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SCIENCE

# Robert Galambos, Neuroscientist Who Showed How Bats Navigate, Dies at 96

By DOUGLAS MARTIN JULY 15, 2010

Dr. Robert Galambos, a neuroscientist whose work included helping to prove how bats navigate in total darkness and deciphering the codes by which nerves transmit sounds to the brain, died June 18 at his home in the La Jolla section of San Diego. He was 96.

The cause was congestive heart failure, his daughter Kate Galambos said.

Dr. Galambos began his career in the 1930s as the technology to study the interior of cells was coming into use. In animal studies, he implanted microelectrodes within single fibers of nerve tissue to capture electrochemical nerve impulses going from the ear to the brain. He then used newly invented electronic amplifiers to capture and record the results.

The result was learning the code by which nerves send messages about sound, said Steven A. Hillyard, a professor of neurosciences at the University of California, San Diego. Each nerve cell responded to a particular sound frequency or that frequency's absence.

Beyond shedding light on how sensory stimuli become perceptions, Dr. Galambos's rigorous experiments led to practical results like surgically implanted devices to provide a sense of sound to the profoundly deaf.

His later studies of electrical activity in the brainstem led him to develop a hearing test for infants and others who cannot verbalize. Surgery, medication or hearing aids can then be prescribed.

Dr. Hillyard called Dr. Galambos, the author of more than 200 scientific publications, “one of the giants of auditory research.”

Dr. Galambos’s best-known accomplishment was teaming with Donald R. Griffin in 1939 and 1940 to prove how bats use reflected sounds to detect objects. That idea had long been discussed, but never proved.

The first step was for Dr. Griffin, already an authority on bats, to publish a paper reporting that bats utter high-frequency cries inaudible to man. He used new techniques developed by G. W. Pierce, co-author of the paper, to capture the sounds.

Dr. Griffin then asked Dr. Galambos to use a method developed by Dr. Hallowell Davis, a Harvard professor and Dr. Galambos’s mentor, to measure bats’ hearing. Dr. Galambos found it an octave or more above that of other animals.

Thus it was proved that bats could make and hear extreme sound. The experimenters then hung wires from the ceiling of a room to show flying bats make ultrasonic cries when avoiding the wires. When their ears were plugged or their mouths tied shut, the bats blundered helplessly into the wires.

Some scientists reacted with disbelief. Dr. Griffin once wrote, “One distinguished physiologist was so shocked by our presentation at a scientific meeting that he seized Bob by the shoulders and shook him while expostulating, ‘You can’t really mean that!’ ”

But the solution stood. Dr. Galambos wrote that it “was so simple, complete and easy to understand that even schoolchildren told the story correctly after hearing it once.”

Robert Carl Galambos was born in Lorain, Ohio, on April 20, 1914. He earned bachelor's and master's degrees in zoology from Oberlin College. His master's thesis was on earthworm locomotion. He earned a Ph.D. from Harvard, writing his dissertation on the bat work.

While there, he assisted on a wartime study on whether loud explosions could cause permanent hearing loss. Part of the experiment involved him and others jumping into Boston Harbor as blasting caps were detonated nearby.

He next graduated with an M.D. from the University of Rochester, then returned to Harvard as a researcher after interning at Emory University Hospital in Atlanta.

He then went to Walter Reed Army Institute of Research, where he worked with David H. Hubel, a future Nobel Prize winner, on studies of how the auditory system of the cat responds to the unexpected. He later worked at Yale and the University of California, San Diego.

In recent years, he switched his attention from ears to eyes, and advanced the theory that the eye sends information to the brain in discrete packets tied to eye movements, rather than continuously.

Dr. Galambos's first marriage, to Jeannette Wright Stone, ended in divorce. His second wife, Carol Armstrong Schulman, died. He is survived by his wife, Phyllis Johnson; three daughters from his first marriage, Joan Gilmore, Kate Galambos and Ann Holben; five grandchildren; and three great-grandchildren.

In 1960, while on an airplane, Dr. Galambos wrote that he had an inspiring thought: that the tiny cells that make up 40 percent of the brain, called glia, are as crucial to mental functioning as neurons.

"I know how the brain works!" he exclaimed to his companion.

But his superiors at Walter Reed found the theory so radical that he was

soon job-hunting. The view at the time was that glia existed mainly to support neurons, considered the structural and functional unit of the nervous system. But Dr. Galambos clung to his belief, despite the failure of three experiments he performed in the 1960s.

Since then, scientific opinion has been shifting in his direction. In 2008, Ben A. Barres of the Stanford University School of Medicine wrote glowingly in the journal Neuron about the powerful role glia are now seen to play. He concluded, “Quite possibly the most important roles of glia have yet to be imagined.”

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