

Learning Outcomes

- Understand the brain/CNS basis of a range of behaviours and cognitive processes
- Gain an overview of major anatomical and functional brain networks – neuroanatomy-based course
- Understand methods and primary sources of data in neuroscience, including animal models, histology, lesion studies, human clinical case studies including interventions, brain imaging techniques, neural network modelling

Unit Outline

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Assessments

Tutorial Quiz 1: Assessing weeks 1 – 5 tutorial and lecture content (7.5%)	DUE WEEK 6
Tutorial Quiz 2: Assessing weeks 1 – 12 tutorial and lecture content (7.5%)	DUE WEEK 13
Participation for class discussions (5%)	
Report: 2000 words based on week 2 tutorial experiment (30%)	DUE WEEK 9
Exam: Multiple choice and short answer questions (50%)	EXAM PERIOD

A brief history of neuroscience

- Changing views about the brain's role in controlling behaviour
- Some crucial methodological developments in anatomy and physiology
- Changing views regarding localisation of function

Ancient Egypt

- The brain was thrown out during mummification, unlike other organs (lung, heart, intestines) which were preserved
- But Egyptian doctors did have some understanding that brain damage could lead to changes in various abilities and behaviours

- Edwin Smith Surgical Papyrus, 1700 BC, believed to be a copy of a document from 3000 BC



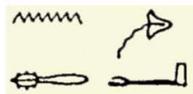
Brain



Membrane enveloping the brain



"corrugations" of the brain



"fluid" in the interior of the head

Some understanding that the brain was important and useful but not important enough to take to afterlife

Ancient Greece

- Alcmaeon of Croton (6th – 5th century BC) was first to consider the brain was the seat of the mind
- Hippocrates (4th century BC) associated brain with sensation and intelligence (also with epilepsy)
- Plato (427-347 BC) also believed the brain was the seat of mental processes
- Aristotle (384-322 BC) believed the heart was the source of intelligence and emotions, and the brain was just a cooling mechanism for the blood
- Herophilus of Chalcedon (3rd century BC) distinguished the cerebrum and cerebellum and described the ventricles - looked at the brain in more detail, believed the ventricles (empty spaces) were responsible for intelligence, where everything is happening

Ancient Rome

- Galen (130-200 AD) – greatest surgeon in Roman Empire
 - observed that head injuries suffered by gladiators led to changes in behaviour
 - did dissections in monkeys and other animals (but not humans)
 - believed that psychic pneuma – a mysterious fluid
 - passed along nerves to all parts of the body and caused muscle contractions (first conception of neural communication)
 - associated the whole brain with psychological functions, but linked higher mental functions (e.g., reasoning) to the ventricles

Renaissance

- Leonardo da Vinci (1472-1519)
 - Worked out the shape of the ventricles by pouring wax into an ox brain
- Vesalius 1514-1564
 - Anatomy based on human dissection
 - Book De Humani Corporis Fabrica
 - Very detailed and high quality anatomical drawings
 - Nerves transmit sensation and motion
- Michelangelo – Sistine Chapel; God inside a brain

Philosophical approach

René Descartes, 1596-1650

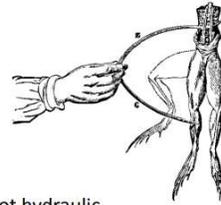
- Wrote De Homine (On Man)
- Dualism: body, soul (=mind)
- Believed that ‘animal spirits’, made up of small particles, flowed from the brain to all parts of the body, to make it move.
 - He chose this gland as there is only one of this gland, while every other part is duplicated in the brain.
- Believed that the soul (mind) and body communicated via the pineal gland, situated in the middle of the brain. ↑

“one could find many reliable precepts, both to cure and prevent diseases...if one had sufficiently made it one’s study to know the nature of our body and had never attributed to the soul the functions which depend only on the body...”

Electrical Communication

Luigi Galvani (1737-1798)

- Electric, rather than hydraulic, transmission in nerves



No head = not hydraulic

Discovered by accident, when experimenting with electricity, accidentally touched a frog leg with an electrically charged scalpel and the leg twitched suggesting that electric transmissions occur in nerves.

Fine anatomy of the nervous system

Camillo Golgi, 1843-1926 - showed neurons

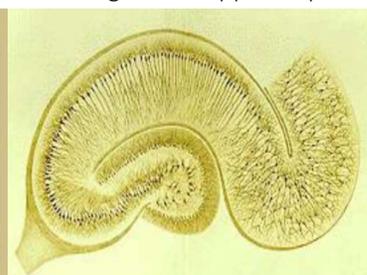
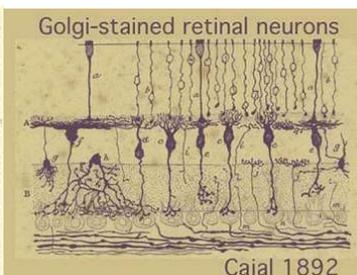
- Silver nitrate staining method
- Enabled visualisation of nerve cell body with processes - evidence brain is not singular mass but rather differentiated

Nerves as cells

Santiago Ramon y Cajal 1852-1934

- Interpreted Golgi’s findings and provided evidence of the existence of individual neurons
- Classified different types of neurons and glia
- Hypothesised the neurons continue to grow and change

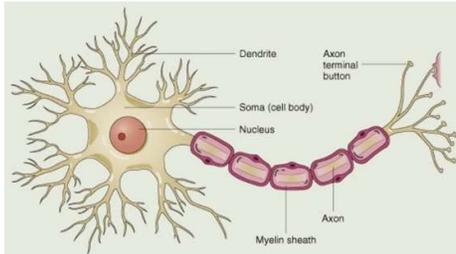
Beautiful Brain: The Drawings of Santiago Ramon y Cajal



Drawing of the hippocampus

Neuron doctrine

- Neurons are anatomically discrete, autonomous cells that can interact
 - Synapses are gaps that separate neurons
 - Information is transmitted in one direction, from dendrite to axon
 - None of these conclusions were possible until the tissue could be stained and examined microscopically
- Golgi and Ramon y Cajal shared the Nobel Prize in 1906



Information comes through dendrite, along the axon then jumps to another neuron.

The information travels in one direction.

Localistic vs Holistic function - functions in the brain are supported by both localistic and holistic approaches.

▸ Phrenology

Franz Joseph Gall 1758-1828

- personality related to different size of brain areas indexed by skull contours; felt the skull for personality traits

▸ Reaction against phrenology

Pierre Flourens (1794-1867)

Investigated Gall's claims experimentally

- Localised ablation of tissue of living rabbits, pigeons
- Hemispheres: perception, movement
- Cerebellum: balance, co-ordination
- Brainstem: breathing and death
- No specific regions for memory & cognition = holistic functions

▸ Localisation: language

The beginning of localisation of cognitive functions

- 1861 – Societe d'Anthropologie in Paris held a series of debates on holism vs localism
- Paul Broca (1824-1880) presented Leborgne, a patient with R hemiplegia and loss of speech and writing
– He could understand speech but uttered only one syllable – “Tan”, along with a few obscenities
- Post-mortem: Stroke involved part of insula and frontal lobe
- 8 subsequent cases with similar lesions
- Broca inferred:
 - that the seat of language was in the inferior posterior portion of the frontal lobe
 - That the two sides of the brain controlled the opposite sides of the body