THE FACULTY OF MEDICINE
Harvard University

David Hunter Hubel

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David Hubel was born in Windsor, Ontario in 1926 into an American (United States) family, who had moved from Detroit to Windsor, where his father worked as a chemical engineer for the Windsor Salt Company. The family moved to Montreal in 1929, where David was brought up, educated and lived until the age of 28. The Hubel family had the advantage of living in Outremont, a middle-class suburb of Montreal that was predominantly French-speaking allowing David to become modestly bilingual. He recalled that as a child he developed a private French/English language with another little boy whose French family lived in the other half of their duplex. He graduated from Strathcona Academy with qualifications to enroll at McGill College- not yet McGill University. Both math and music became passions during his elementary and high school years.

In his final year at McGill, he applied to both a graduate program in physics and to medical school. Acceptance came from both and to his horror he was faced with his first big career decision. He chose medicine and in the fall of 1947 entered McGill medical school together with a large contingent of World War II veterans, many of whom were considerably older than the other students in the class.

Despite having little preparation in biology—David's main interests had been mathematics and physics in high school--he excelled in medical school. He found the subjects of neurology, neuroanatomy and neurophysiology exceedingly well taught and got to know both Herbert Jasper, the preeminent Canadian clinical neurophysiologist, and Wilder Penfield, the legendary neurosurgeon.

Following graduation from medical school, David did a rotating internship at the Montreal General Hospital. By 1952, he became interested in doing research, so at 26 years of age, he asked his former teacher Herbert Jasper if he could work with him doing neurophysiology. He did a year of neurology

residency at the Montreal Neurological Institute, followed by a year of neurophysiology under Herbert Jasper. He ended up, however, mostly doing clinical neurological exams on Jasper's epilepsy patients. He swore after this year that he would never read another EEG again, but Jasper did apparently stimulate his interest in developing methods to record from awake animals.

In 1954 David married Ruth Izzard and they moved to Baltimore for a residency in Neurology at Johns Hopkins. After this residency, because of the doctors' draft, he enlisted in the US Army in order to wrangle a position at Walter Reed Hospital, where he was allowed to do research under the benign neglect of Michelangelo Fuortes and Robert Galambos. One of the projects Mike suggested was to try inserting wires into a cat's brain under anesthesia, and then allow the cat to wake up, and see if he could record neuronal activity. It didn't work at first, but in the process of getting it to work, David invented the tungsten microelectrode and adapted the closed chamber method of Philip Davies (a way of sealing an electrode in the brain so that pulsations did not interfere with recording single neurons), both of which were essential for the work he later did with Torsten Wiesel.

David was a tinkerer, and he invented and made just about all the equipment for single cell recording that he and his collaborators would use over the years. David had a lathe with which he made electrode advancers-- beautifully simple hydraulic syringe-like things that would advance an electrode slowly and precisely through the cortex. They consisted of a precision-fit plunger inside a small Lucite tube filled with oil (which leaked all over) to drive the plunger. He figured out how to make tiny electrolytic lesions to mark electrode tracks by putting an electrode in a raw egg white and seeing how much current was needed to make a tiny white spot. His inventions allowed him to record single cell activity in the lateral geniculate body, the primary visual cortex, and the auditory cortex in awake cats. The methods David developed at Walter Reed to record from awake cats became a model for studies of behaving monkeys, making David in some sense the father of this approach that is now used all over the world.

After his service at Walter Reed, David had arranged to do a postdoctoral fellowship with Vernon Mountcastle at Johns Hopkins, but the fellowship would have to be postponed because Mountcastle's laboratory was being renovated. Determined to continue doing research, David contacted Stephen Kuffler at the Wilmer Institute next door. Steve accepted David into his lab and suggested that he collaborate with Torsten Wiesel, another postdoc in his lab. Having met and heard David give a splendid talk in Atlantic City, Torsten was delighted to get a chance to have such an outstanding collaborator.

From the very beginning David and Torsten saw eye-to-eye on the way to forge ahead. At their first lunch meeting they sketched out the plan to build on Steve's discovery of the center-surround receptive field arrangement in cat retinal ganglion cells: to look at response properties of cells all along the visual pathway. This marked the beginning of a nearly 20-year long collaboration of two open and curious minds seeking the way and finding out secrets hidden in complex circuits that provide the basis for visual perception. David's insights, technical skills and his ability to clarify and express new and surprising concepts were essential to their discovering so much from recording the activity of just a few out of several millions of nerve cells.

Hubel and Wiesel soon found out that cells in visual cortex responded to contours of specific orientation, that individual cells received and coordinated signals from both eyes, and based on these two features the visual cortex had a beautiful columnar architecture. Once they had discovered this cortical organization, the next obvious question was to find out if cats and monkeys are born with this precise and sophisticated wiring or if visual experience was necessary for its development—the classical nature/

nurture question. They established from experiments in newborn animals and by visual deprivation that the main pathways and circuitry are present at birth and therefore arise from innate mechanisms. They also established that early in life there is a critical period of neural plasticity during which these connections crucial for normal vision can be erased or significantly modified. David was a spectacular writer and lecturer in presenting the work he and Torsten had done, which was likely critical for the quick acceptance of their discoveries. His presentations were always crystal clear and sprinkled with a sense of irreverence and humor.

These discoveries were recognized in ophthalmology as relevant for children born with a cataract and led to the now accepted procedure of removing the cloudy lens soon after birth, thereby saving the vision in the impaired eye. David was always eager to point out that this clinical procedure was introduced because of many years of basic research in cats and monkeys. When he was president of the Society for Neuroscience David became an outspoken advocate for animal research and received special recognition for his advocacy. For their work, which led to a revolutionary new understanding of not only the functional organization and developmental rules of the visual cortex but also common principles in other sensory and motor areas of the cortex, Hubel and Wiesel were awarded the Nobel Prize in 1981.

Torsten moved to the Rockefeller University in 1983. David remained at Harvard, but did not rest on these laurels; he kept doing experiments for several more decades. He teamed up with younger colleagues, yet always himself participating in doing the experiments. He disdained people who took credit for their students' and postdocs' work by putting their names on papers to which they had made no substantial contribution. David was always curious and even used daily experiences to gain insights into how we see. For example, when he was in his seventies he wrote an essay published in *Nature* on the lack of completion across the dark adapted fovea of a striped pattern observed when he went to the bathroom at night. One time when he noticed a migraine aura beginning, he carefully mapped the progression of the scintillations as they progressed towards his vertical meridian, in order to find out if the electrical storm would cross from V1 into V2 (it didn't).

David was a wonderful mentor, almost in spite of himself. He was interested in what he was interested in and pursued it with an exemplary focus and intensity. It was obvious that what he really cared about was the truth—not what other people said or thought, but what was the actual truth of the matter. Despite the blue sign on his door that read "Ask me if I care," David really did care. The secret was to get him interested in what you were interested in, and then you had a formidable intellectual ally. In fact, if you couldn't get David interested in what you were working on, it was a very good indication that what you were working on probably was unimportant.

David had a clear mind, and a sneaky sense of humor that he used to skewer the pomposity one often encounters in science. He had a certain look—a "naughty boy" grin—that he would get when he was about to do this. When someone was rambling on about some experiment that didn't make much sense with a weird result that just couldn't be right, David would start that grin and eventually interject, "That's the kind of result you wouldn't believe, even if it were true!" He often dismissed ideas by *reductio ad absurdum*, saying it made about as much sense to study visual receptive fields with sinusoidal gratings (a practice that was in vogue at one time) as to study the action potential with Fourier analysis. Yes, you could do a lot of fancy mathematics (something about which David knew far more than he ever let on in these debates), but it didn't get you anywhere if the formalism was wrong headed. You had to *think* about what you were doing!

David cared about language to the point of being pedantic and gave away copies of Fowler's or Strunk & White to anyone who he thought might benefit. "Two commas or none! Only one weasel word per sentence!" Music was an important part of his life. He played the piano since childhood and became a pretty good player of the flute. He loved Beethoven and the Vienna School but could not stand Mozart. At meetings he was lively and inspiring; he loved the dinners at the Harvard Society of Fellows, which he attended religiously every Monday.

David was a very private person and his family was very important to him. He and Ruth, his wife of nearly sixty years, spent most of their life together in Massachusetts and summers in Newfoundland raising their three boys Karl, Eric, and Paul, all of whom are accomplished in their respective fields.

Ultimately, it is David's lucidity, his common sense, his love of truth and, above all, his love of doing things with his hands—building gizmos, weaving & woodwork, soldering up circuits, milling do-hickeys and running experiments—that abide and inspire.

Respectfully Submitted,

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