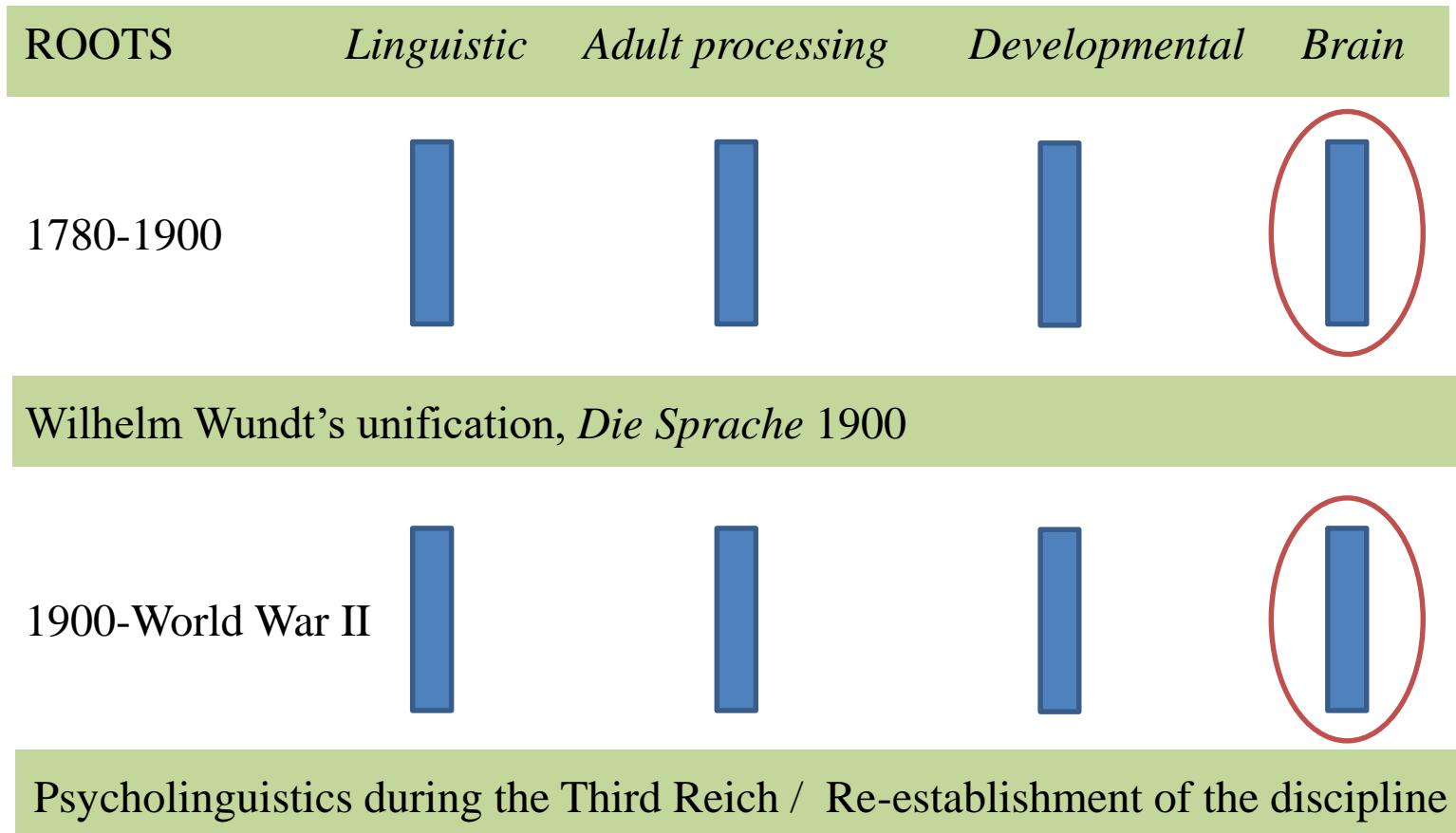
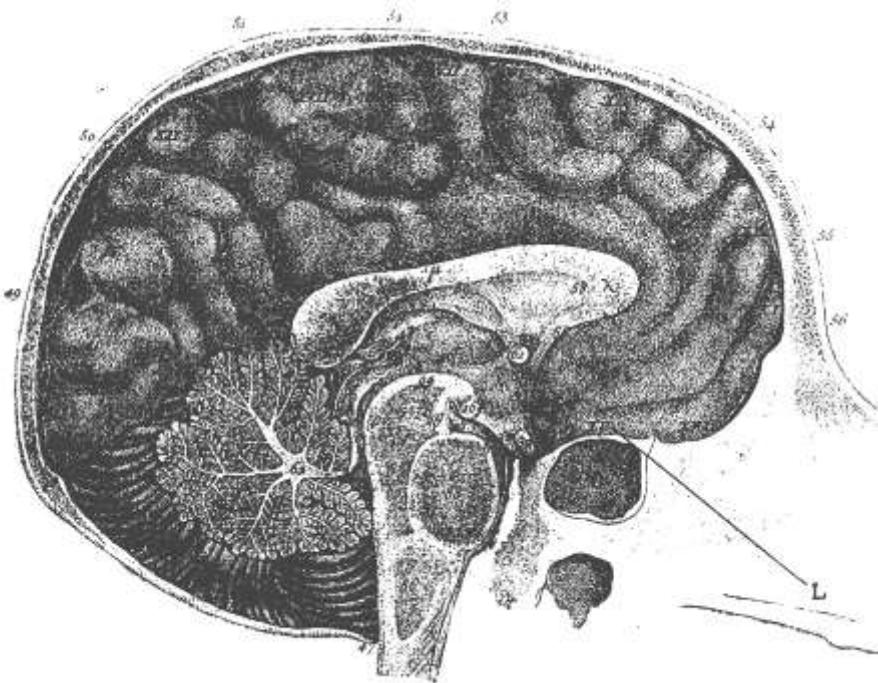


# LECTURE 2 BRAIN AND LANGUAGE



# FRANZ JOSEPH GALL (1758-1828)



# GALL'S MAGNUM OPUS

*Anatomie et physiologie du système nerveux en général et du cerveau en particulier; avec des observations sur la possibilité de reconnaître plusieurs dispositions intellectuelles et morales de l'homme et des animaux par la configuration de leur têtes.*



4 Books. Paris 1810, 1812 (together with Spurzheim), 1818, 1819 (alone).

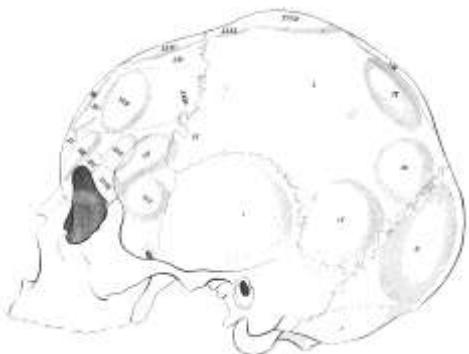
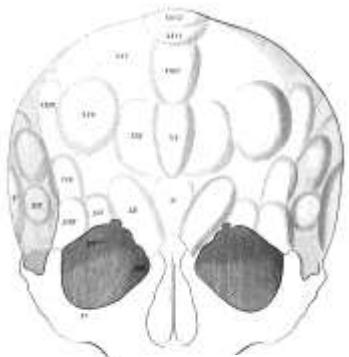
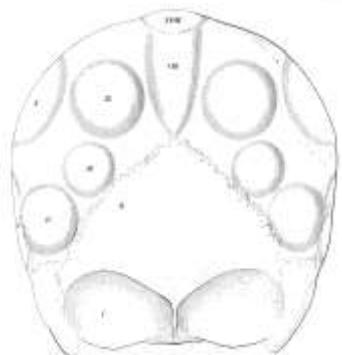
## GALL (1818) ON SPURZHEIM:

*Others have already accused him of plagiarism: it is at least very ingeneous to make books by clips of the scissors.*

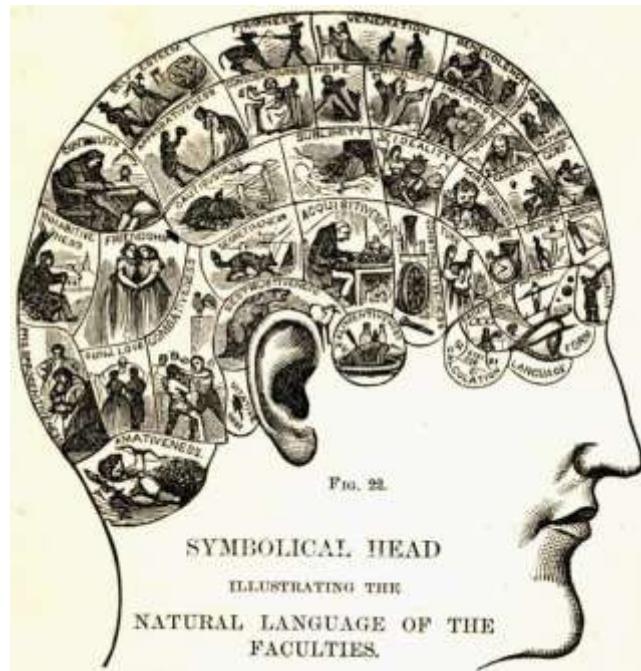
*Déjà d'autres l'ont accusé de plagiat; c'est au moins très-ingénieux de faire des livres à coups de ciseaux."*

# GALL VERSUS SPURZHEIM

Gall



Spurzheim



# GALL (1819) ON BROCA'S APHASIA

The patient was an officer, hit by a foil “*in the midst of left canine tooth region, close to the nostril, in oblique direction from below up*”, penetrating some 3.5 inch “*into the internal posterior of the left frontal lobe, in such a way as to reach the anterior part of the mesolobe.*” The patient was right hemiplegic and “*the memory for words had totally extinguished*”.

Book 4, p. 53-54.

M. Édouard de Rampan, âgé de vingt-six ans, reçut avec un fleuret, dont la pointe avoit été rompue sur son plastron, un coup à la partie moyenne de la région canine gauche, près de l'aile du nez, dans une direction oblique de bas en haut, et un peu de dehors en dedans. L'instrument pénétra à la profondeur de trois pouces et demi ou environ, à travers la fosse nasale gauche, traversa la lame criblée de l'ethmoïde près de l'insertion de la faux du cerveau, et paroît avoir pénétré, dans une direction verticale et un peu oblique, d'avant en arrière, à la profondeur de cinq à six lignes dans la partie interne postérieure du lobe antérieur gauche du cerveau, de manière à se rapprocher de la partie antérieure du mésolobe.

La mémoire des noms a été totalement éteinte, et ne se produit aujourd'hui que très-difficilement, tandis que la mémoire des images, et de tout ce qui est susceptible de démonstration, est dans l'intégrité la plus parfaite.

## TWO BASIC ASSUMPTIONS IN GALL'S THEORY

### (1) Functional symmetry of the brain, Bichat's law

*All specific systems of the brain are double,  
like those of the spinal chord and of the senses.*

.

*Tous les systèmes particuliers du cerveau sont doubles,  
comme ceux de la colonne vertébrale et des sens.*

Gall & Spurzheim, 1812, Vol 1, p. 225).

### (2) The two language faculties, memory for words and the philological faculty, are localized in the anterior cortex.

# PHRENOLOGICAL HEAD OF FRANZ JOSEPH GALL (1823)



# JEAN-BAPTISTE BOUILLAUD (1796-1881)



Bouillaud, J. (1825). Recherches cliniques propres à démontrer que la perte de la parole correspond à la lésion des lobules antérieures du cerveau, et à confirmer l'opinion de M. Gall sur le siège de l'organe du language articulé. *Archives générale de Médecine*, 3, 25-45.

## MAX DAX (1770-1837) and GUSTAVE DAX (1815-1874)

Max Dax (physician in Montpellier) kept statistics on loss of speech and hemiplegia, but never published his paper.

Gustave Dax (physician at Sommières) continued the statistics

On March 23 and 24, 1863 Gustave Dax submitted their papers on 370 cases of hemiplegia, to the Académie de Sciences and to the Académie Nationale de Médecine.

## PEER REVIEW ANNO 1865

Response Lélut (1865): *my opinion can no longer be changed, nor modified; the relation one wanted to establish between some fact or faculty of mind, and some part of the central nervous system is no less and no more than phrenology*”, which is a “*pseudo-science*”.

*mon opinion ne saurait plus ni changer, ni se modifier ... la relation qu'on cherchait à établir entre tel fait ou telle faculté de l'esprit, et telle partie du système nerveux central... Ceci n'est ni plus, ni moins que de la phrénologie, et je me suis, je crois, assez occupé de cette pseudo-science pour n'avoir plus à y revenir.*

(Lélut 1865, p. 173).

## THE DAX PUBLICATIONS, April 28, 1865

Dax, M. (1865). Lesions de la moitié gauche de l'encéphale coïncident avec l'oublie des signes de la pensée. – Lu au Congrès méridional tenu à Montpellier en 1837, par le docteur Marc Dax. *Gazette Hebdomadaire de Médecine et de Chirurgie*, 17, 259-260.

Dax, M.G. (1865). Sur le même sujet. *Gazette Hebdomadaire de Médecine et de Chirurgie*, 17, 260-262.

# PAUL BROCA (1824-1888). A slow discovery: 1861, 1863, 1865

1861:

\*Meeting of the Paris Anthropological Society on cerebral localization of functions, organized by Auburtain and Gratiolet.

\*Test case Leborgne (Tantan): no speech since 21 years, frontal lobe damage? Autopsy April 17.

\*First Broca paper, on autopsy: Left frontal lobe “softened” (*ramolli*) over most of its extension.

\*Second Broca paper on autopsy details and theoretical implications: Probable cause of loss of speech: oldest lesion, in left third frontal convolution. Theoretical issue:

*“localization of a single faculty suffices to establish the veracity of the principle”*. Principle verified by this case.

However: *“precise localization of functional organs is unsolvable in the present stage of science.”*

\*Third Broca paper. Case Lelong. Recent loss of speech. Recent small stroke lesion in third convolution. *“third frontal convolution seems indispensable”* However: *“I am thus inclined to attribute to a pure coincidence, the absolute identity of the lesion site in my two patients.”*



# PAUL BROCA (1824-1888). A slow discovery: 1861, 1863, 1865



1863:

Broca presents, on April 2<sup>nd</sup>, new paper to the Anthropological Society, again on the *principle of localization*. Six more patients. “*Hence, here are eight facts where the lesion is sited in the third frontal convolution. This number appears to me sufficient to invite strong conjectures. And, quite remarkably, in all these patients the lesion was on the left side. I don't dare to draw a conclusion from that and I wait for new facts.*”

And: “*Everything I just said only relates to a single localization, the one for articulated language, a well-defined issue and it is already much to be almost certain about at least one well-determined site; but will it be possible to provide the same demonstration for other less circumscribed faculties? That may be very difficult.*”

# PAUL BROCA (1824-1888). A slow discovery: 1861, 1863, 1865



1865:

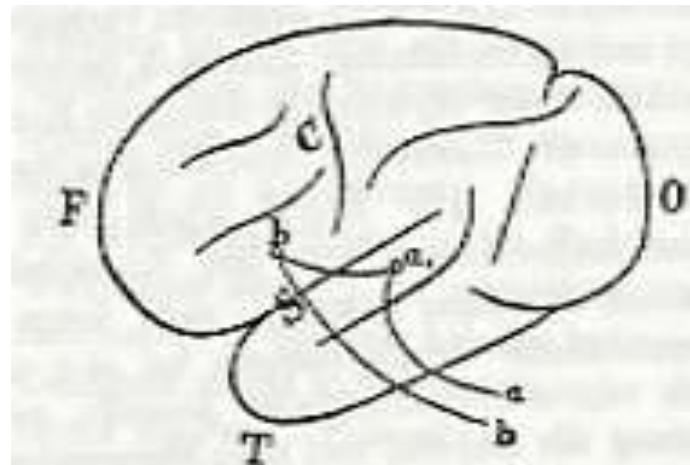
Broca presents, on June 15, his definitive paper to the Anthropological Society, now addressing the left-hemispheric issue. *“I persist in thinking, till more amply informed, that real aphémie, that is loss of speech without paralysis of the articulatory organs and without destruction of intelligence, is connected with lesions of the third frontal gyrus”* The paper addresses *“the singular predilection of aphemic lesions for the left hemisphere of the brain.”*

“*I don't like priority discussions*”, but Dax's paper appeared “*two years after my first publications on aphémie*” (i.e., in 1863).

# CARL WERNICKE (1848-1905)



*Der aphasische Symptomencomplex. Eine  
psychologische Studie auf anatomischer Basis.*  
Breslau 1874

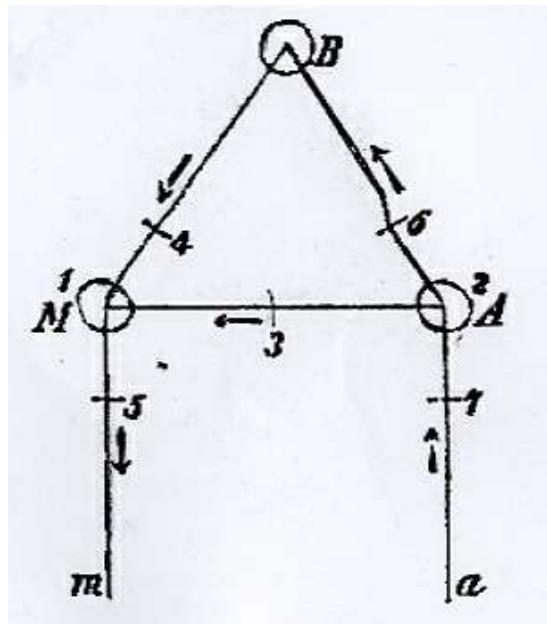


Line segment **a-a<sub>1</sub>**: the incoming acoustic nerve from oblongata (**a**) to its projection site in the temporal lobe (**a<sub>1</sub>**). Broca's area: **b**. Line segment **b-b<sub>1</sub>**: the centrifugal speech motor nerves back to the oblongata (**b<sub>1</sub>**).<sup>[ii]</sup> Segment **a<sub>1</sub>-b**: the fibers connecting **a<sub>1</sub>** and **b** across the Sylvian fissure through the insula.

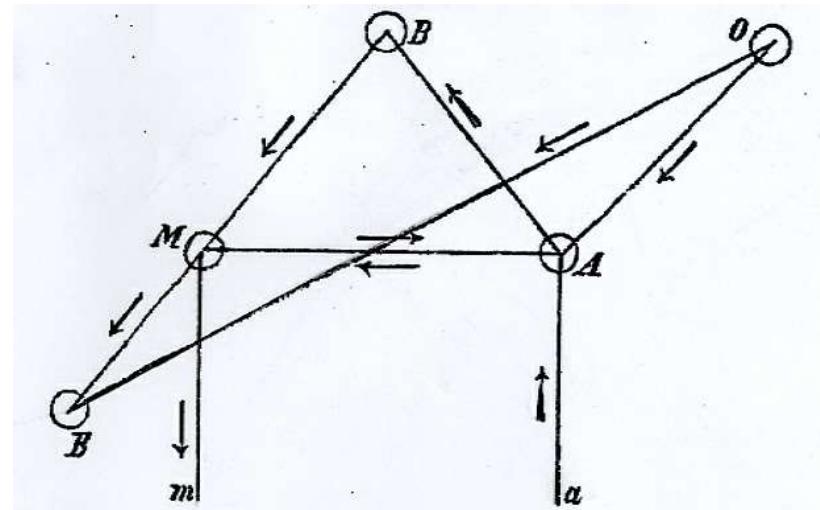
# LUDWIG LICHTHEIM (1845-1928)

Lichtheim's "house" (1885)

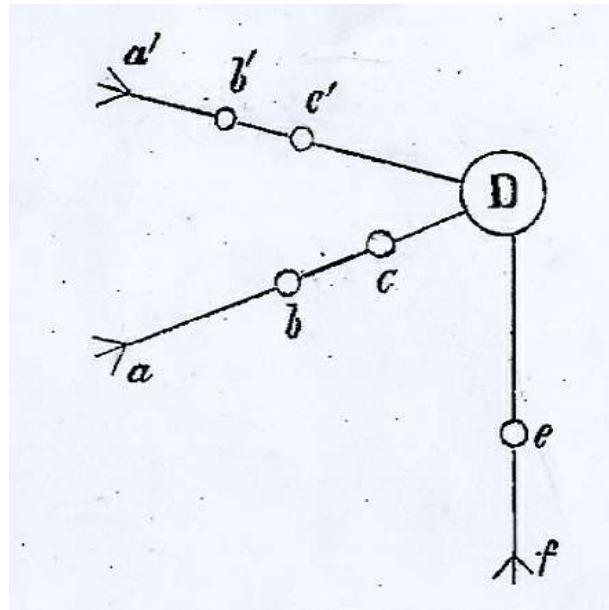
speech



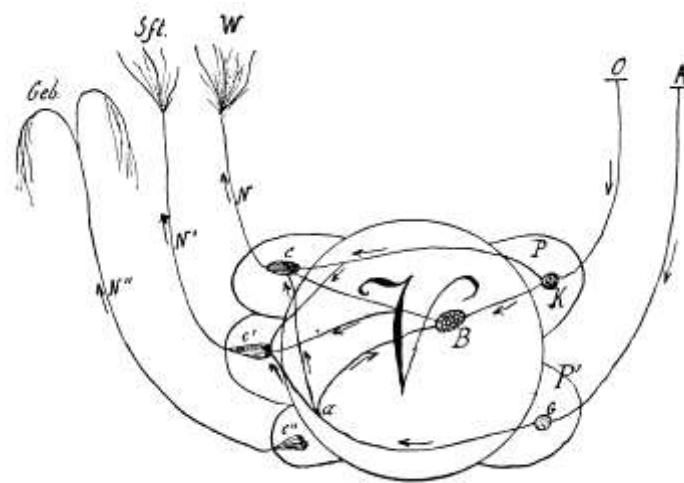
written language



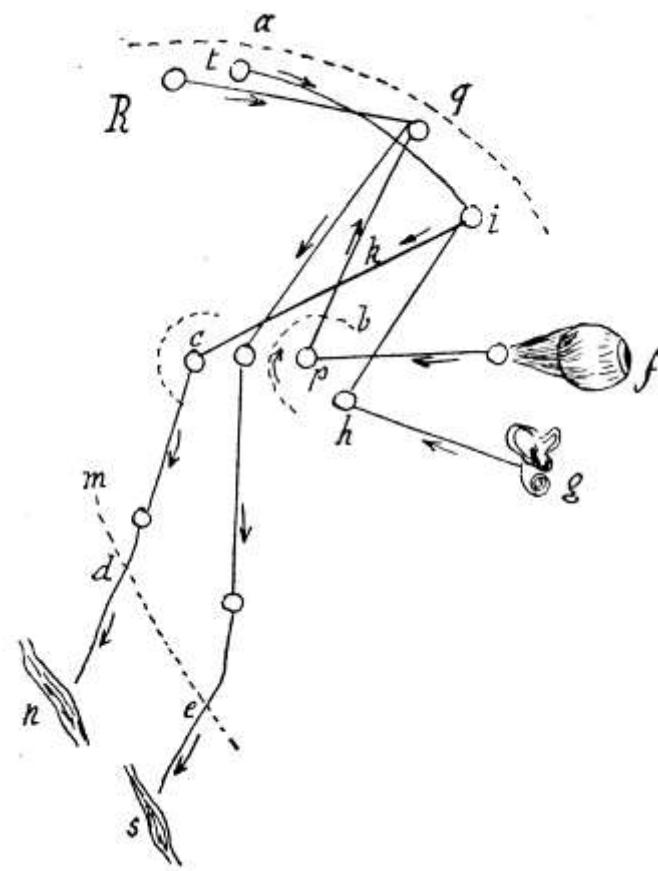
Baginsky 1871



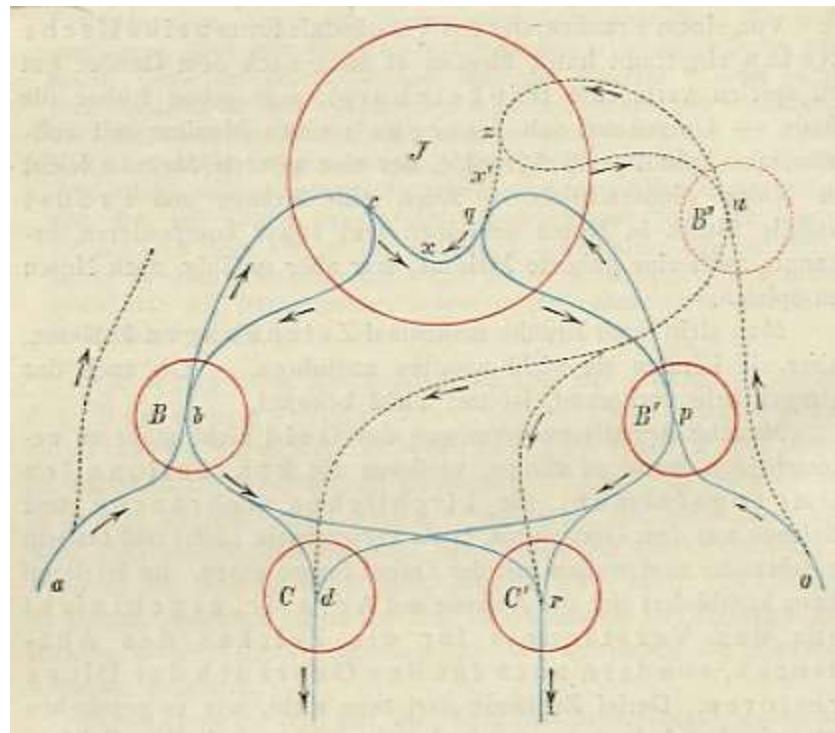
# Spamer 1876



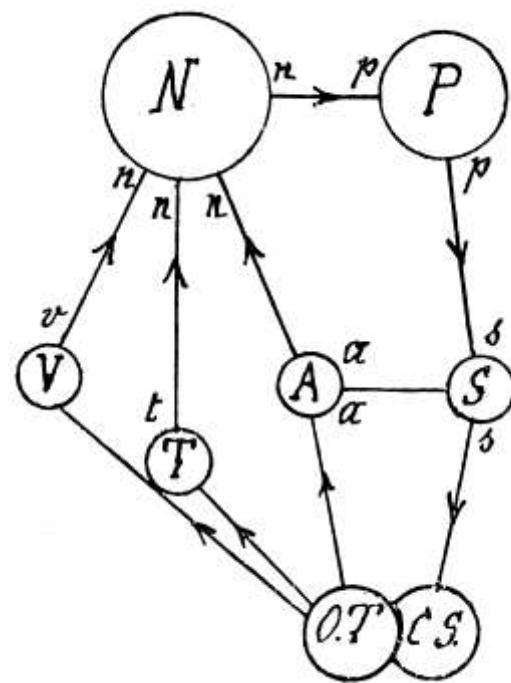
# Poincaré 1877



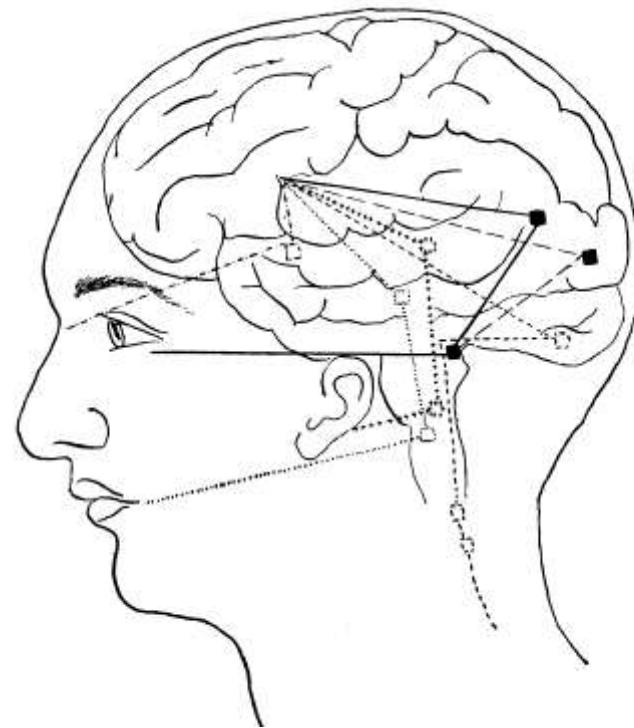
# Kussmaul 1877



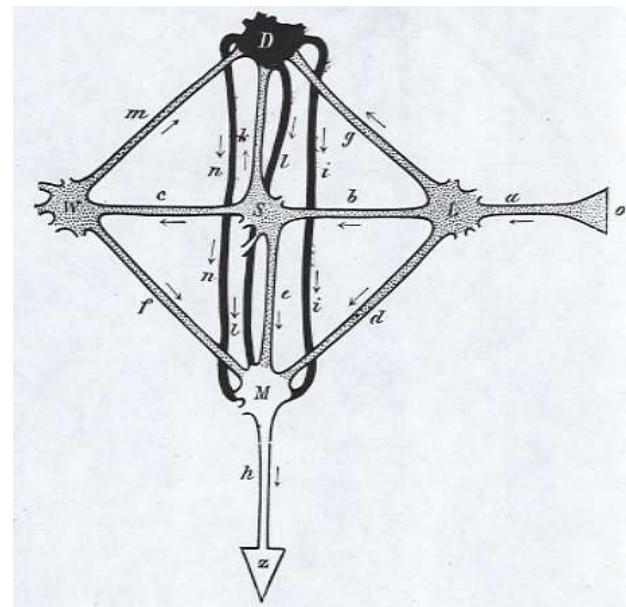
# Broadbent 1879



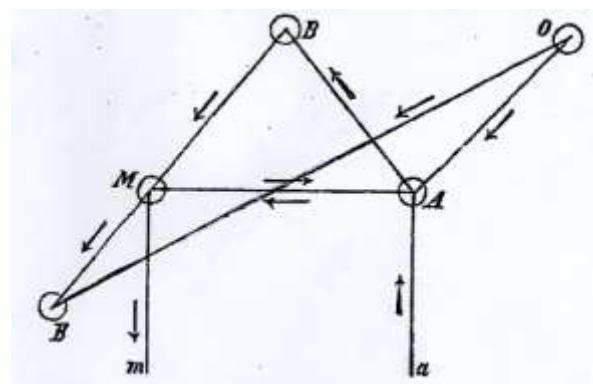
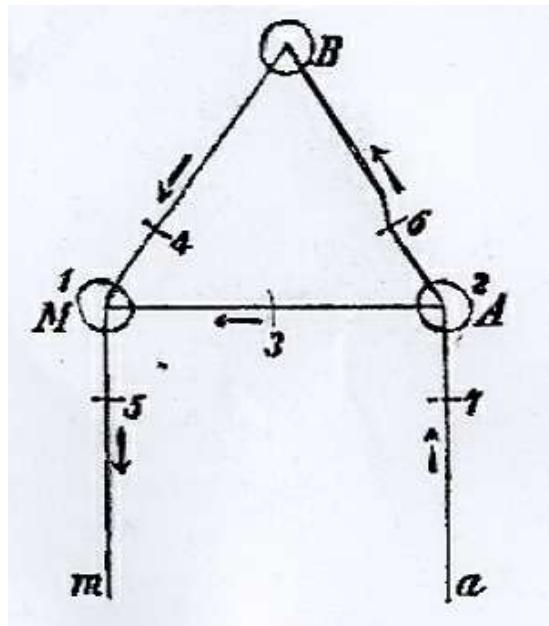
Magnan 1881



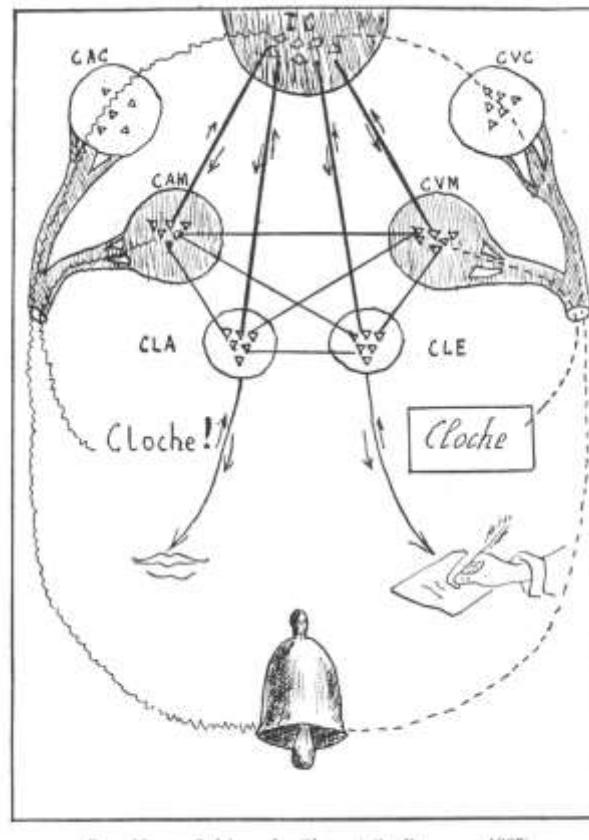
# Preyer 1881



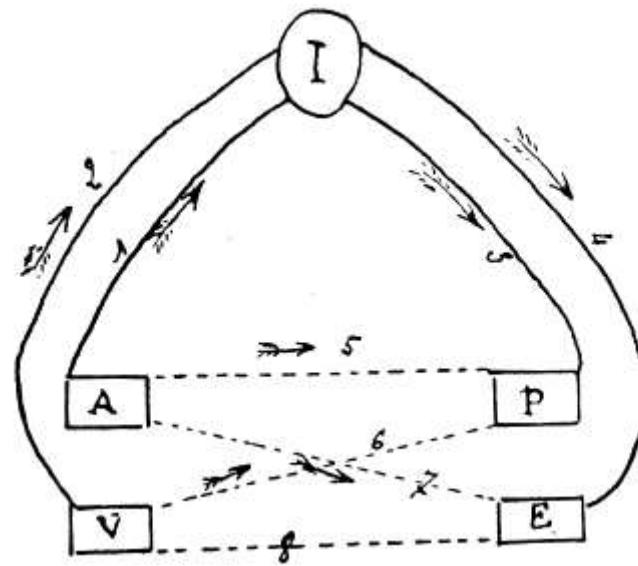
Lichtheim 1885



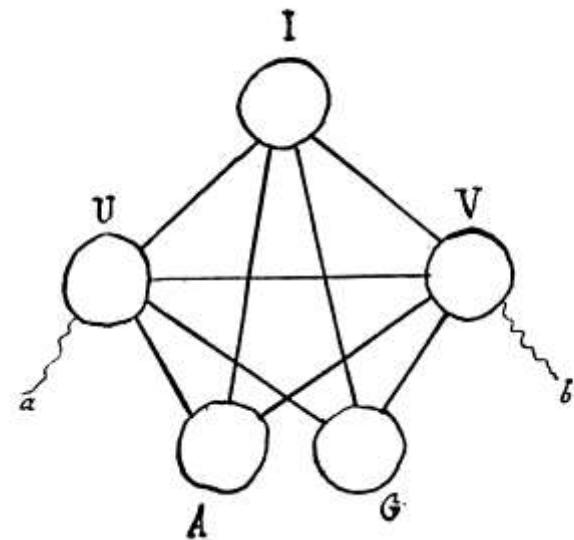
# Charcot 1885



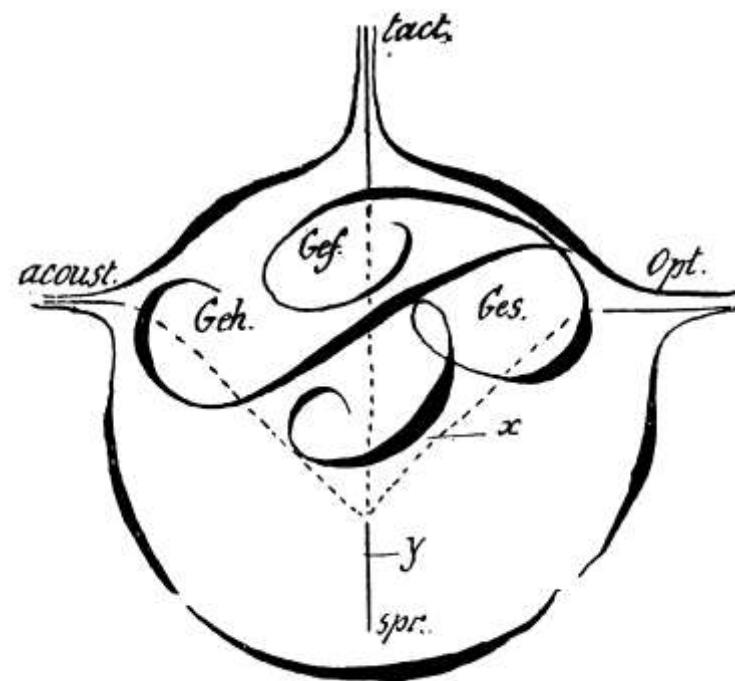
# De Ballet 1886



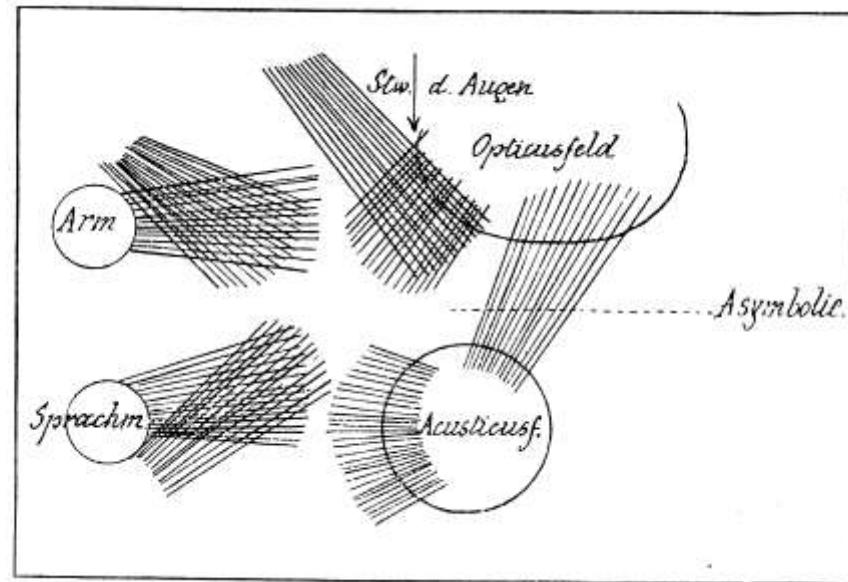
Banti 1886



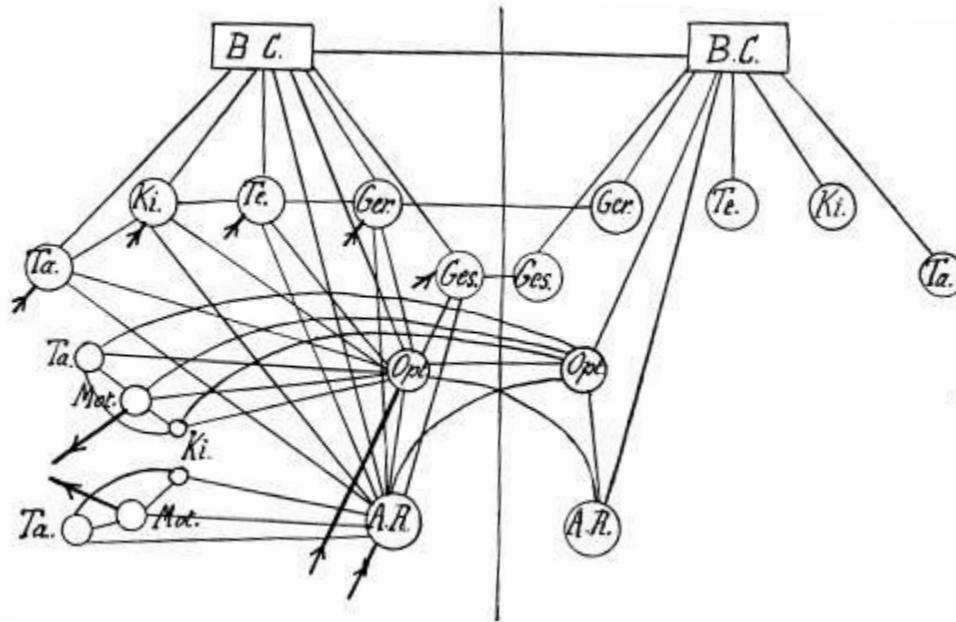
Mouli 1890



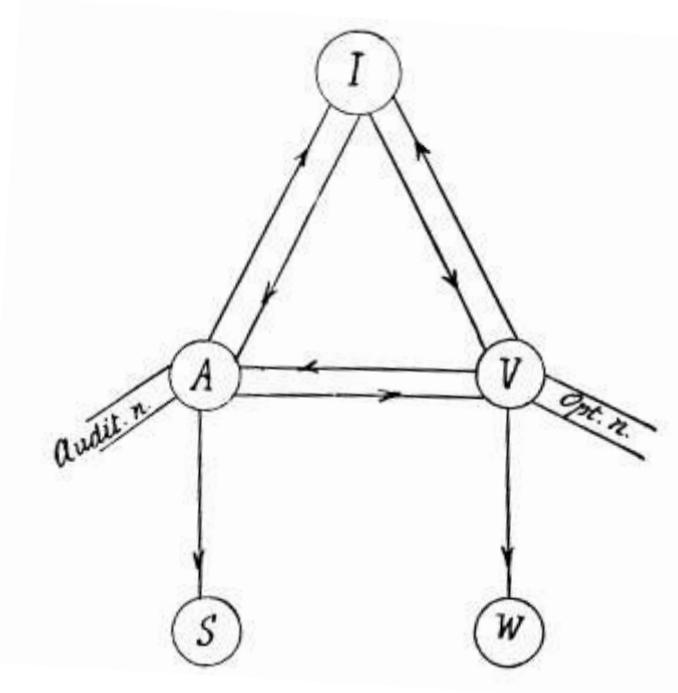
Freud 1891



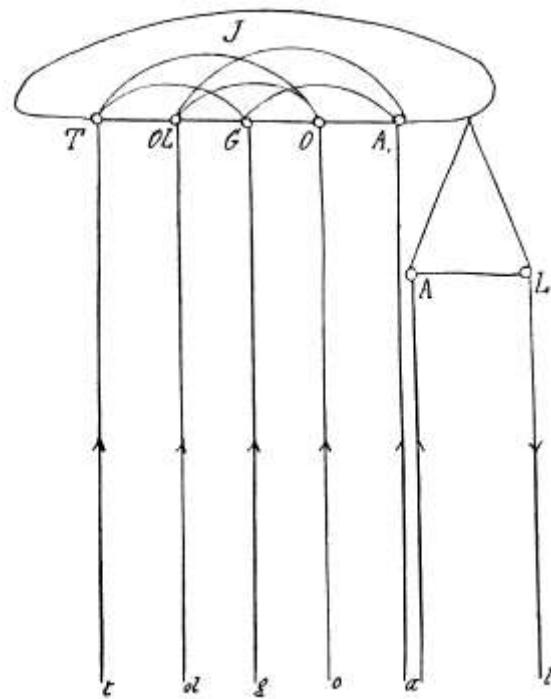
# Goldscheider 1892



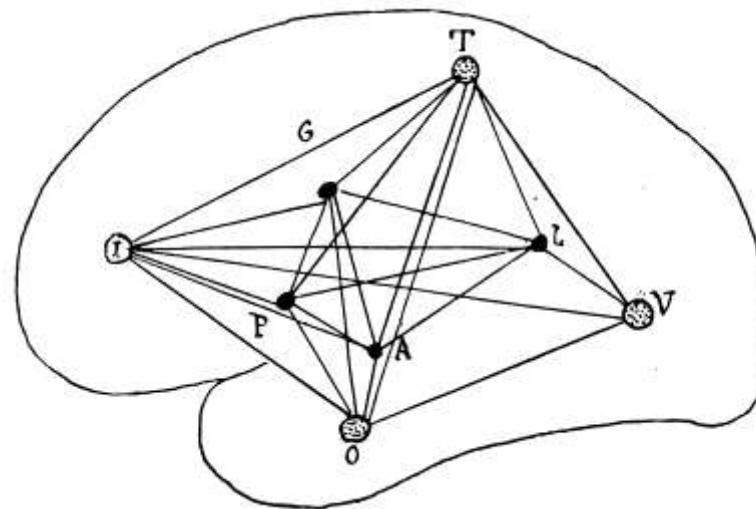
Shaw 1893



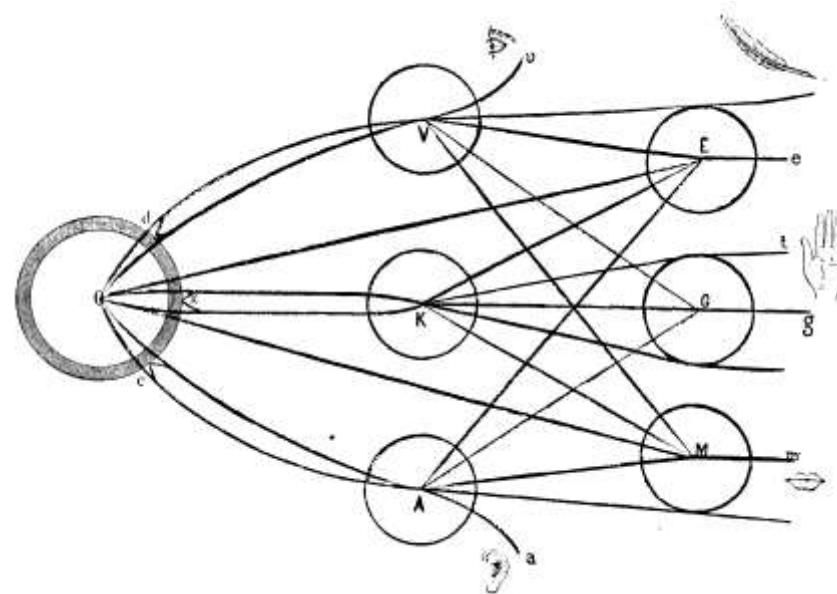
Leube 1893



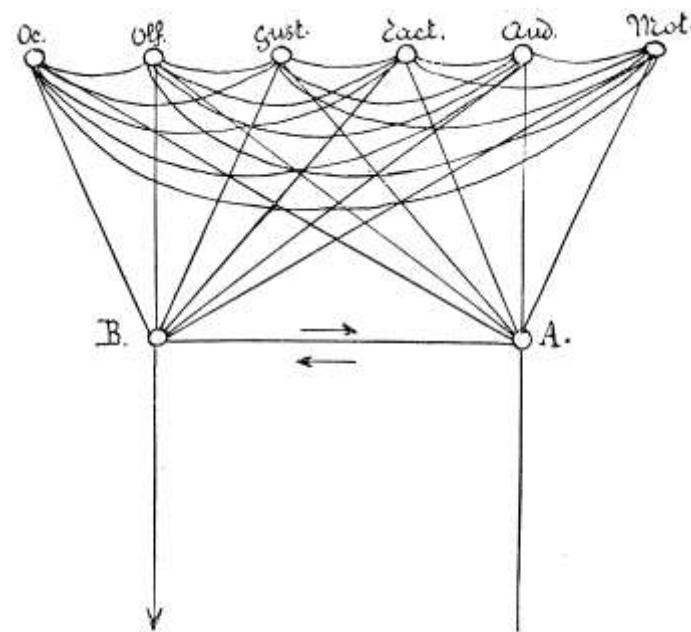
Brissaud 1894



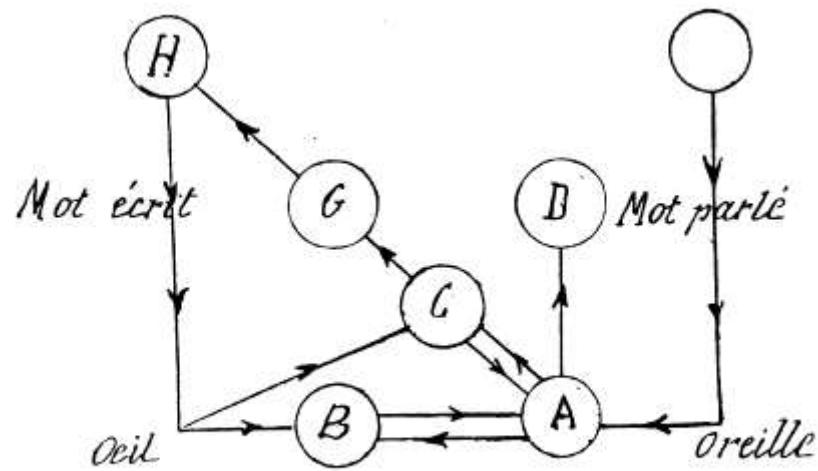
# Ferrand 1894



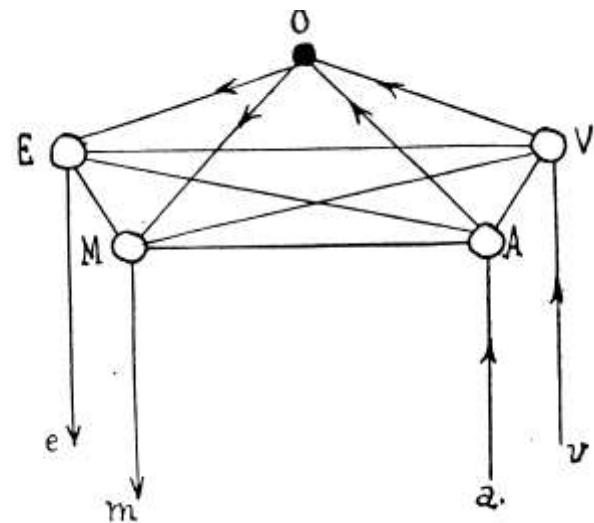
# Wyllie 1894



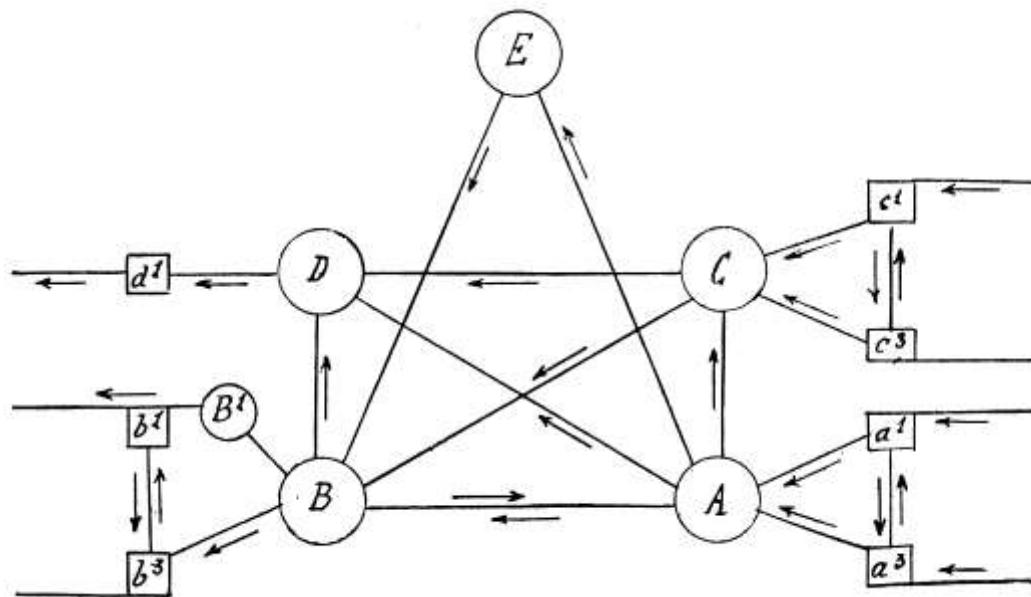
# Grashey 1895



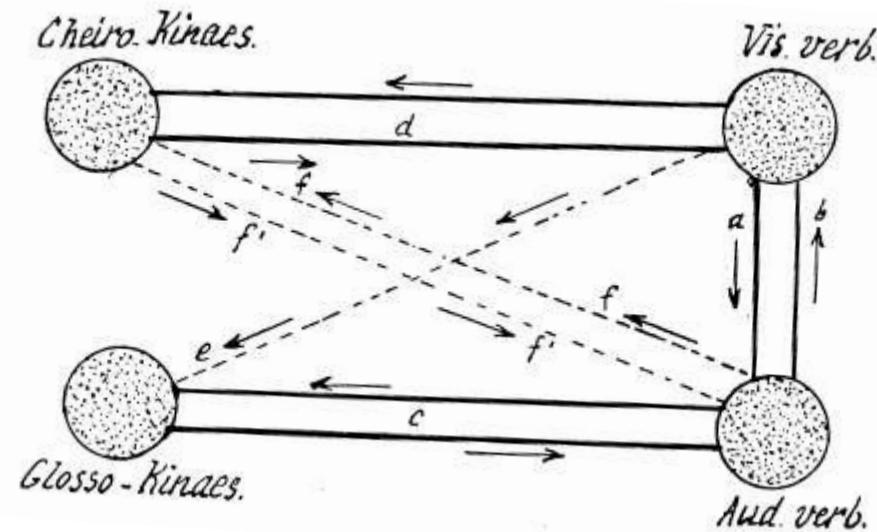
# Grasset 1896



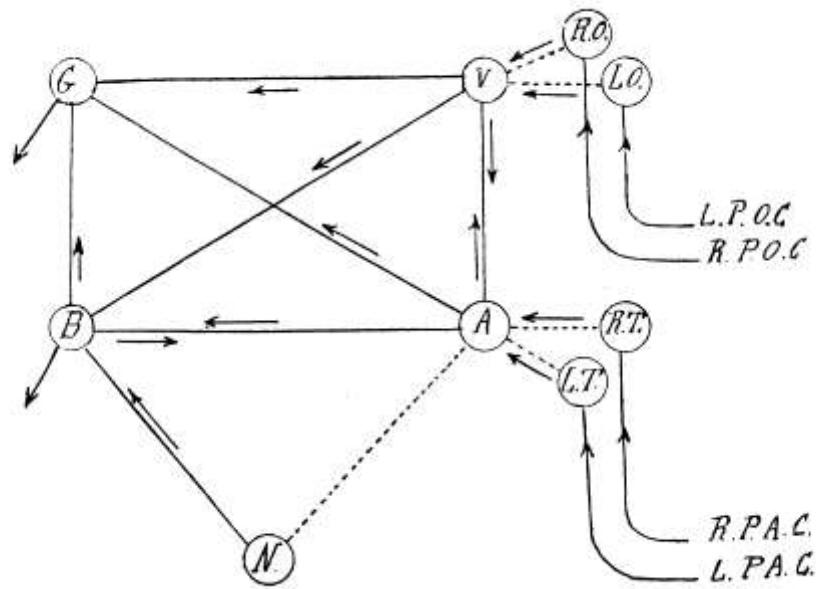
# Elder 1897



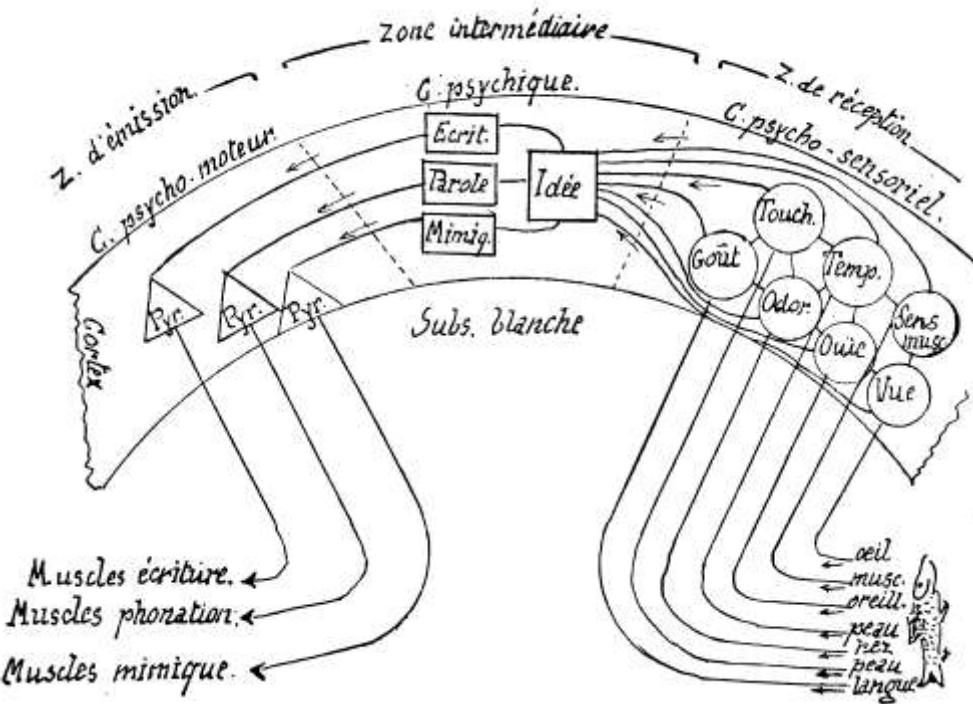
Bastian 1897



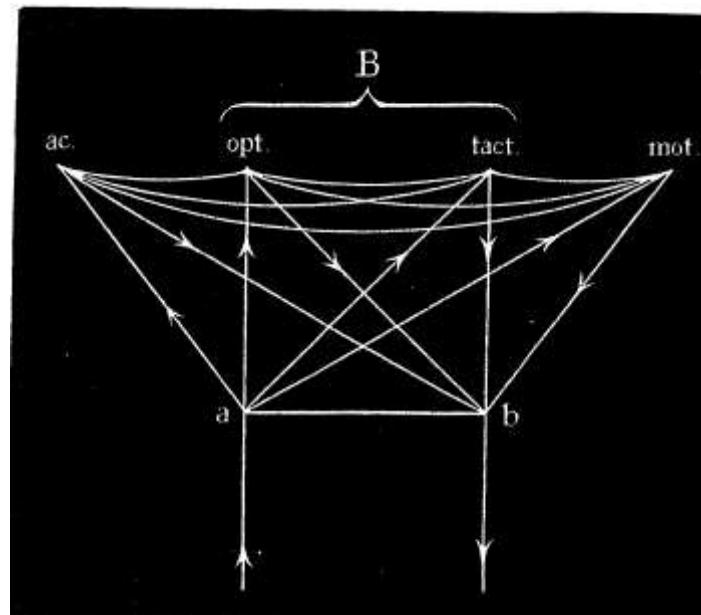
# Mills 1898



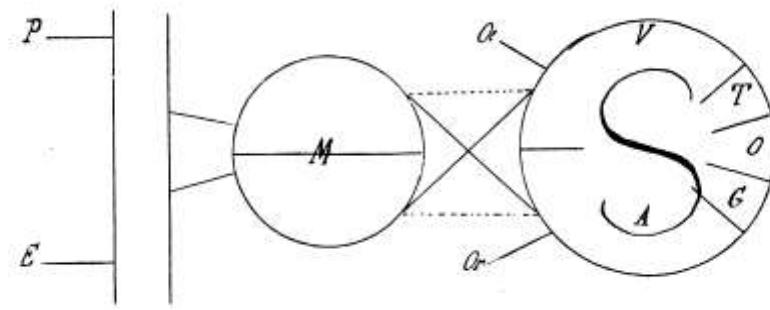
# Hughes 1903



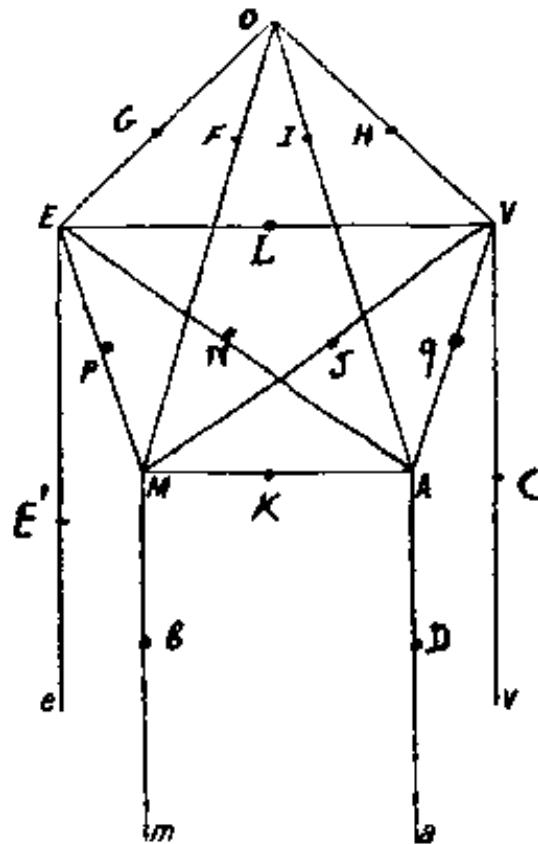
Wernicke 1903



# Purser 1907



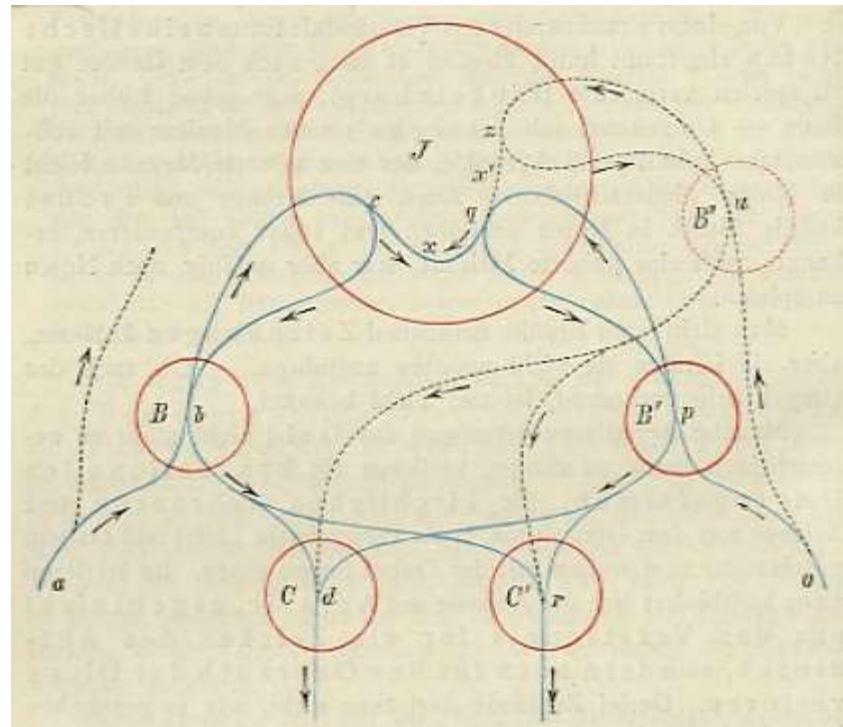
D'Barat 1917



# ADOLF KUSSMAUL (1822-1902)



*Die Störungen der Sprache.  
Versuch einer Pathologie der  
Sprache* (1877).



# WILLIAM JAMES (1842-1910)



*Meanwhile few things show more beautifully than the history of our knowledge of aphasia how the sagacity and patience of many banded workers are in time certain to analyze the darkest confusion into an orderly display.*

(W. James 1890, I, 56)

# LECTURE 2 BRAIN AND LANGUAGE

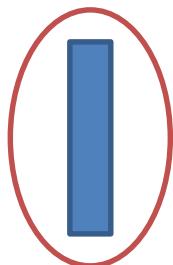
ROOTS	<i>Linguistic</i>	<i>Adult processing</i>	<i>Developmental</i>	<i>Brain</i>
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1780-1900



Wilhelm Wundt's unification, *Die Sprache* 1900

1900-World War II



Psycholinguistics during the Third Reich / Re-establishment of the discipline

# PIERRE MARIE (1853-1940), iconoclast



There is only one kind of aphasia, an intellectual disorder. The critical location is Wernicke's area.

Broca's area plays no role in language function. Word blindness does not exist. Word mutism does not exist.

There are no regions that store sensory or motor word images. Associationist accounts of aphasic syndromes make no sense.

Broca's aphasia is just aphasia complicated with anarthria. Anarthria is caused in the lenticular zone.

# THE APHASIA DEBATE, Paris June-July 1908



Pierre Marie



Jules Dejerine

JULES DEJERINE (1849-1917) and  
AUGUSTA KLUMPKE (1859-1927)



# HENRY HEAD (1861–1940)

## *Aphasia and kindred disorders* (1926)

*There are no ‘centers’ for the use of language in any form, but solely certain places where an organic lesion of the brain can disturb speech in some specific manner.* (p. 140)

*An act of speech comes into being and dies away again as an alteration in the balance of psycho-physical processes: a state, never strictly definable, merges into another inseparable from it in time.* (p. 474)

*The processes which underlie an act of speech run through the nervous system like a prairie fire from bush to bush; remove all inflammable material at any one point and the fire stops.* (p. 474)



KURT GOLDSTEIN (1878-1965)

Über Aphasie. *Schweizer Archiv für Neurologie und Psychiatrie* (1927)

*Language and language disturbances*  
(1948)



Adhémar Gelb & Kurt Goldstein (1920). *Psychologische Analysen hirnpathologischer Fälle.*

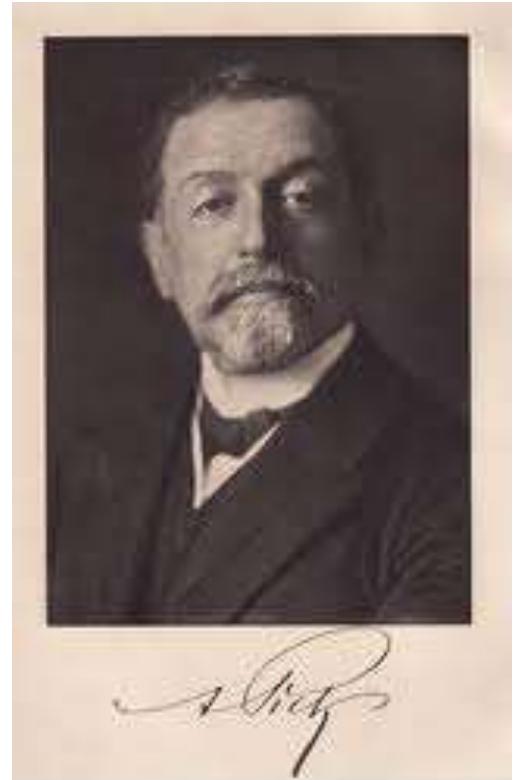
## GOLDSTEIN'S PSYCHOLOGICAL HOLISM

*The single can only be understood at all from the whole.*

*(Every) individual speech-performance is understandable only from the aspect of its relation to the function of the total organism in its endeavor to realize itself as much as possible in the given situation.*

But *instrumentalities of language* depend on intact well-localized regions of the brain.

ARNOLD PICK (1851-1924)



*Die agrammatische Sprachstörungen.  
Studien zur psychologischen Grundlegung  
der Aphasielehre.*  
Vol. I (1913).

*Stage theory of speaking*

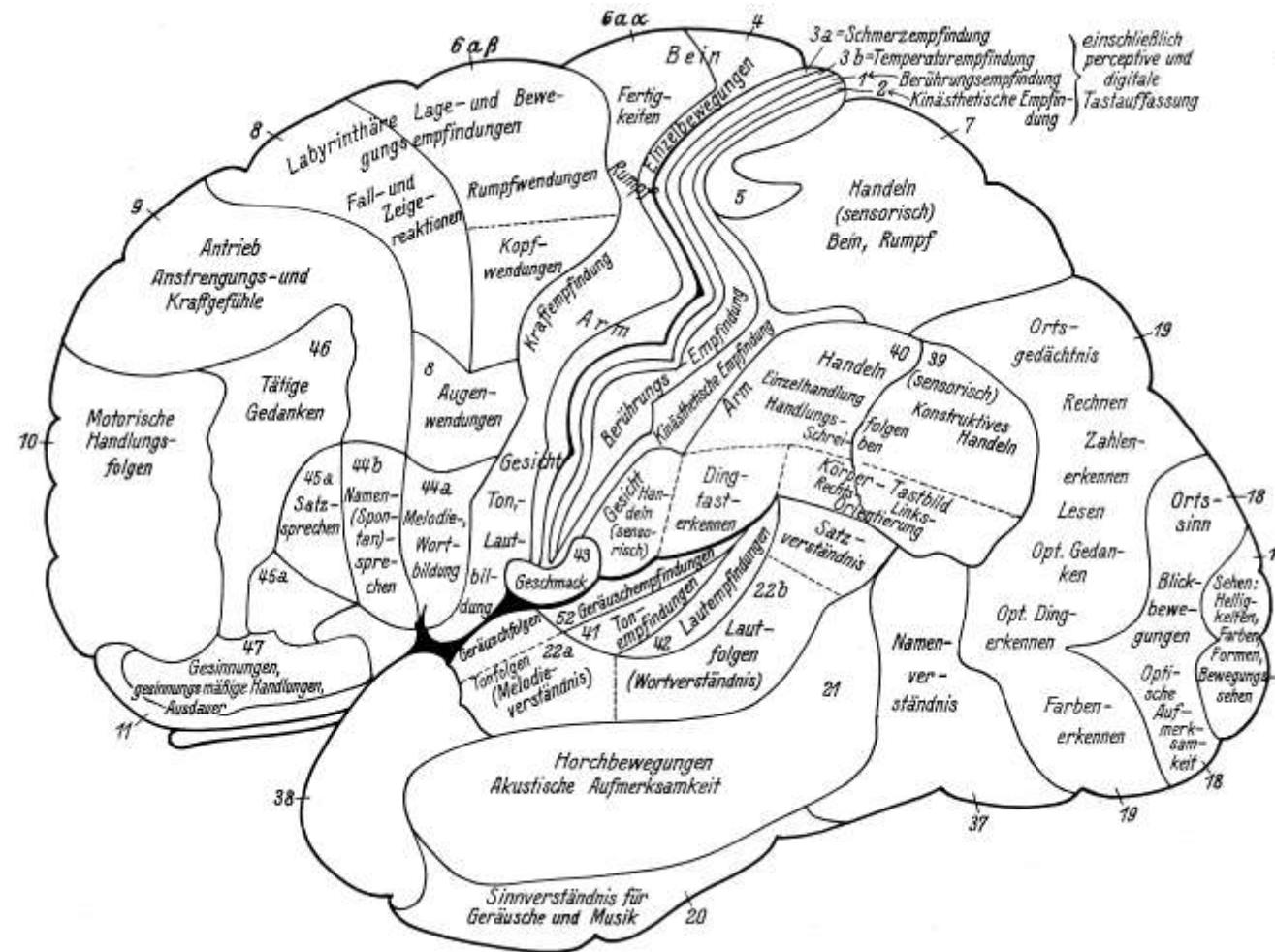
1. Expressive intention
2. Thought schema  
(including language-dependent thinking for speaking)
3. Grammaticalization
4. Word selection



KARL KLEIST (1979-1960)

*Gehirnpathologie* (1934)

# KARL KLEIST'S FUNCTIONAL BRAIN MAP (1934)



MAX ISSERLIN (1879-1941)

Über Agrammatismus. *Zeitschrift  
fur die gesamte Neurologie und  
Psychiatrie* (1921)

Telegram style is an adaptation, an *Einstellung*  
“*Speaking no time — telegram style*”.

Aphasie. In: O. Bumke & O.  
Foerster (Eds.), *Handbuch der  
Neurologie* . Vol. 6 . (1936)



# ROMAN JAKOBSON'S 1941 THEORY

A universal phonological hierarchy of binary distinctions:

consonant versus vowel

*pa*

nasal versus non-nasal

*ma-pa*

labial versus dental

*pa-ta, ma-na*

narrow versus broad vowels

*ipi-papa*

palatal versus velar vowels

*ipi-pupu*

\*

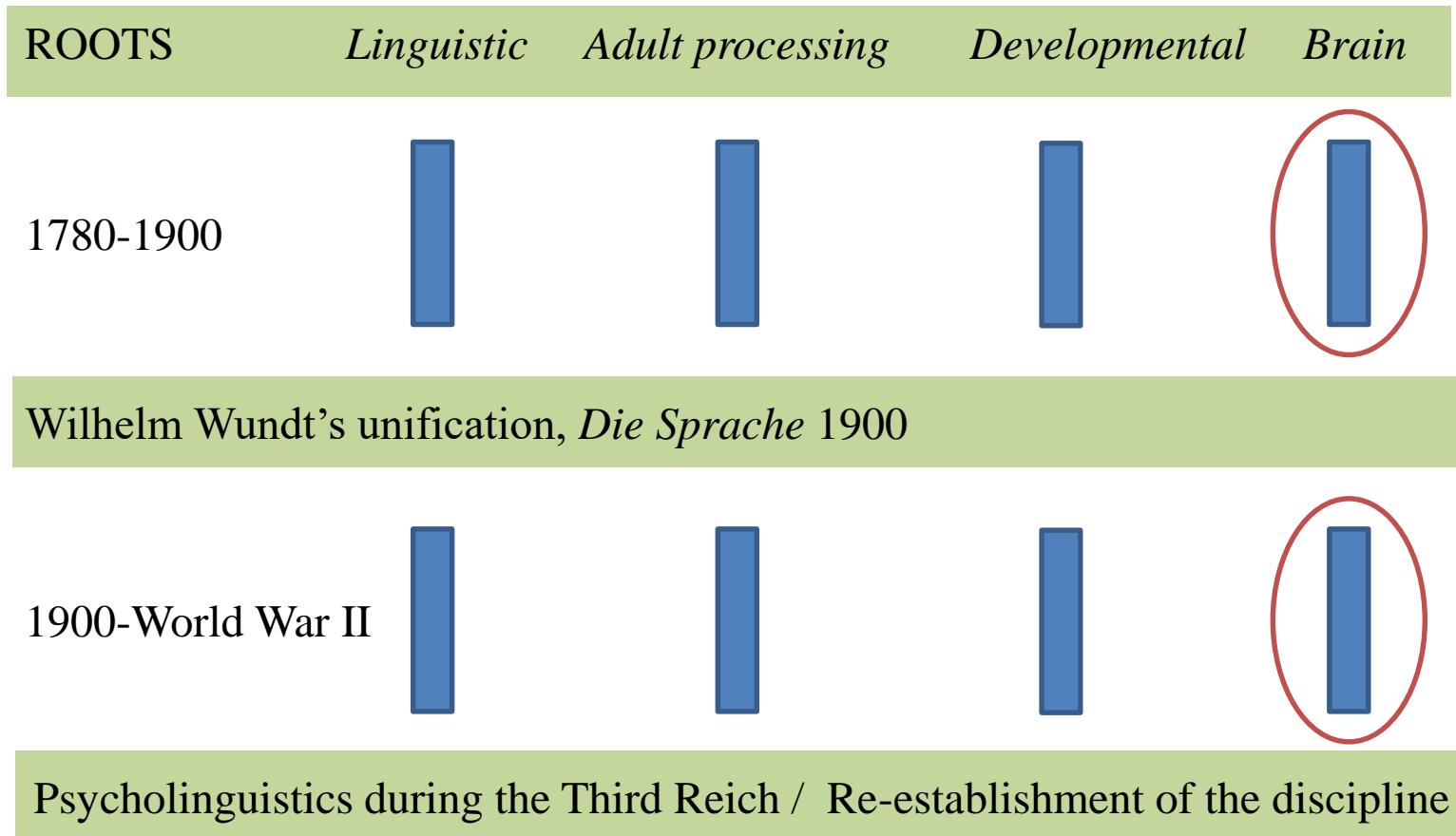
\*

\*

lateral versus central liquids

*rippe-lippe*

# LECTURE 2 BRAIN AND LANGUAGE





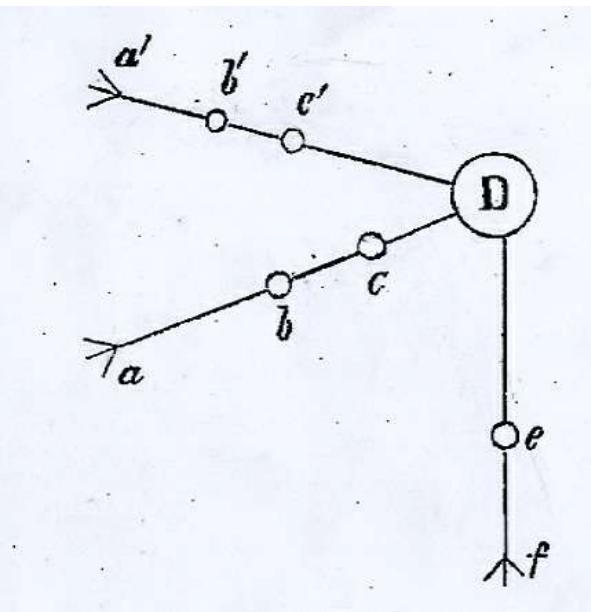
# ADOLF BAGINSKY (1843-1918), the first diagram maker

*optical input*

*speech input*

*c: center for sound memory*  
*e: center for coordinated movements*

Baginski (1871)



*speech output*

## GALL, THE FIRST SERIOUS BRAIN ANATOMIST

*Flourens about Gall: a profound observer whose genius has opened for us the study of the anatomy and physiology of the brain. One can estimate his work only at its true value if one is acquainted with the depth of ignorance which prevailed when he appeared. I shall never forget the impression I received the first time I saw Gall dissect a brain. It seemed to me as if I had never seen that organ.*