DISCOVERIES IN THE HUMAN BRAIN.
NEUROSCIENCE PREHISTORY, BRAIN STRUCTURE, AND FUNCTION.
By Louise H. Marshall and Horace W. Magoun.

The overwhelming impact of this book is not just the discoveries it describes so well, but the portraits it paints of the discoverers. Without the tools and scientific techniques presently available, these scientists used their minds, patience, perseverance, and scientific method to deduce and discover facts of enduring importance. The discoverers and their discoveries emerge in sharp focus from these beautifully illustrated and comprehensively referenced pages. Each of the dozen chapters concludes with a brief overview of its essential messages, consolidating for the reader its relevance to previous chapters and its contribution to those which follow.

The introduction embraces three broad postulates. The first, the continuum, is the relentless, continuing but ever-changing evolutionary process. This launches the reader directly into the early evolutionary gestation of the most important and versatile of organs, the human brain, recorded over time by its protector—the skull—as it responded to the many and changing physical and social pressures imposed by man’s early environment. These, stimulating or necessitating invention for survival, led to the continuing adaptation of the early human brain as outlined by the skulls of Olduvai (Tanzania) and elsewhere. A medical student pilgrimage by one of us to Olduvai in the 1960s not many years after the Leakeys’ discoveries, reinforced by the infectious enthusiasm of the lone guide and custodian who had worked with them, was an unforgettable experience reawakened by this introductory chapter.

The second postulate recognizes the hierarchy of levels of nervous system structure and function, and, with Ivan Sechenov—named by Pavlov the ‘father of Russian physiology and scientific psychology’—came the birth of electrophysiology.

For more than fourteen centuries the third postulate, dating from Galen, that function determines structure, spawned all aspects of evolutionary thought and scientific progress. For example, in AD 177 Galen acknowledged this primacy of function over form when writing about the human hand. Here he questioned whether the hand, for its task, was better cleft into many divisions or better to remain wholly undivided. A more modern example pertaining to the nervous system was Ramon y Cajal’s observation and subsequent description (1892) of the embryonic pyramidal cell, with its development of axonal collaterals and protoplasmic processes correlating with the increasing size and convolutional complexity of the cortex. In 1894 Cajal went on to hypothesize these would correlate with intellect.

‘Cerebral gymnastics are not capable of improving the organisation of the brain by increasing the number of cells . . . but it can be admitted as very probable that mental exercise leads to a greater development of the dendritic apparatus and of the system of axonal collaterals in the most utilized cerebral regions.’

Cajal acknowledged this was not a new idea, but that it was now supported by ‘the positive facts of structure’.

The concept of the brain’s central role was supported by Plato and the Hippocratic physicians. From the brain . . .

‘comes joys, delights, laughter and sports, and sorrows, griefs, despondency and lamentations. And by this, in an especial manner, we acquire wisdom and knowledge and see and hear, and know what are foul and what are fair . . .’

The authors, with many such quotations from authors of the past, introduce the reader to their often delightful turns of phrase in addition to their thinking and reasoning.

Plato’s pupil Aristotle, despite recognizing that man has the largest brain of all animals, and probably being the first to describe a cerebral ventricle, believed the brain simply cooled the blood and that the heart was the locus of thought and sensation. This was the widely held belief throughout the middle ages. At the time of Galen’s death in around AD 200, the brain had been reinstated as the body’s central organ and locus of the soul and Galen’s description of the nervous system—as the brain, spinal cord, and nerves—had been introduced.

After Galen there followed a long eclipse which lasted until the sixteenth century due to little practical study of the human cerebrum. This was in large part due to the dogmatism and perceived infallibility of Galen, whose observations on the anatomy of animals were transferred without hesitation to human anatomy. Interestingly, Galen himself had lamented the prejudice which prevented the dissection of the human body. Neurology was his greatest anatomical achievement and most of the gross structures of the brain were described by him. But despite Galen’s dominance, further headway was made. For example, functions were allocated to certain parts of the brain, specifically to the middle ventricles (third) and to the posterior (fourth). It was that great anatomist Leonardo da Vinci, who, in 1490, drew the ventricles of an ox after injecting them with molten wax to form a cast once the brain tissue was removed. The birth of modern anatomy came in the sixteenth century with Vesalius (1514–64) and his publication De humani corporis...
fabrica libri septum (1543). Vesalius, who before his banishment from France had dissected corpses from cemeteries and gallows, rejected the ventricles as the residence of the soul and cited the brain as the organ of intelligence, movement, and sensation. It is interesting to note that despite Vesalius’ influence, Descartes (1596–1650) saw the human body purely as a mechanical contrivance—a machine made by the hand of God, incomparably better than any machine of human invention. In 1649, a year before he died, Descartes located the origin of the soul to the pineal, although Thomas Willis (1621–1675) had six years before, in 1643, located the origin of ‘animal spirits’ to the choroid plexus. Descartes also attributed to the pineal gland a central role in human sensation and action. He was invited to the Court of Sweden by Queen Christina to discuss philosophy, which they apparently did until 4 o’clock in the morning. Descartes died in Stockholm ‘in the land of bears, among rocks and ice’. Due perhaps to Descartes’ death, study of the choroid plexus succeeded the pineal as the centre of attention and enquiry during the nineteenth century. Whatever the reason, this ultimately led to the discovery of the blood–brain barrier, first stated clearly by Goldman in 1909, who ‘with a pharmacologist’s intuition’ forecast that ‘Every practical attempt to affect the diseases of the central nervous system chemotherapeutically will have to rely upon the greater or lesser permeability of the epithelium of the plexus . . .’

In this way, the remarkable story unfolds, from the ventricles via the surface contours—the fissures and ‘coils’—to the cortical hemispheres. This is followed by the lobes and with localization of function by stimulation and ablation experiments, thence to the development of evoked potentials. The practice of phrenology and the debate which followed on the localization of intelligence within the cranium, served to promote the concept introduced by Gall (1758–1828), that certain areas of the brain surface correlated with specific faculties or functions; the prelude to the localization of function within the lobes such as frontal lobe pathology with loss of speech. The description by Swedish theologian and scientist Emmanuel Swedenborg (1688–1772) of the homunculus is briefly mentioned. This remarkable man localized hemiplegia to the brain and paraplegia to the spinal cord. Of interest, Swedenborg died in London and was buried there in the Swedish Lutheran Church. In 1908 the Swedish Government brought his remains back to Sweden with considerable ceremony, and they now lie in the Cathedral at Uppsala not far from those of Linnaeus. He was initially reburied with the wrong skull but this was later replaced by what was felt to be the correct skull when it was found in England!

Sir Henry Head (1861–1940) is credited with promoting the theories of Hughlings Jackson (1835–1911), the ‘Grand Doge’ at the National Hospital, Queen Square, whose challenge of Broca’s views on strict localization centres heralded the conflicting views relating to aphasias which lasted well into the twentieth century; Jackson stated ‘To locate the damage which destroys speech and to locate speech are two different things.’ It was Sir Henry Head whose 

studies of the localization of cortical function in British casualties of 1914–18 are described in The Regeneration Trilogy by Pat Barker, winner of the 1995 Booker Prize. Of further interest, in 1903 Head sectioned a branch of his own radial nerve and, assisted by WHR Rivers, determined the nature of the sensory loss.

The later chapters, dealing with the continuing history of discoveries, their discoverers and the inevitable controversies surrounding each and every one, continues the readers’ journey through the concepts and facts relating to cerebral asymmetry and behavioural laterality, cerebral fine structure, cerebral neurochemistry, the cerebellum, thalamocortical pathways and consciousness and the pituitary—hypothalamic axis. The final chapter brings these apparently disparate ‘beings’ together by describing the three major integrative systems—limbic system and memory, corticothalamic connections and cybernetics with the brainstem reticular formation and arousal.

And so the reader travels forward to the discoveries of the many succeeding and contemporary explorers but at the same time is frequently encouraged to return to reflect on earlier discoveries. In this way one is introduced to the ideas and thinking of the many minds which sustained the continuing momentum of discoveries in the human brain into the later nineteenth and early twentieth centuries towards the here and now. Inevitably, this makes one wonder what the next millennium has in store.

The habit and scholarship of physicians to write the history of medicine dates from antiquity. ‘The longer you can look back, the further you can look forward’ said Winston Churchill when addressing the Royal College of Physicians in March 1944. Probably the greater truth, medically speaking, is that knowledge of the present greatly increases an interest in the observations of the past; this book is the ideal destination for those who believe this to be true.

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