David Hunter Hubel

(1926–2013)

Neuroscientist who helped to reveal how the brain processes visual information.

When David Hunter Hubel died on 22 September, the world lost a great neuroscientist. It also lost a passionate advocate for a style of small-scale research that may still be one of the most powerful ways to make discoveries.

Hubel studied the brain circuitry that underlies vision in collaboration with neurophysiologist Torsten Wiesel. By working on one neuron at a time, the pair gave neuroscientists a new understanding of a cortical circuit that contains millions of neurons and hundreds of millions of connections.

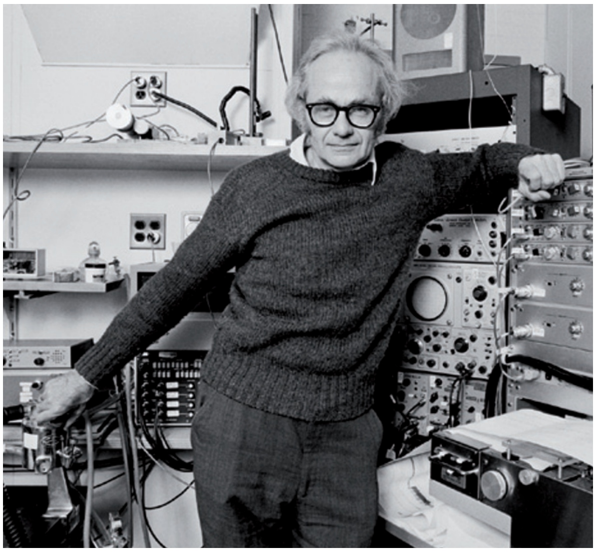
Hubel was born in Windsor, Canada, and grew up in Montreal. His father was a chemical engineer, and, as a boy, Hubel enjoyed tinkering with both electronics and chemistry. In 1947, he graduated from McGill University in Montreal with a bachelor's degree in mathematics and physics. He then took a leap and attended medical school, also at McGill.

Hubel received his doctor of medicine in 1951 and trained as a neurology fellow at Johns Hopkins University School of Medicine in Baltimore, Maryland. His studies were briefly interrupted when he was drafted into the US Army. In 1958, neurobiologist Stephen Kuffler invited Hubel to join his lab and work with Wiesel at the Wilmer Eye Institute at Johns Hopkins. Thus began an extraordinary 25-year collaboration. In fact, Hubel and Wiesel worked so closely and published so extensively together that some people thought that they were one person, named Hubel N. Wiesel.

In 1959, Hubel and Wiesel moved with Kuffler to Harvard Medical School in Boston, Massachusetts. When they started their experiments in the late 1950s, the visual cortex was essentially uncharted territory. In their 2004 book, *Brain and Visual Perception* (Oxford University Press), Wiesel described how he and David "approached the visual cortex as explorers of a new world".

Kuffler had shown during the 1950s that shining spots of light on a small part of a rabbit's field of view triggered strong signalling in specific neurons in the retina, with nearby neurons having overlapping 'receptive fields'. This work revealed that, in travelling from the photoreceptors to the output neurons of the retina, visual information is deconstructed into an image that resembles a George Seurat-like pointillistic painting. But how it is resynthesized to generate a complete picture of the world, as seen by both eyes, remained a mystery.

Hubel and Wiesel found that the spots of light that so effectively activated retinal



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neurons and the neurons of the lateral geniculate nucleus (a relay point between the retina and the visual cortex), had no effect on the neurons in the visual cortex. Then, one evening, the pair noticed that a view of the edge of one of their stimulus slides made cortical neurons respond robustly. Furthermore, many of these 'edge-detecting' neurons were responding to information from both eyes.

Hubel and Wiesel had just discovered the first visual-circuit steps used to reassemble our binocular view of the world. They reported their findings in two beautifully written studies in *The Journal of Physiology* in 1959 and 1962.

In the years that followed, Hubel and Wiesel found that neurons responsive to the same line or edge orientation clustered together in vertical columns stretching from the outer surface of the visual cortex to its inner white matter. And neurons responding best to stimuli presented to the right or to the left eye were located near each other, also in vertical clusters.

This columnar architecture seemed so precise that initially, researchers thought it was hard-wired. But through studies of cats and monkeys that had had one eyelid sealed, as well as of children with congenital cataracts, Hubel and Wiesel found that visual experience could alter it. They observed that, during a restricted developmental window, when vision in one eye was impeded, the good eye 'hijacked' cortical circuits that should have been shared equally between the two eyes. This finding was the first example of how experience can change brain circuits. In 1981, Hubel and Wiesel were awarded the Nobel Prize in Physiology or Medicine for their studies of how the visual cortex processes information, along with neurobiologist Roger Sperry.

David had a lifelong love of art and music. Sometimes in the evenings, when I was a PhD student in his and Wiesel's lab during the 1970s, the haunting sounds of his flute would waft down the hallway. He also enjoyed fabricating the tools of his trade, such as tungsten microelectrodes, often using the lathe that he kept in his lab.

Aside from his children (David had three sons with his wife, Ruth), his largest personal legacy may be his passion for fundamental, discovery-based research. He communicated this enthusiasm to legions of graduate and medical students with spellbinding lectures, often using illustrations of optical illusions to link the science of the visual system to the beauty of art and visual perception.

David worried publicly about the state of biomedical research: large labs lead by faculty who are too busy with grant-writing and administration to be able to participate in their own experiments. Even after he closed his own lab, he ran a seminar for Harvard undergraduates, teaching them the fundamentals of neuroscience as well as hands-on lab techniques, including how to use a lathe, solder a circuit board and look through a microscope.

David showed generations of young scientists and clinicians how science can become art and how art can become science. Our understanding of the brain and perception has changed profoundly because of him. ■

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