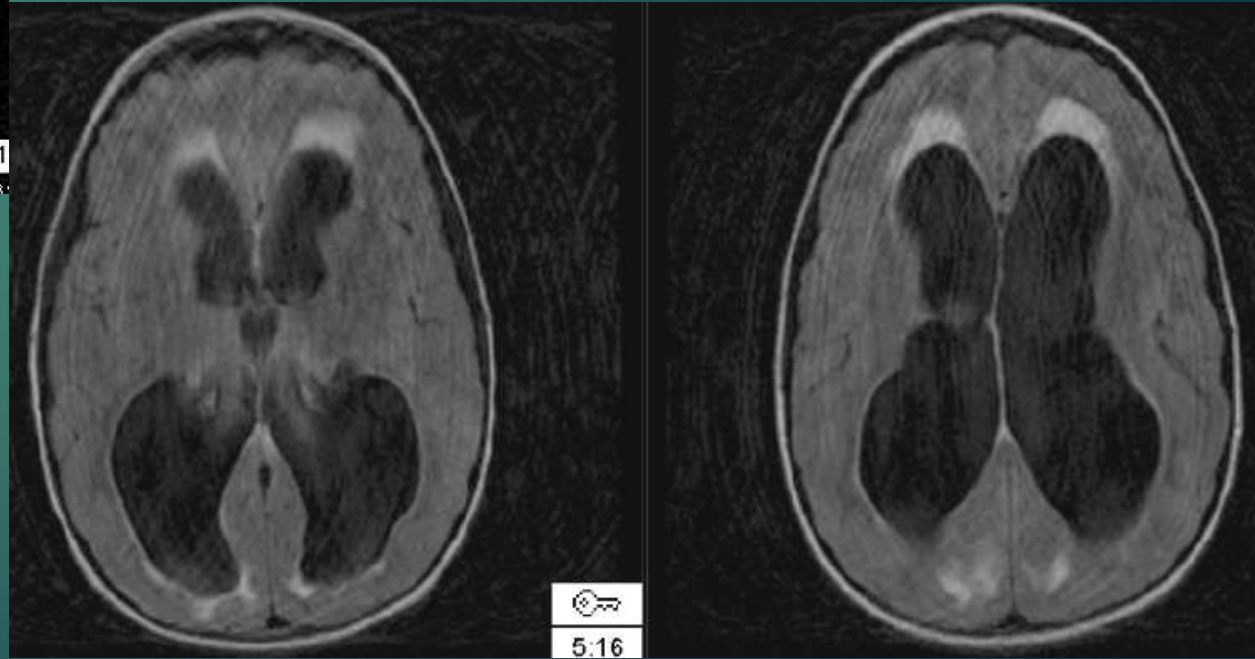
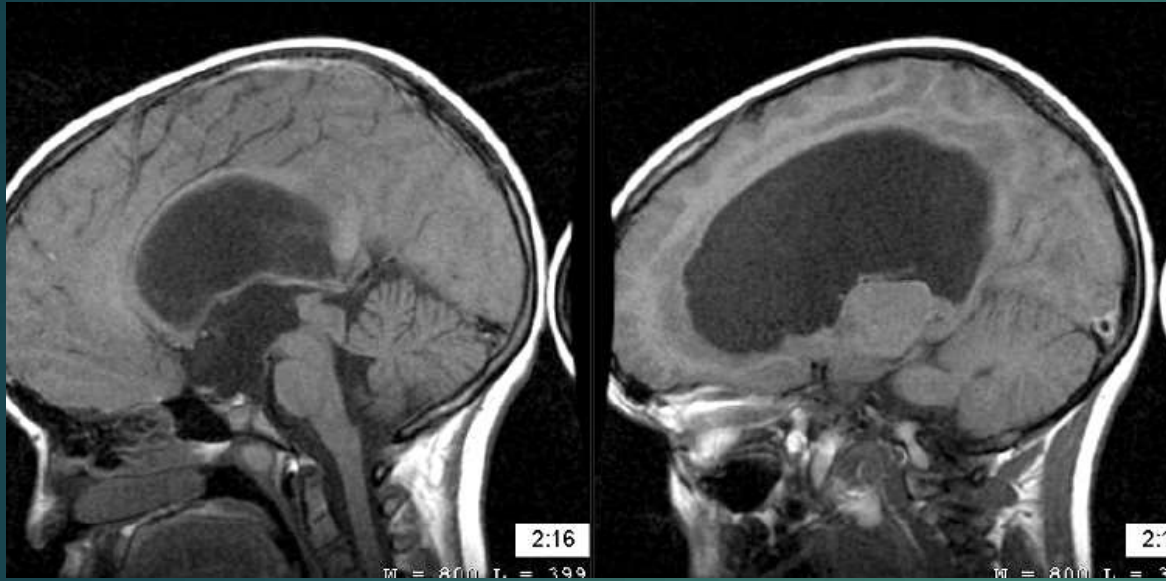


Images record tissue density as measured by variable attenuation

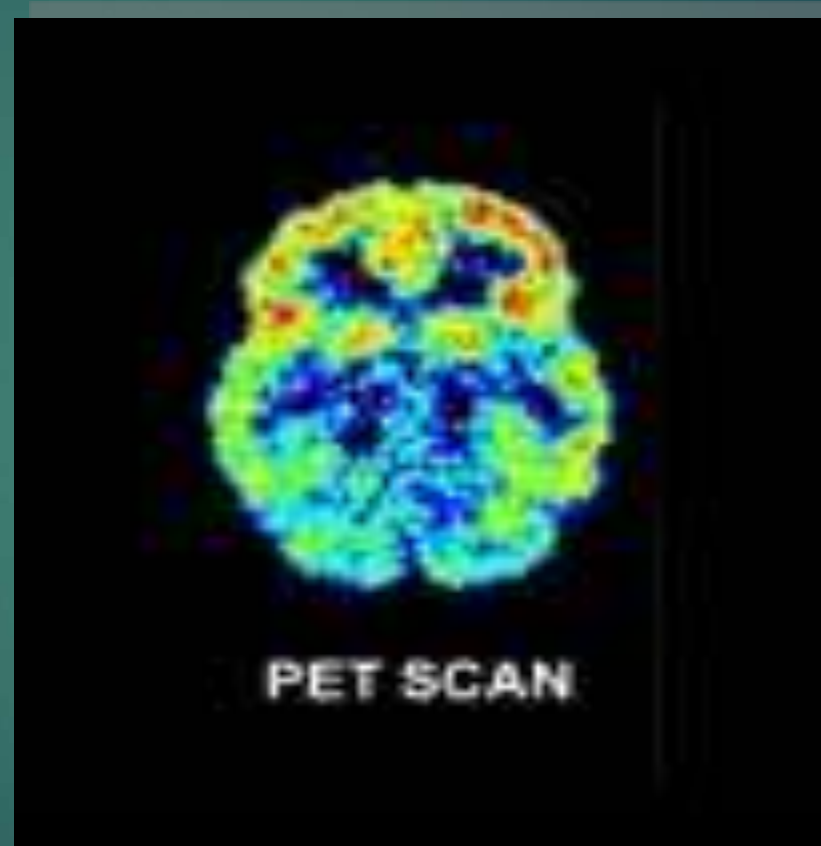
Severe Mass Effect from Tumor & Subdural



7 yo, right sided weakness, mild ataxia



Edward Hoffman & M. E. Phelps, 1974: Positron Emission Tomography (PET)



Blood flow and oxygen utilization

Positron Emission Tomography (PET)

- Developed in 1950s, applied to humans 1970s

- Label compounds of interest with positron tracers (glucose, oxygen, water)

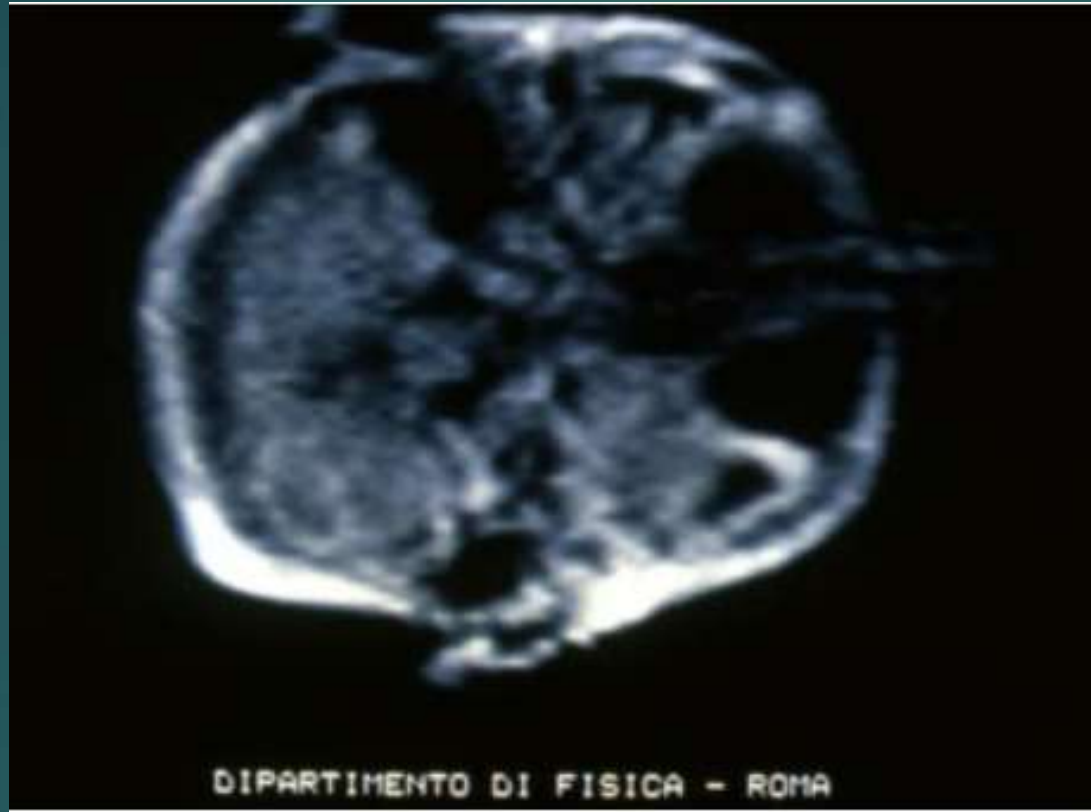
- Tracers distribute in brain, measure radioactive decay of tracer



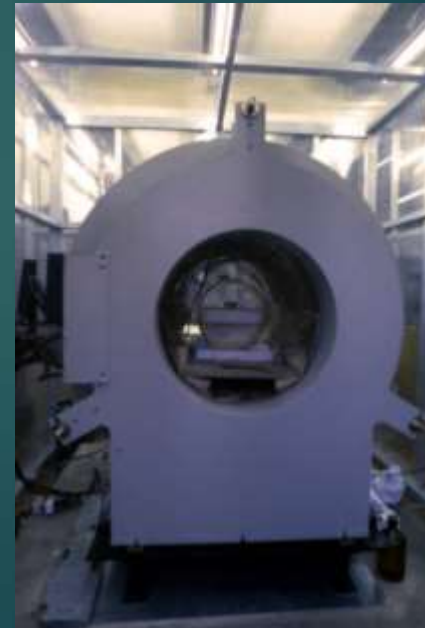
www.drugabuse.gov

- Poor temporal resolution, expensive, requires

First NMR of Human Brain 1983, Rome



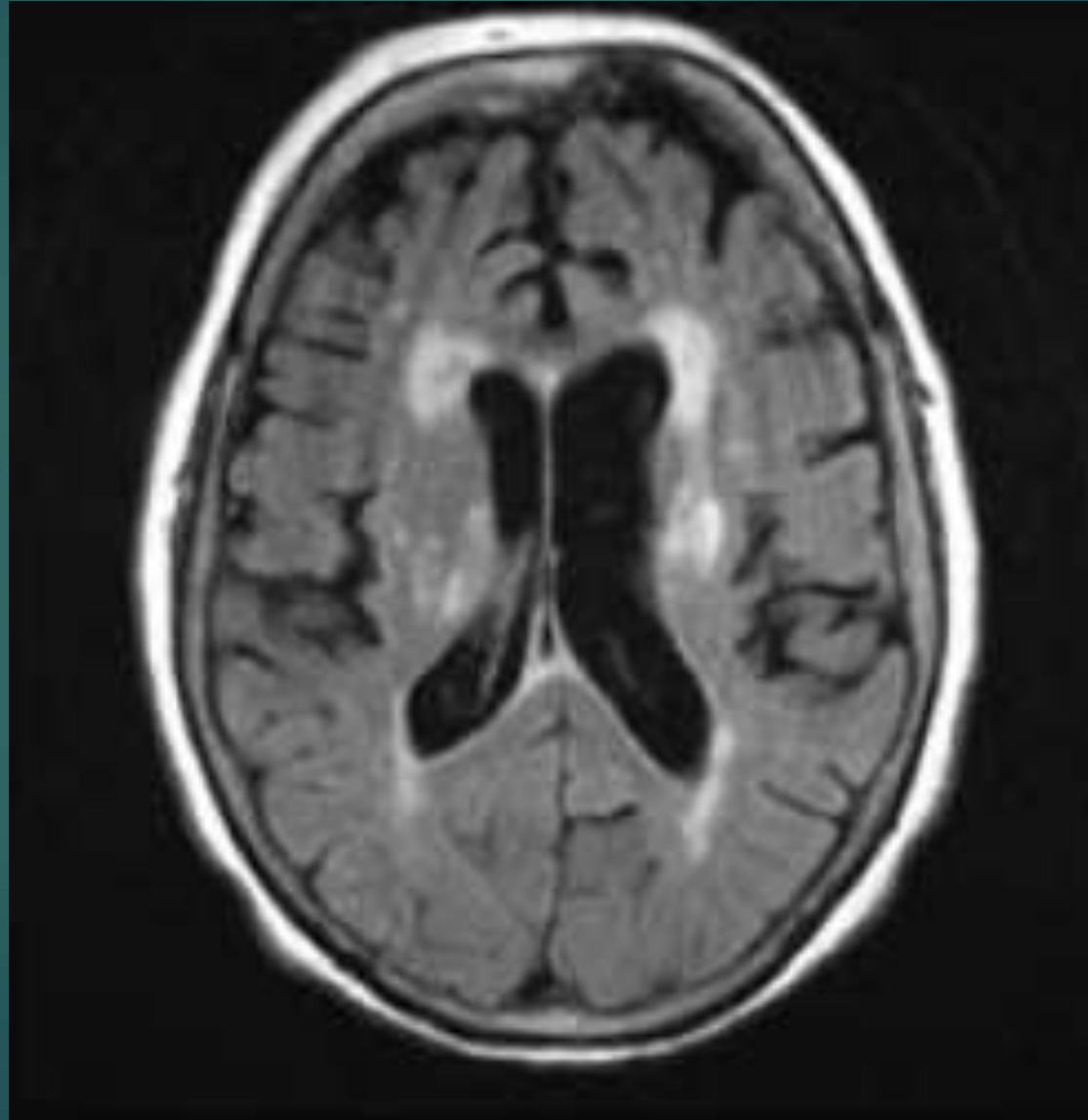
First NMR image (of mouse) in 1974



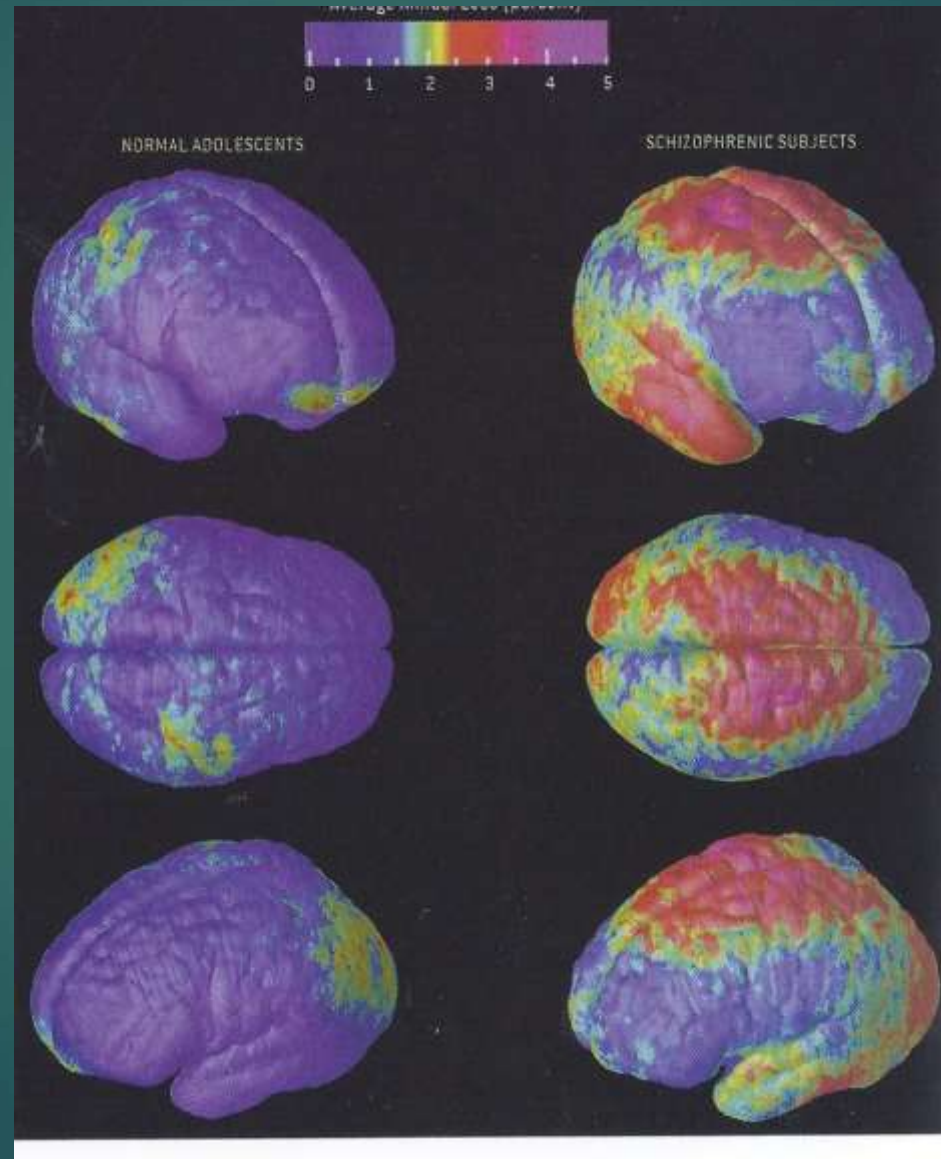
7 Tesla Siemens Magnetom: second best

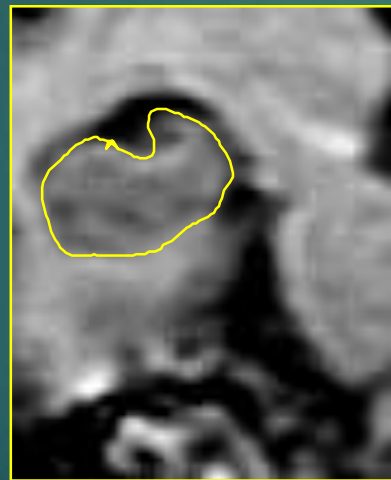
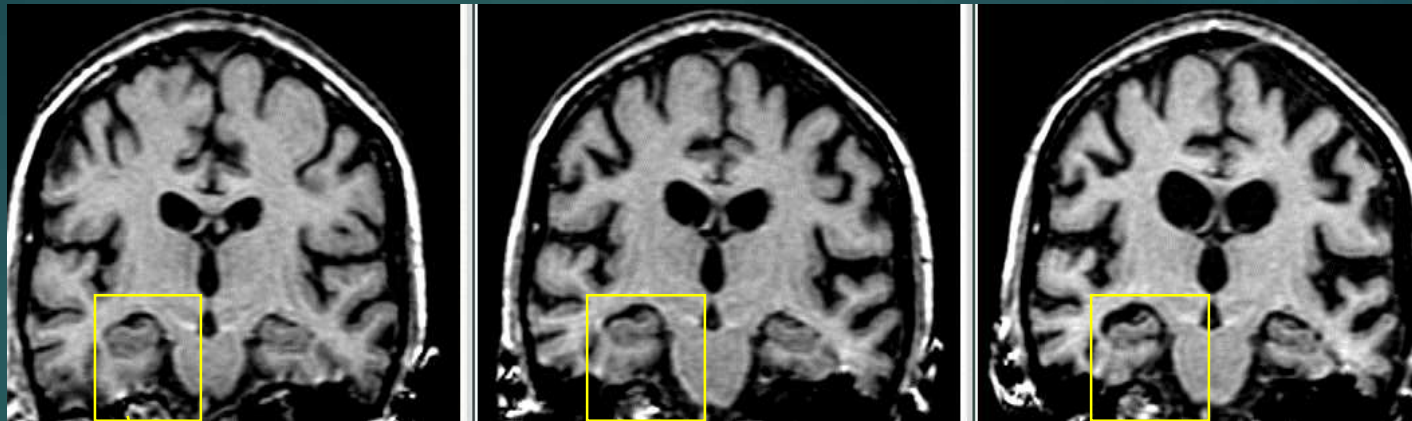


Microvascular ischemic disease: UBOs

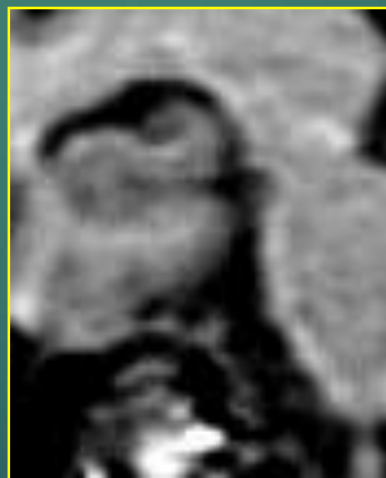


MRI: Childhood onset Schizophrenia – grey matter loss

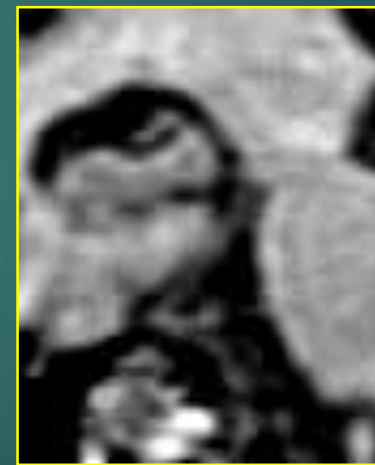




Time 0



18months

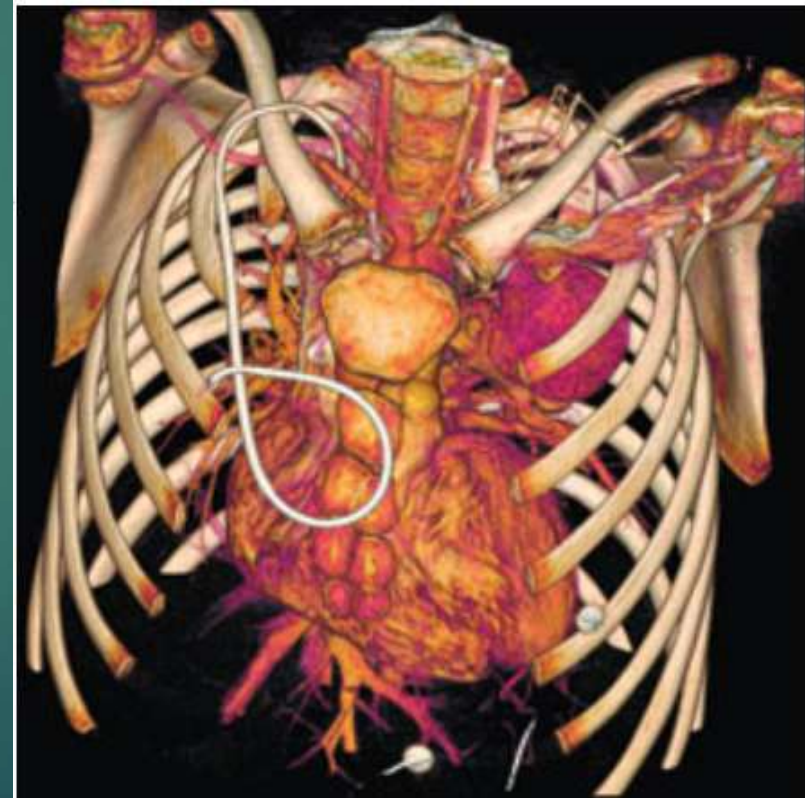
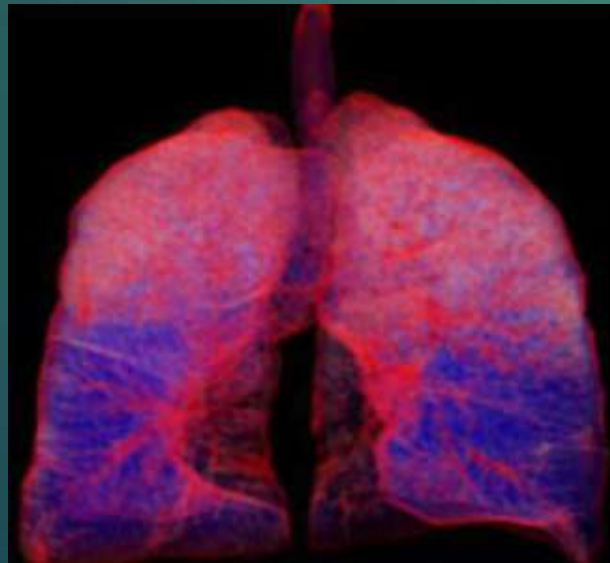


36months

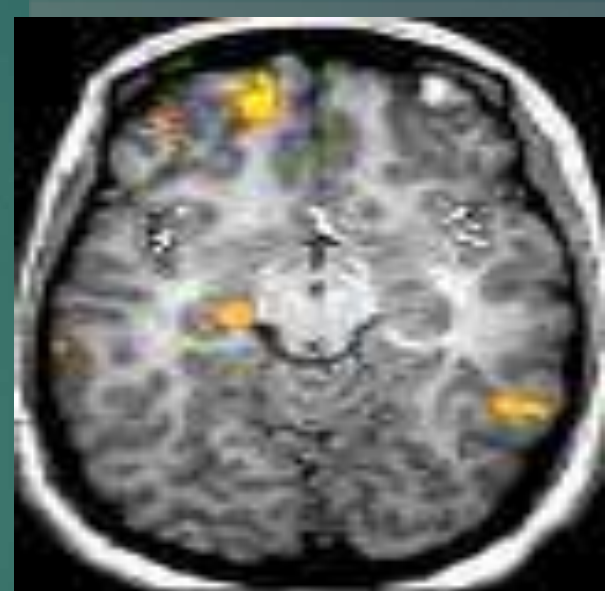
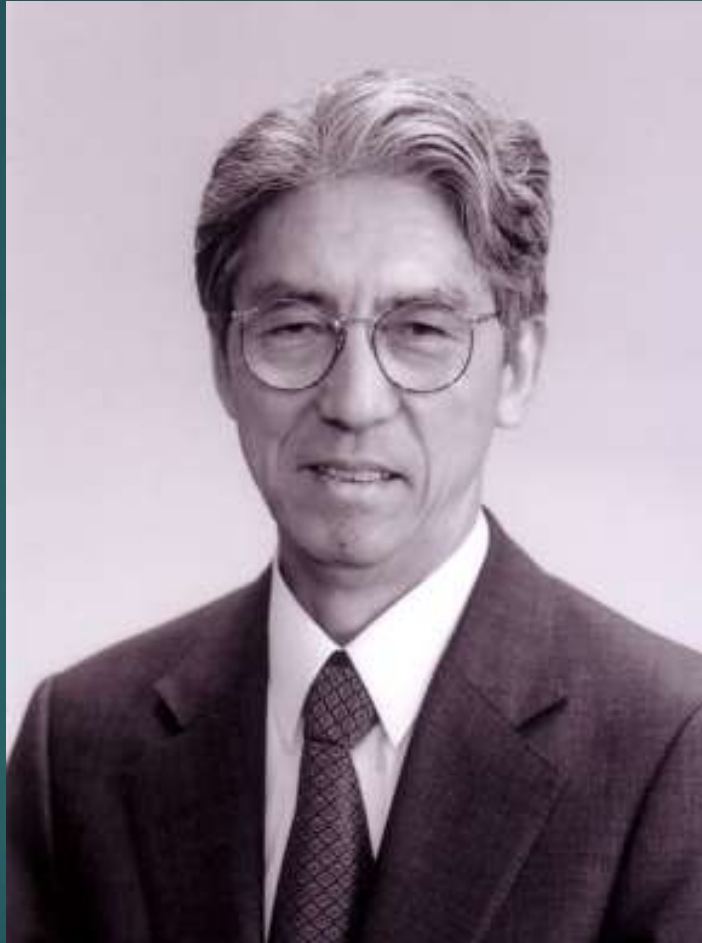
Hippocampal
Loss

Serial coronal MRI of an individual with initially mild AD

CT - Multidetector Imaging

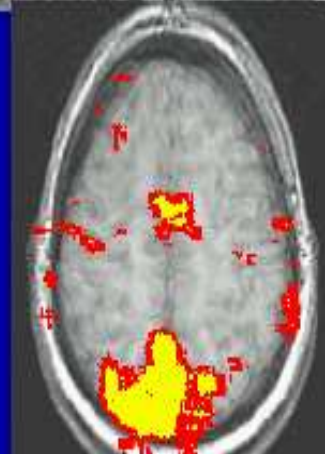
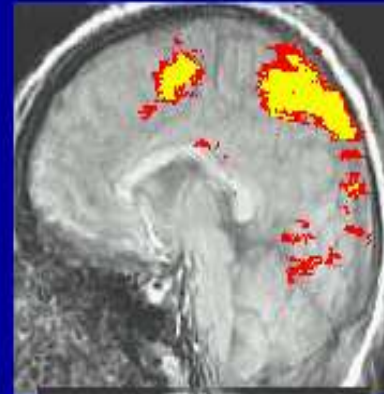


Seiji Ogawa, A.T.T. Bell Labs, 1990: **FMRI**

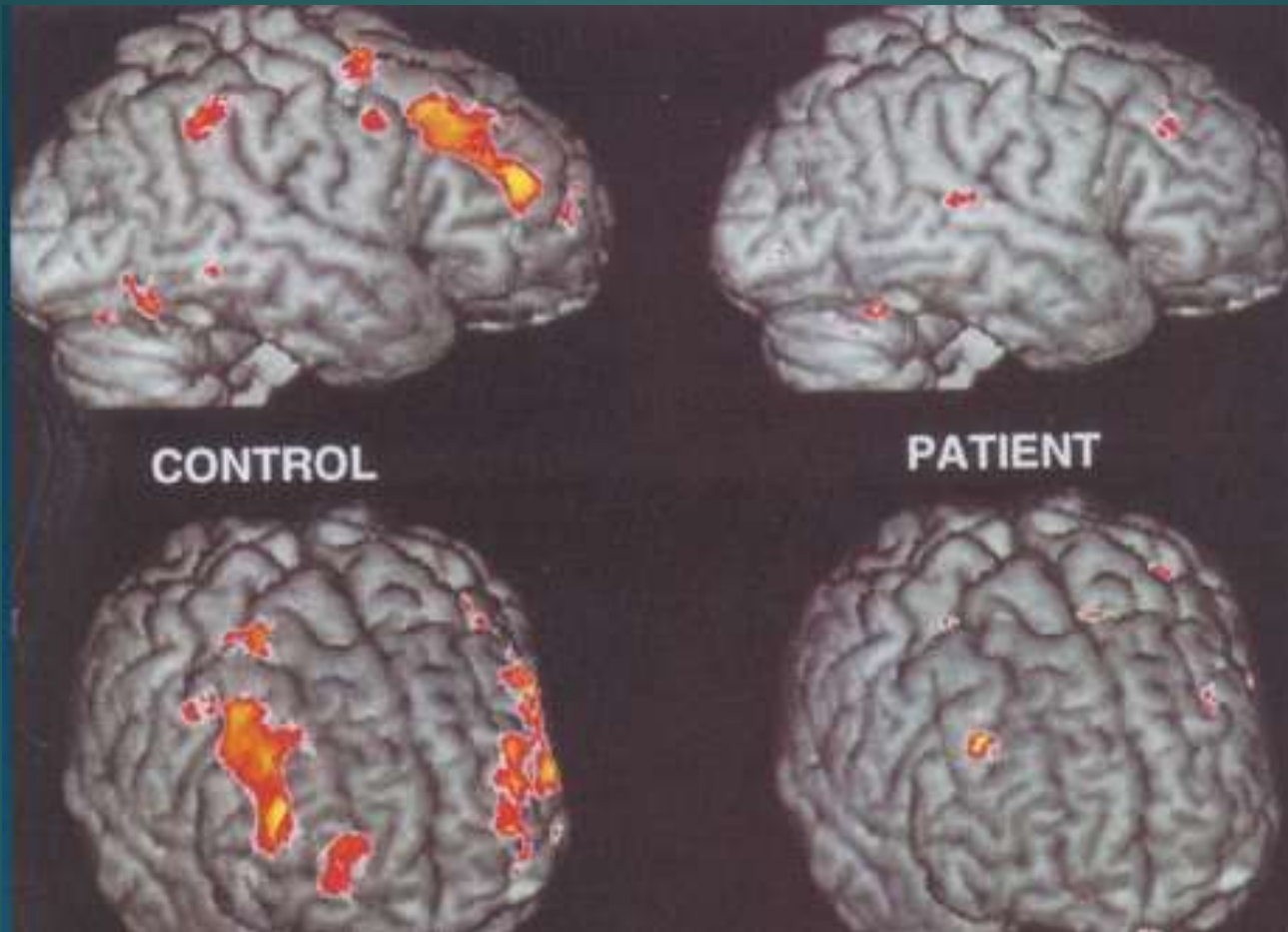


Functional MRI (fMRI)

- Developed in 1991
- Uses MR to detect changes in blood flow across functional states
- Blood oxygen level dependent (BOLD) response
- Good spatial and temporal resolution



fMRI: Reduced working memory in schizophrenia

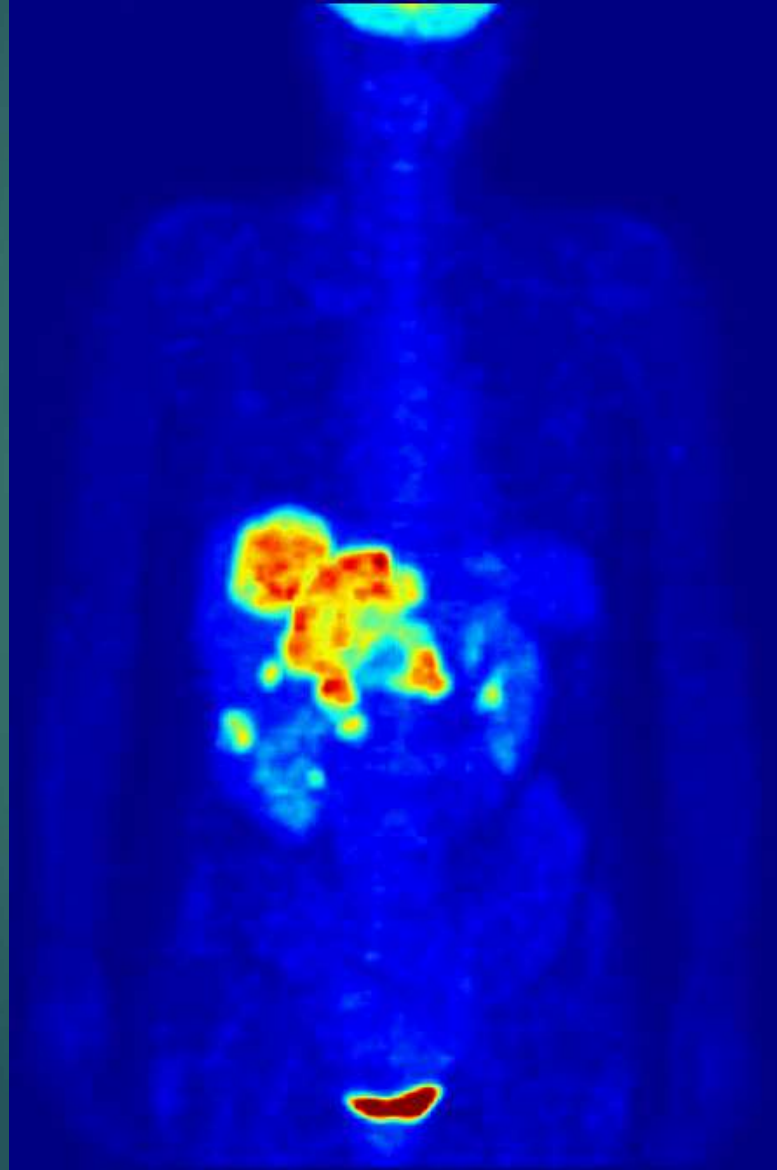


Reduction in blood flow in dlPFC in schizophrenia

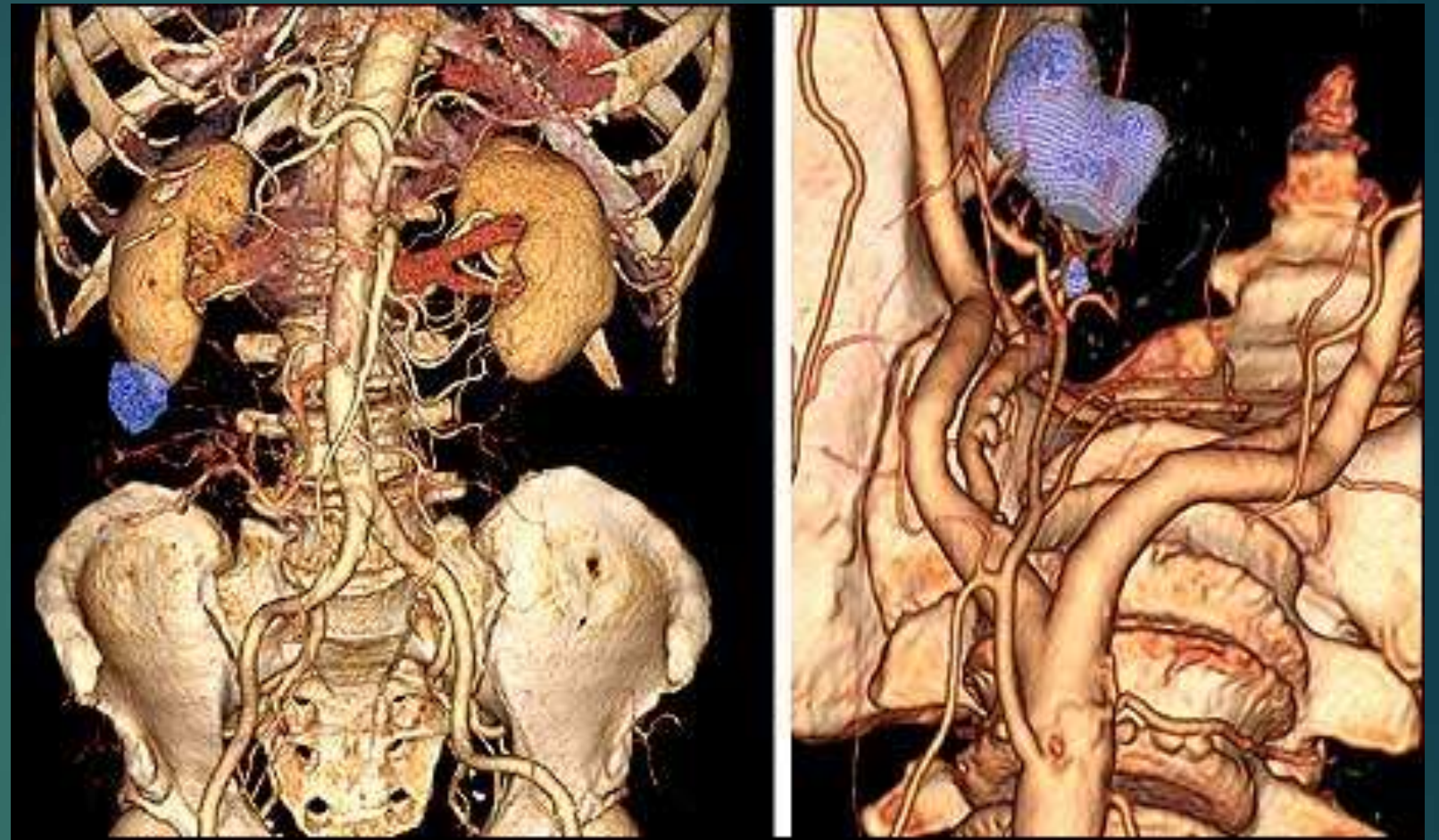
Anatomical Brain Images Alone Can Accurately Diagnose Chronic Neuropsychiatric Illnesses

- An automated method to diagnose individuals as having one of various neuropsychiatric illnesses using only anatomical MRI scans.
- Differentiation from MRI datasets of persons with ADHD, Schizophrenia, Tourette Syndrome, Bipolar Disorder, or persons at high or low familial risk for Major Depressive Disorder
- Sensitivity 81-100%, specificity 71-100%; mostly >94%
- Patterns of morphological variation across brain surfaces, extracted from MRI scans alone, can successfully diagnose the presence of chronic neuropsychiatric disorders
- CJV: Use of differences in known groups with 10+ years of clear clinical diagnosis, and using the technique in predictive or differential diagnostic classification. This study is a proof of concept, not a proof of clinical utility.

Whole-body PET scan using ^{18}F -FDG to show liver metastases of a colorectal tumor

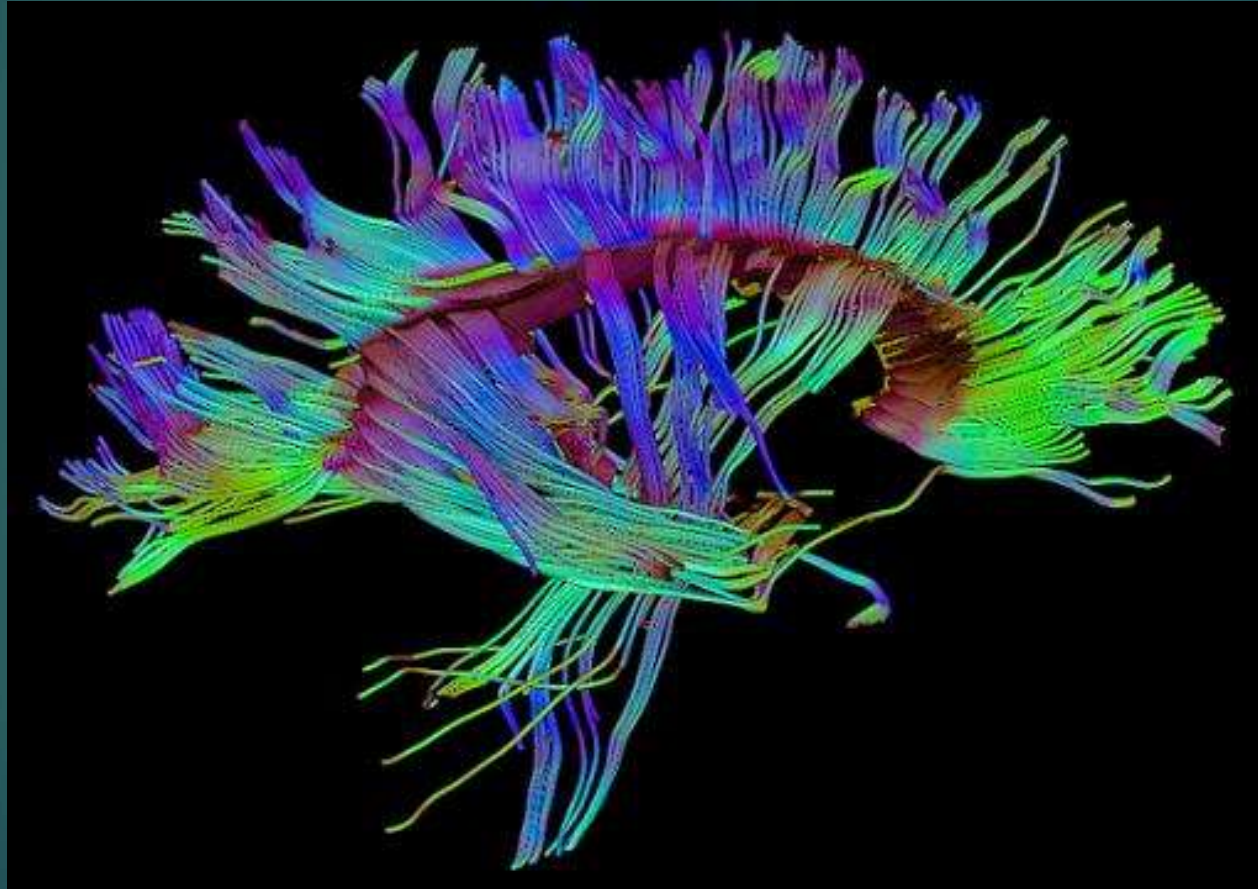


PET and surgery



Both colon cancer scans shown here were captured with GE Healthcare's Discovery PET/CT at the National Cancer Center in East Japan. The fused volume rendering of a PET/CT angiography (above left) provides vascular and metabolic visualization for surgical planning. In the zoomed view (above right), the surgeon is able to better understand the blood supply and vascular involvement of the tumor

White Matter: Diffusion Tensor MRI in TBI



SPECT of Epileptic Focus:

A: ictal increased metabolism; B: normal hypometabolism

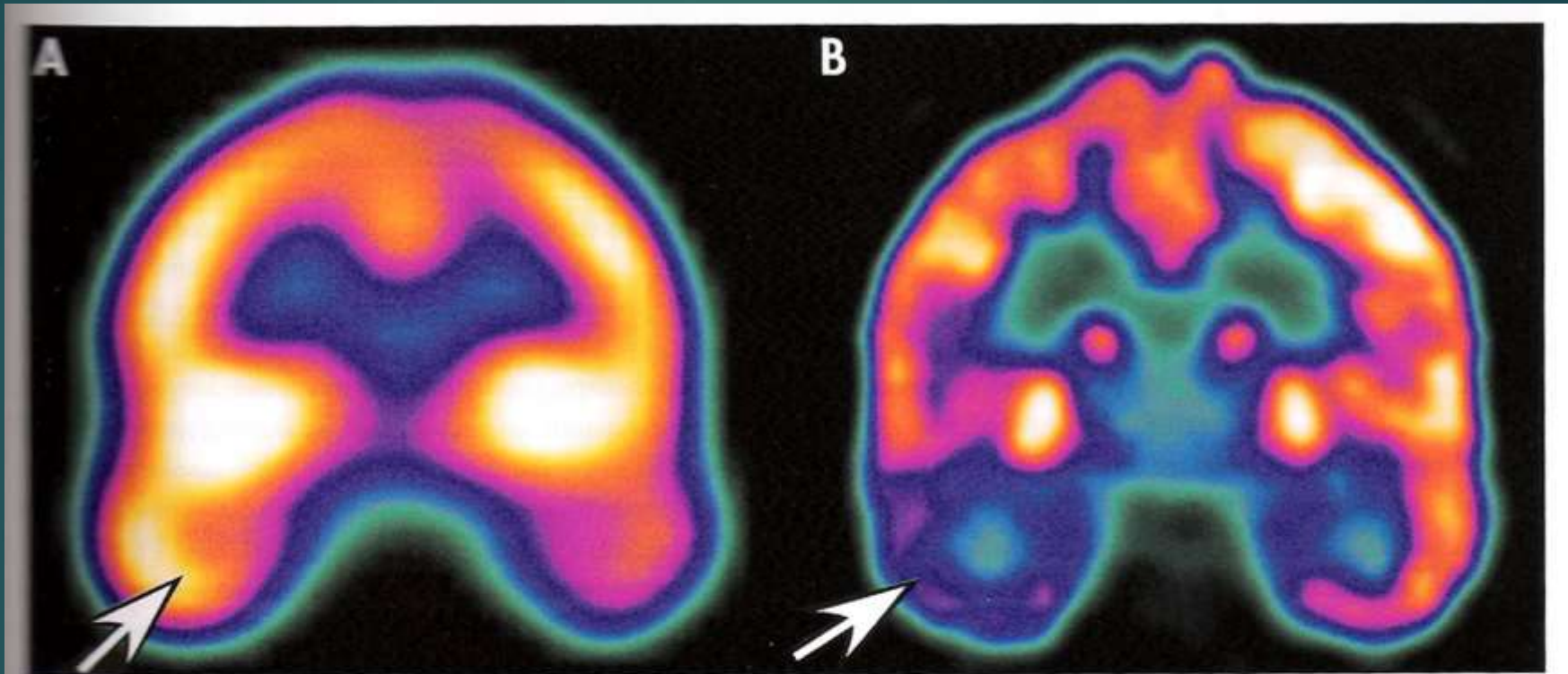
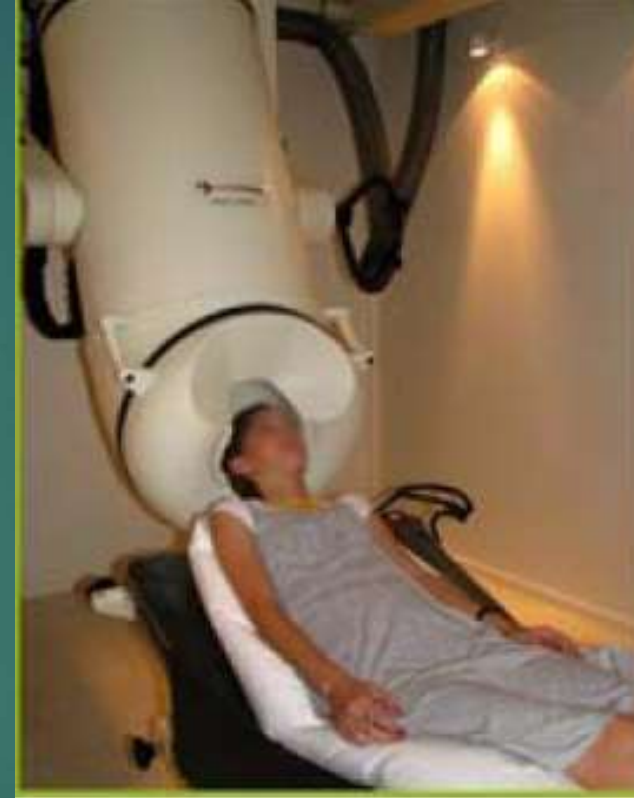


FIGURE 7-27. Nuclear medicine imaging is useful for visualizing the area of an epileptic focus. (A) Scans obtained during a seizure (ictal scan) will show increased perfusion or metabolism, as illustrated here with a coronal single-photon emission computed tomographic image of cerebral blood flow (*arrow*). (B) Scans obtained in the absence of seizure will show decreased perfusion or metabolism, as illustrated here with a coronal positron emission tomographic image of cerebral metabolism (*arrow*).

(Cummings and Mega, 2003)

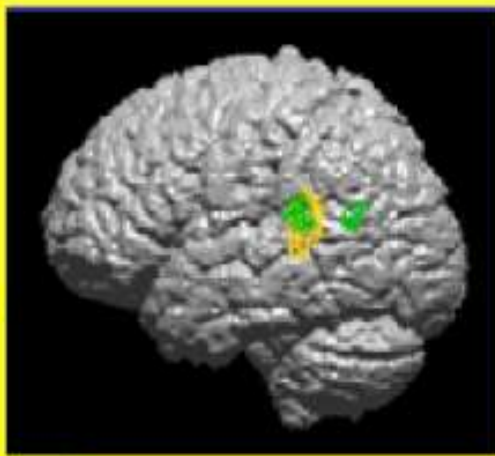
MEG: Magnetoencephalography



No Magnets; a technique for mapping brain activity by recording magnetic fields produced by electrical currents occurring naturally in the brain, using arrays of SQUIDs (superconducting quantum interference devices) which can measure extremely weak signals,

MEG: Bilinguals

Receptive Language-Specific Cortex in Bilinguals



Patient #1



Patient #2



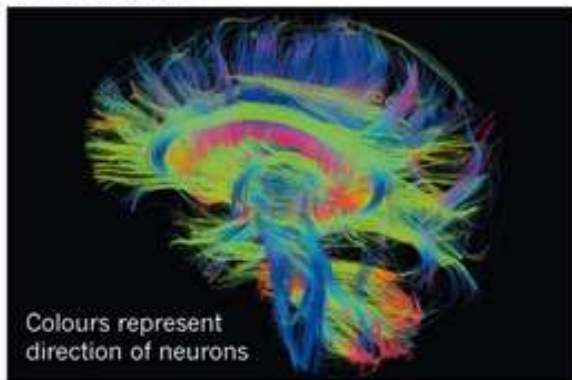
Patient #3

SCANNING THE CONNECTOME

The Human Connectome Project aims to trace the brain's long-range communication network using two main techniques, both of which rely on magnetic resonance imaging (MRI) to obtain data from living people.

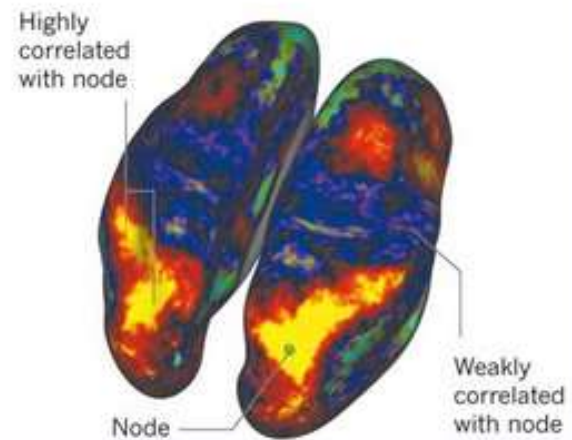
Mapping structure

Diffusion spectrum imaging detects the movement of water molecules that flow along nerve fibres in the brain. The result is a map of the brain's neuronal network.



Mapping function

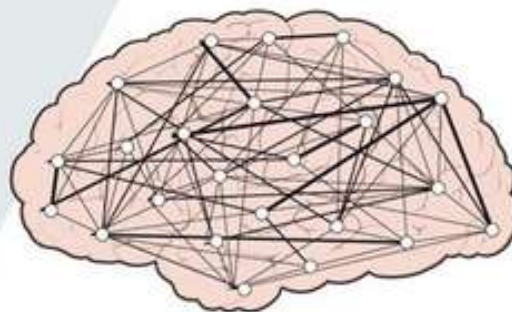
Resting-state functional MRI maps resting brain activity, then looks for correlations between one area and another. Highly correlated areas are thought to have some kind of functional link.



The brain has many areas specialized for specific functions, some of which are shown here.



Data on structure and function can be combined and analysed using tools such as network theory.



The connectome ties these areas together, allowing the brain to function as a coherent whole. The project's goal is to understand how the connectome works.

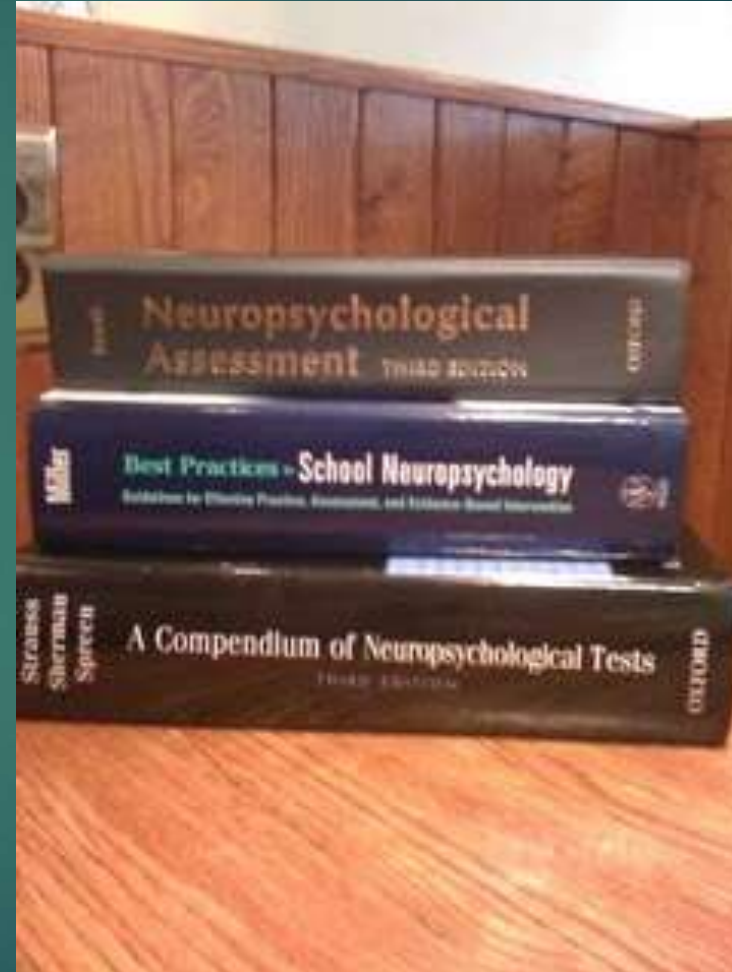
Diffuse
Tensor
Imaging

Rs-fMRI:
Resting state
fMRI

Growing
perception that
brain disorders
are
disorders of
connectivity.

First Commandment of NP Assessment

- ▶ *"If one writes a book on neuropsychological assessment, thou shall not write a book that is less than 3 inches thick or less than 3 lbs in weight"*



Recommended Library

- ▶ Best Neuroscience: *Principles of Neural Science*, 5th Ed, Eric R. Kandel (Ed), et al., 2012
- ▶ Best Undergraduate: *Biological Psychology*, 11th Ed, James W. Kalat, 2013
- ▶ Best Graduate: *Fundamentals of Human Neuropsychology* – Bryan Kolb & Ian Wishaw, 2008
- ▶ The NP Foundation: *Neuropsychological Assessment* 5th Ed, Muriel Lezak, 2012
- ▶ *The Little Black Book of Neuropsychology: A Syndrome-Based Approach* by Mike R. Schoenberg and James G. Scott , 2011
- ▶ *Clinical Neuropsychology*, Kenneth M. Heilman and Edward Valenstein, 2011

Recommended Library 2

- ▶ *Clinical Neuropsychology: A Pocket Handbook for Assessment*, Peter J. Snyder, Paul D. Nussbaum and Diana L. Robins, 2006
- ▶ *Best Norms: A Compendium of Neuropsychological Tests: Administration, Norms, and Commentary*, Esther Strauss, Elisabeth M. S. Sherman and Otfried Spreen, 2006)
- ▶ *Neuroanatomy Through Clinical Cases*, Second Edition, by Hal Blumenfeld, 2011
- ▶ *Feedback that Sticks: The Art of Effectively Communicating Neuropsychological Assessment Results*, Karen Spangenberg Postal and Kira Armstrong, 2013
- ▶ *Encyclopedia of Clinical Neuropsychology*: 4 Volume set Hardcover by Jeffrey Kreutzer, John DeLuca, Bruce Caplan (Editors), 2012
- ▶ 2014 edition of the "*Standards for Educational and Psychological Testing*"

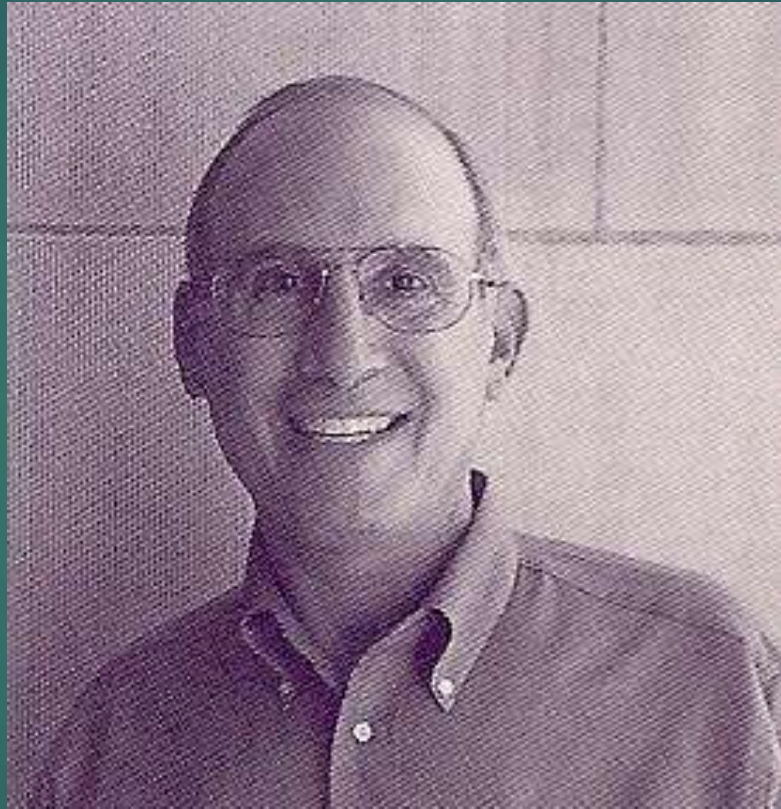
History of Brain

- ▶ *Garrison's History of Neurology* - Lawrence C. McHenry, Jr.
- ▶ *Minds behind the Brain: A History of the Pioneers and Their Discoveries* - Stanley Finger
- ▶ *Origins of Neuroscience: A History of Explorations into Brain Function* by Stanley Finger
- ▶ *A History of Neuroscience in Autobiography*, ed. Larry R. Squire, 8 volumes
- ▶ *Brain, Vision, Memory: Tales in the History of Neuroscience* by Charles G. Gross
- ▶ *A Hole in the Head: More Tales in the History of Neuroscience* by Charles G. Gross
- ▶ *Disturbances of the Mind* – Douwe Draaisma
- ▶ <http://www.whonamedit.com>

History of Neuropsychology

- ▶ *Classic Cases in Neuropsychology* – Chris Code, et. al.
- ▶ *Exploring the History of Neuropsychology: Selected Papers* by Arthur Benton
- ▶ *Pathways to Prominence in Neuropsychology* – Anthony Stringer, et al.

Stanley Finger: **History of Neuroscience**

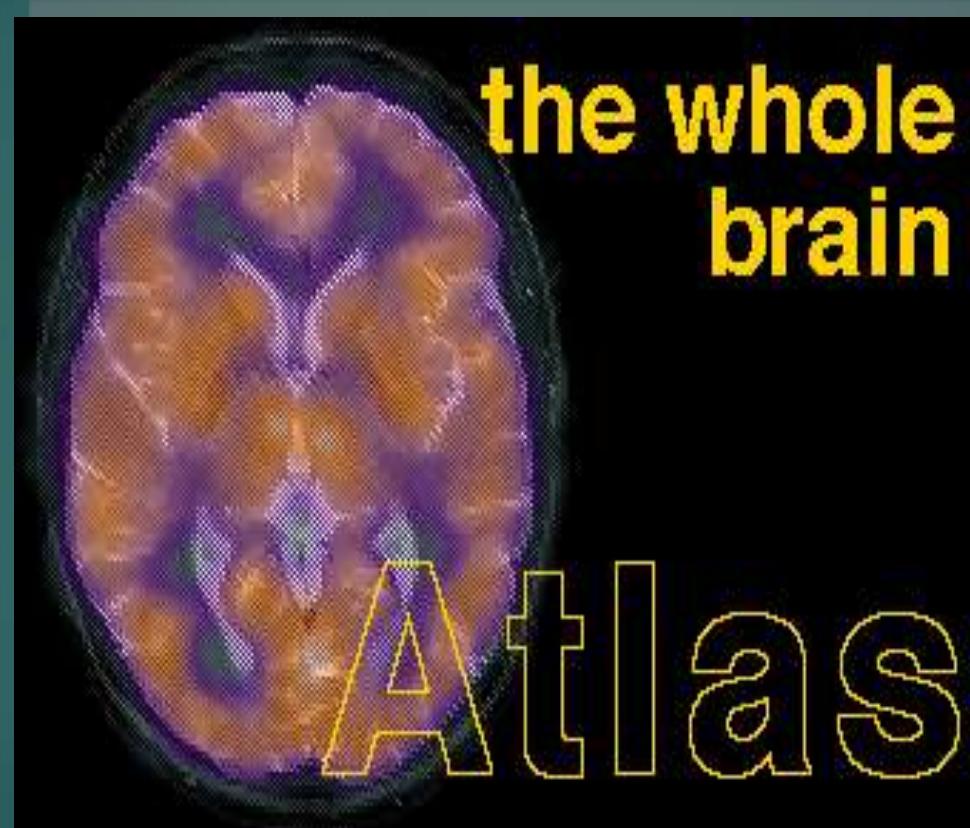


Minds behind the Brain: A History of the Pioneers and Their Discoveries

Origins of Neuroscience: A History of Explorations into Brain Function

Whole Brain Atlas: [Internet Neuroanatomy](http://www.med.harvard.edu/AANLIB/home.html)

<http://www.med.harvard.edu/AANLIB/home.html>



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