

Roger Wolcott Sperry (1913–1994)

During a conversation in the spring of 1994, I attempted to convince Roger Sperry of the importance of writing an autobiography. His reply was astonishing: "Do you really think I have made a difference?" This tenacious and quiet man devoted his entire professional life to answering the most fundamental questions of psychology. In the process, Sperry left behind a series of important experiments and provocative theories about the human brain and behavior that have ineluctably changed the history of psychology.

Sperry was born in Hartford, Connecticut on August 20, 1913 and was raised in an upper-middle-class environment that stressed academic achievement. He received an English degree in 1935 from Oberlin College. As an undergraduate, however, he enrolled in Introduction to Psychology, taught by R. H. Stetson, who had studied at Harvard University with William James, Josiah Royce, and Hugo Münsterberg. On the first page of Sperry's notes taken in that class were written two questions that were to be the theme not only for that course but for Sperry's own professional life: Where does behavior come from (nature vs. nurture)? and, What is the purpose of consciousness?

The initial question Sperry set out to answer involved the ontogeny of behavior. He believed the best way to pursue this basic question was to study with Paul Weiss, an eminent neuroembryologist, at the University of Chicago's Zoology Department. In addition to learning important neurosurgical techniques, he also began a pattern of questioning his mentors that would eventually become his trademark. Weiss had concluded that nerve fibers were interchangeable and, in essence, that peripheral neural structures could be molded according to the task involved. Sperry began a series of experiments involving the transposition of hind muscles and nerve fibers of the rat. As early as 1938, two years before receiving his PhD in Zoology in 1941 at Chicago, Sperry had presented findings contrary to Weiss's that indicated that muscular coordination was unmodifiable when nerve fibers were interchanged.

Sperry turned to Karl S. Lashley for further training because he was especially interested in Lashley's principle of equipotentiality. In 1941 Sperry became National Research Council Fellow at Harvard. From 1942 to 1946, he was a Biology Research Fellow at the Yerkes Laboratories of Primate Biology in Orange Park, Florida. There he focused on another series of experiments involving the rearranging of both motor and sensory nerves, and eventually sensory organs (specifically the eye), as well as testing neocortical electrical waves. He expanded the range of organisms he studied to include amphibians, fish, and monkeys. By the late 1940s he concluded that nerve fibers were

not interchangeable and that, contrary to popular belief at the time and to the findings of both Weiss and Lashley, neuronal circuitry was established very early in the course of development and did not appear to be grossly modifiable.

Sperry returned to the University of Chicago in 1946 as Assistant Professor of Anatomy (and, in 1952, of Psychology). During this time he began to search for the mechanism responsible for the immunability of nerve fibers. By 1948 he had reported that the orderly patterning of synaptic associations occurred in the regeneration of fiber tracts. A few years later he had outlined the mechanism of neural maturation and eventually the regulative factors that directed the orderly growth of neural circuits. Chemical specificity controlled by heredity was considered the determining factor for neural growth and regrowth. According to Sperry, the results of these experiments indicated that "nature" had a more important role in behavior than previously considered.

In 1949 a routine chest x-ray showed Sperry to have, unexpectedly, evidence of tuberculosis. So in 1950, Chicago sent Sperry and his new bride and eventual lifelong collaborator, Norma Deupree, to Saranac Lake in the Adirondack Mountains in New York for treatment. During this time, he began writing his monumental concepts of mind and brain, first published in the *American Scientist* in 1952.

Sperry also shifted the nerve cutting experiments from the peripheral to the central nervous system. By 1954 his base of operations had moved to the California Institute of Technology in Pasadena where he had been appointed to the prestigious position of Hixon Professor of Psychobiology. Interestingly, he was the only scientist in the Division of Biology who focused on behavior. Sperry was isolated from mainstream Caltech science of the day not only in his focus of study but also in his basic conceptual views of the philosophy of science. He considered himself a reductionist until about 1963 but was always puzzled by mind-brain relationships. Nevertheless, his laboratory continued to produce a variety of well-designed experiments and carefully written publications. The first article on cognitive changes following division of the corpus callosum had actually appeared in 1953 while he was still at Chicago. Laboratory activities at Caltech gradually began shifting toward the study of interhemispheric communication through the corpus callosum. Numerous experiments were performed on cats and monkeys with the collaboration of a host of graduate students, postdoctoral fellows, and visiting scientists from around the world.

A young neurosurgeon, Joseph Bogen, had followed

Sperry's work on the dissection of the corpus callosum in nonhuman animals and believed that this operation could help "restore to function an apparently hopeless case of post-traumatic focal epilepsy". Together with neurosurgeons Philip Vogel and Bogen, as well as several graduate students, Sperry initiated a series of experiments to determine the effects of this type of operation on neurocognitive functions. For the next 20 years, Sperry and his collaborators produced fascinating studies that indicated the two hemispheres of the brain had unique capabilities. Furthermore, the combination of both hemispheres working together produced a unified state of consciousness that amounted to more than the simple additive effects of the two hemispheres alone.

Sperry's initial attempts to answer the nature-nurture question through experiments on connectionism eventually led him to study the second question posed in his introductory psychology course, that of consciousness. This apparent shift from neurospecificity to the split brain was planned as part of a 50-year research program to understand better the questions of ontogeny of behavior and the purpose of consciousness.

By 1964, Sperry's laboratory was producing numerous findings about brain-behavior relationships, resulting in questions about the purposes of consciousness not previously posed, much less answered. In the spring of 1964, Sperry presented a colloquium to the Division of Biology at Caltech at which he put forth his ideas that consciousness was emergent from brain activity and, more important, that consciousness had a top-down causal control on component neural activity. For the first time in psychology's history, the concept of emergent interactionism with downward control was postulated as the basic explanation of mental causality. Hence, behavior was not only the culmination of complex interworkings of neuronal patterning, but such patterning would give rise to consciousness. This consciousness would have a direct causal effect on specific neuronal activity. Besides the fact that he was the first to propose this idea, what was particularly important was that this theory was a scientifically-based concept formulated from 30 years of careful and ingenious nervous system research. The strong foundation on scientific findings is critical in light of Sperry's own perception that science was an important missing ingredient in most philosophical concepts.

By the 1980s Sperry had all but shut down his laboratory and had begun to focus on the philosophical and societal implications of these ideas (issues that he had first published in 1952). He believed that the concepts of consciousness and downward causation would have profound effects on psychology. Primarily, he believed that these ideas contributed to the downfall of behaviorism and to the development of the cognitive revolution. He also believed that this cognitive revolution, which by nature is scientific and psychologically-based, could initiate a paradigm shift for the other sciences. Recent works in physics and mathematics, for example, have begun to address concepts such as chaos and mentalism as critical factors in understanding complex biological activity. For Sperry, such an outcome

was inevitable. However, in his last APA presentation he chided fellow psychologists for not taking the lead to understand the far-reaching implications of the cognitive revolution. Furthermore, Sperry also believed that the traditional scientific paradigm used both in psychology and the other sciences was insufficient for resolving the problems of the modern world. During the last decade of his life, he published numerous works which indicated that the introduction of cognitive and emergent causation, in contrast, provided a new and powerful paradigm for science which, in turn, would yield a robust, heuristic, and ethical means of explaining and understanding ourselves and the world we live in. One outcome of his most recent writings was the development of two international conferences at which a "Declaration of Human Duties" was drafted.

Sperry remained shy and reserved throughout his life, preferring not to seek the spotlight. Whereas colleagues were willing to go forward with their (and in some cases, his) ideas, he preferred to let his science and ideas speak for themselves. After close to 300 articles published in numerous languages and in the most prestigious journals, there is little question that his science and ideas have spoken loudly. He received numerous important honors and awards during his lifetime that attest to this fact. Sperry was elected to the National Academy of Sciences in 1960 and later to the Pontifical Academy of Sciences (1978). He received the Karl Lashley Award of the American Philosophical Society (1976), the Wolf Prize in Medicine (1979), the Ralph Gerard Award from the Society of Neuroscience (1979), the National Medal of Science (1989), and, most recently, the Lifetime Achievement Award from the APA (1993). His most distinguished prize was the (1981) Nobel Prize in Medicine/Physiology that he shared with Harvard neuroscience researchers David H. Hubel and Torsten N. Wiesel.

Sperry was imprinted on the mind-brain problem at a very tender age through a chance reading of William James, probably around the age of 10. For the next half century, his focus was unwavering and his connection to psychology central to his thinking and research. A more tenacious researcher, a better designer of elegant experiments, and a more intellectually demanding thinker would be difficult to find in the history of psychology and science. His ideas have made a permanent impact on neuroscience, neuropsychology, psychology, philosophy, and society. Sperry was one of the intellectual giants of the 20th century. Hence, it is hard to imagine how anyone who had this impact could even begin to question whether he had "really made a difference."

Sperry, Board of Trustees Professor of Psychobiology, Emeritus, at California Institute of Technology, died at the age of 80 on April 17, 1994 in Pasadena, California from complications arising from a neuromuscular degenerative disorder. He is survived by his wife, Norma Deupree Sperry, two children, Glen Tad Sperry and Janeth Hope Sperry, and two grandchildren.

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