Obituaries

Physiological Psychologist Roger Wolcott Sperry (1913-1994)

Editor's note: *Roger Sperry, Nobel prize-winning physiological psychologist, is remembered here by one of his early students and followers, Robert W. Doty. Sperry, an APS Charter Fellow, is perhaps best known for his pioneering "split-brain" research and his work on neurospecificity which won him, among other awards, the Nobel Prize for Medicine (1981) and the National Medal of Science (1990). One of a handful of psychologists (i.e., sensory physiologist Georg von Békésy and APS Charter Fellow Herbert Simon) to have received the Nobel Prize, Sperry's research has had a profound effect on the progress of physiological psychology specifically and brain science generally. Insights are provided into Sperry's later endeavors and philosophical interests, in the January 1990* Observer, *but Robert Doty presents here a personal remembrance of this scientific giant and an elaboration on Sperry's most recent philosophical writings. As a graduate student, Doty took Sperry's neuroanatomy course in the late 1940s, and Sperry served as a guest examiner on Doty's dissertation defense committee.*

On Sunday, 17 April 1994, Roger Sperry obtained surcease from a quickening neurological loss of motor control that had been insidiously crippling him for almost three decades. For this exceptional athlete, avid fisherman, savvy fossil hunter of the wilder American West, peerless surgeon, and talented sculptor his affliction must have been particularly difficult to bear. He did so with quiet courage, remarking toward the end in his typically gentle humor that he was beginning to fear some encroachment upon more than his motor system. But, there was not the slightest evidence of this in his writings or correspondence. Mercifully, the final thrust was from cardiac arrest rather than failure of brainstem motoneurons. The accompanying photo, provided by one of his former students, Marge Scott Scherick, shows him in sturdier circumstance in the late 1950s.

Roger Sperry will forever stand as one of this century's intellectual giants. He had an almost uncanny knack of selecting problems of fundamental import, and then devising ingenious experiments to yield clear, definitive answers. He revolutionized two fields of neuroscience, showing: (a) that neuronal connections are formed and maintained with a high degree of precision, presumably via chemical interchange; and (b) that each cerebral hemisphere is potentially an independent cognitive mechanism. An even greater societal impact, however, may yet flow from his philosophical reworking of the mind-brain problem, promulgating a directly simple concept that could reverberate throughout human behavior.

He was born in Hartford, Connecticut, on 20 August 1913, but I know naught of his early years. It is apparent that his talents were well-nurtured at Oberlin College, where in 1935 he received his Bachelors degree in English, and then continued for a Masters degree in psychology two years later. His first major philosophical contribution (1952), arguing the primacy of movement over perception as a guide to comprehending the mind-brain relationship, acknowledges his indebtedness to his young professor of psychology at Oberlin, R. H. Stetson.

Pursuing this interest in movement, he continued at the University of Chicago with Paul Weiss, a major figure in zoology. From a long series of ingenious experiments Weiss had come to propose a physiologically peculiar theory of "resonance" between a muscle and its central control circuitry (see Weiss, 1952). While Weiss' facts remain largely unchallenged, Sperry's doctoral thesis and later work ultimately forced a complete re-evaluation of Weiss' interpretation. This process was perhaps crowned by Sperry's dramatically brilliant experiments on newts with rotated eyes. The newt forever reacted as though the world were upside down, even when the optic fibers from the rotated eye were allowed to reform their central connections. His thesis work on cross-innervation and muscle transposition in rats had, in addition, also put an end to almost a century of nonsense about facile reorganization of the central nervous system consequent to changing peripheral connections, as he meticulously set forth in his 1945 review.

Now a successful iconoclast, it was natural that he should turn next to that incomparable shaker of the temple of neuroscience, Karl Lashley, as a postdoctoral mentor. On his fellowship at Harvard and the Yerkes primate laboratories, then at Orange Park, Florida, he attacked another dubious concept of neuronal integration, that electrical fields or waves are critical in neocortical processes. The approach was to place multiple insulating elements (mica plates or subpial scarring) or short-circuiting

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elements (tantalum pins) into the cortex, and then examine the function subserved by the affected system. The effects were essentially nil, and in sum adumbrated the now well-supported idea that the neocortical feltwork is organized vertically, into overlapping and interdigitating "columns" of neurons.

Returning to the University of Chicago, he began, with Ronald E. Myers, investigating the puzzle of the corpus callosum. Although there had been sporadic work, reported in German and Russian, showing behavioral consequences in animals of severing this massive interconnection between the two hemispheres, observations at the University of Rochester in the early 1940s by two skilled psychologists, A. J. Akelaitis and K. U. Smith, on epileptic patients with large but varying transections of the callosum, had failed to find significant deficit. This can best be attributed to the incompleteness of many of the transections as well as to the inadequacy of their tests; but the fact that such patients seemed to display normal mentality and bimanual dexterity (e.g., playing the piano), provided a startling challenge to understanding what might be going on in the brain. The clever invention of the "split-brain" preparation, severing the optic chiasm to channel all visual input to one or the other hemisphere, followed by transection of various interhemispheric connections, allowed thorough and decisive testing of the latter pathways in conveying visual information from one half of the brain to the other. Exploitation of this procedure by Sperry and his students rapidly led to appreciation of the manifold roles of the interhemispheric commissures in behavior.

It was Sperry's extensive experience with the animal models, thoroughly revising both concepts and techniques, that made possible the unprecedented insights into functions of the individual hemispheres in man. The shortcomings of the University of Rochester experiments could now be avoided when human patients—again treated largely successfully with callosotomy (and transection of the anterior commissure) for intractable epilepsy by neurosurgeons Phillip J. Vogel and Joseph E. Bogen—became available for testing in the Sperry laboratory. His proof that human consciousness could reside in the linguistically retarded right hemisphere was on an intellectual par with the Copernican and Darwinian revelations that helped define man's place in nature; for it is apparent from the work of Sperry and his colleagues that each human brain has, potentially, two vast networks capable of human experience—a fact cogently verified in instances of left hemispherectomy.

Such separability of the "lives" of the two cerebral hemispheres poses profound philosophical enigmas, and Sperry, true to his 1952 interest in the mind/brain dilemma, pursued and wrote widely on the meaning of these discoveries. Here, again, he has taken a revolutionary step, although now in the realm of philosophy proof will be incomparably more elusive. The deceptively simplistic nature of his proposal is that the mind, wholly a creation of the brain, works back upon the brain *pari passu*, and therefore controls the neuronal outcome.

In other words, decision devolves from mind *per se* rather than as the ineluctable culmination of cascading neuronal connections ascending causally from Brownian motion to neuronal populations. Such upward evolution, from atomic level to neurons, would inescapably induce a mere robotic mind, driven by the chemistry of its past and the chance though intricate fluctuations of the moment; whereas if the causal chain proceeds from the highest, mental level downward, the integrated output of the neuronal action incorporates, and is controlled by, the conscious decision so familiar to each human being. This immediately gives new meaning to consciousness, and returns responsibility to the mind as distinct from ionic whim. "Materialists" will no doubt bridle at the thought, contradicting as it does some three centuries of effort to depict mental experience solely in terms of molecular-neuronal events; yet there is nothing "immaterial" in the concept, only the supposition that the operation of certain vast neuronal networks transcends their molecular description. In a manuscript to be published posthumously, Sperry renders the choice between "upward" versus "downward" control with his usual ingenuity: (a) given that the brain is the *sine qua non* of mental experience, and (b) that ignorance is essentially total as to how this comes about, it is not only more logical to assume that the mental aspect is capable of controlling the entity (i.e., the neuronal network), it is socially far more constructive than accepting, willy nilly, arguments for the robotic mind in the absence of decisive evidence either way! It bears emphasis that nothing "psychic" is implied in these ideas, Sperry having already made the astutely devastating criticism of such pseudoscience; were paranormal communication to exist, where better to expect it than between the two hemispheres of patients lacking the corpus callosum!?

As he so richly deserved, Sperry, a Charter Fellow of the American Psychological Society, was repeatedly honored for his contributions: the Passano Award, 1973; the Lashley Award of the American Philosophical Society, 1976; the Wolf Prize in Medicine, 1979; and the Lasker Medical Research Award, 1979; the Nobel Prize in Physiology and Medicine, 1981, which he shared with David H. Hubel and Torsten N. Wiesel; and the National Medal of Science, 1989. Of equal value to him was the keen enthusiasm of his many students and colleagues, so richly instantiated in the volume edited by Colwyn Trevarthen (1990); and yet another Festschrift is in the making; it was to have honored his 81st birthday.

We all mourn his passing, yet more rationally must celebrate the memory of a life so wonderfully and courageously lived.

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