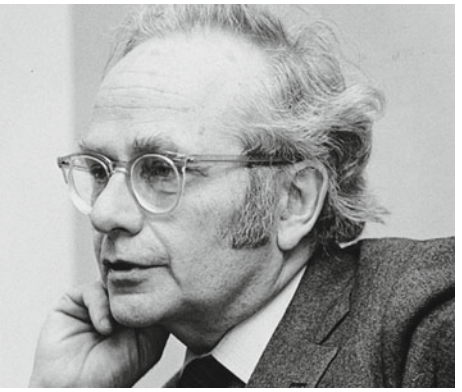
Chapter 95
Hubel, David Hunter 1926–2013



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David Hubel was born on February 27, 1926 in Windsor, Ontario, Canada to American parents. His father was a chemical engineer. The family moved to Montreal where Hubel attended public schools and privately experimented with chemistry and participated in his father's hobby of photography. He attended McGill College in Montreal where he studied medicine, graduating in 1951, followed by a residency at the Montreal Neurological Institute. In 1954, he was offered a neurology residency at Johns Hopkins University in the USA. As a dual citizen, Hubel was drafted for two years into the Armed Forces at the Walter Reed Institute in Washington. There he was able to do neurophysiological research work, beginning with the development of a microelectrode making possible measurement of electrical currents in single neurons of the brains of cats. After moving back to Baltimore in 1958, he resumed work at the Wilmer Institute of Johns Hopkins where he did cooperative work with another researcher, the Swedish neuroscientist

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Torsten Wiesel, who had been involved in making electrophysiological measurements in lateral geniculate cells in cats. This was the starting point of a nearly two-decade long joint effort, ultimately resulting in both of them receiving the Nobel Prize for Physiology or Medicine in 1981. In 1959, Hubel, Wiesel and their mentor Stephen Kuffler were recruited by the Harvard University Medical School where Hubel remained and maintained a lab until much past his official retirement. Hubel died on September 22, 2013 in Lincoln, MA [1].

95.1 Neurobiology of the Mammalian Visual System

Their first research concerned the determination of the receptive fields of neurons of cats in the striate cortex of their brain, finding neurons that respond to straight lines of varying angles and others that respond to movements. With this approach, they opened an entirely new path of research concerning the neurobiology of the mammalian visual system. They expanded the tests to higher mammals, spider and rhesus monkeys and macaques, where they found comparable results. These and further experiments indicated the presence of what they called simple, complex and hyper-complex kinds of cells in different locations of the animals' brains. In rhesus monkeys, they located cells with opponent-color responses as well as cells where color and spatial responses interacted. They determined the lateral geniculate nuclei in the brain to be major transition points of data between the eyes and the vision center at the back of the brain. They identified six layers in the lateral geniculate nuclei (LGN) in which different aspects of the information received in the retinas is processed before being passed on to the visual center in the back of the cortex (Figs. 95.1 and 95.2). They followed the information from the LGNs to the cortex. There they identified layers in so-called ocular dominance columns where the information is further processed depending on the dominant function of the column of cells: motion, brightness, color, etc.

Another field of their research was the effect of early visual deprivation on how the physiology of the visual system is expressed in the brain, indicating that deprivation results in damage from which the visual system does not completely recover.

Hubel and Wiesel co-authored a total of 28 articles describing their extensive and revolutionary research work into the neural complexity of the mammalian visual system, laying much of the foundation of an expanding field of knowledge that, however, continues to remain incomplete. Hubel and Wiesel ended their cooperation in the mid-1970s. Hubel began collaborations with other vision researchers: Margaret Livingstone, Stephen Macknik/Susana Martinez-Condé and others [1].

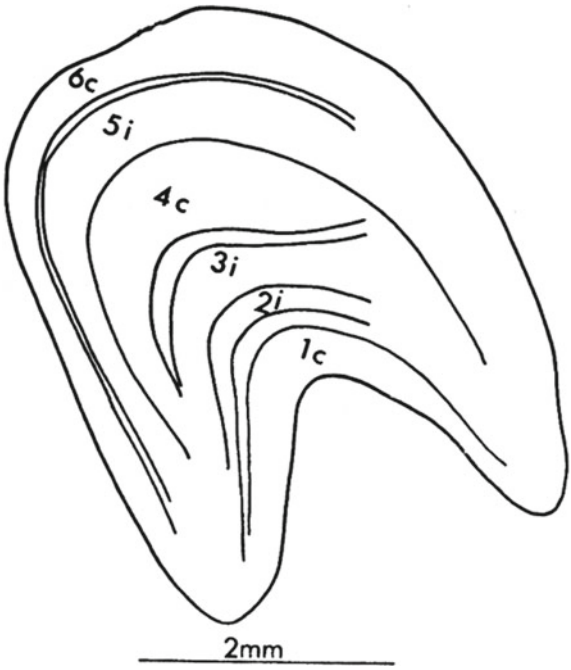

Fig. 95.1 (Left) Sketch of the cross-section through a lateral geniculate nucleus (LGN) of a monkey showing the six layers of neurons that process data obtained from post-retinal neurons in both eyes. *i* indicates information from the eye on the same side as the LGN (ipsilateral), *c* indicates information from the opposite eye (contralateral). Each layer contains a representational map of the field of vision, with the maps precisely aligned [1]

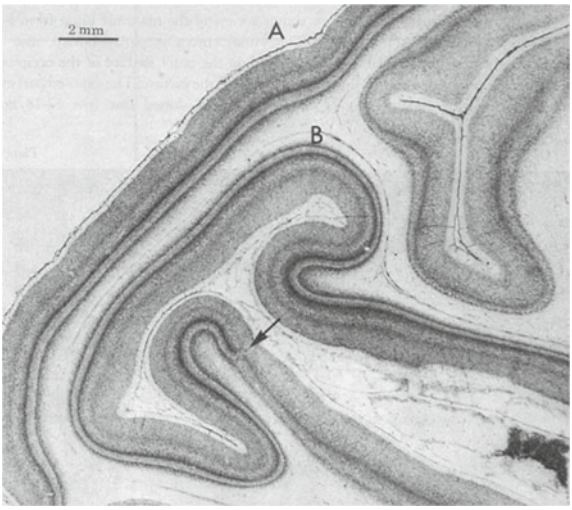

Fig. 95.2 (Right) View of layers of the visual area of the cortex of a cat, with A representing the outer and B an inner layer of the cortex. Different internal layers can be distinguished, being representative of the six layers identified by Wiesel and Hubel in LGN as well as the cortex [1]

Reference

1. D.H. Hubel, T.N. Wiesel, *Brain and Visual Perception* (Oxford University Press, New York, 2005)