Archibald Philip Bard

October 25, 1898 — April 5, 1977

By Timothy S. Harrison

PHILIP BARD WAS BORN on October 25, 1898, in Hueneme, California, the youngest of seven children. He died in California on April 5, 1977. Although he was a tireless student of central nervous system physiology, much of Bard's genius transcended science into unique intellectual relationships with a wide variety of people, including other nervous system scientists of his era. Many of these individuals came to Johns Hopkins often and to Bard specifically for advice with some of their most perplexing problems.

Two factors contributed to Philip Bard's remarkable, unsought leadership. The first was exposure in depth to Walter Cannon at Harvard. Around Professor Cannon were scientists from all over the world, and there was an exceptional faculty in physiology. Senior staff consisted of Cannon, Alexander Forbes, Alfred Redfield, and Cecil Drinker; junior staff included Hallowell Davis, William B. Castle, David Brunswick, and Harold Himwich. Bard interacted instinctively with them all, initially as a graduate student and later as a junior faculty member for two years.

The second key to Bard's leadership was strength of character. This permeated all of his interpersonal relationships and was clear immediately upon meeting him. His friendship was total and permanent. The only scientist in his family, Philip inherited from his father and other family members selfless respect and a sustained deep interest in others.

In 1741 the Bards emigrated from Ireland's County Antrim, settling into 5,000 acres of farm land, which was later redistricted into Pennsylvania. Many family members lived in or near Chambersburg, where Philip's father, Thomas Robert Bard, was born in 1841. Denied a Princeton education by the premature death of his father in Chambersburg, Thomas instead read law with the local judge.

Through his success with a small local railroad and other activities, Thomas Bard attracted the attention of financier Thomas A. Scott, and was hired by him in 1864 when Bard was twenty-three years old. Scott commissioned Thomas to develop potential land and oil interests in California, and on May 16, 1871, Thomas Bard first appeared in California. He became a permanent resident, raised a family, and built Berylwood, the Bards' first California home, where Philip Bard was born. Thomas also served one term in Washington as a senator from California.

Philip openly admired his father and it was he who sent Philip to the Thacher School in the Ojai. Academically Philip was unmotivated and a mediocre student. His confessed interests in student affairs, horses, and baseball were passions his father understood. Nevertheless, headmaster Sherman Day Thacher recognized unusual talents in his pupil and, along with family

friend Walter Alvarez, suggested medicine to Philip.

Philip graduated from the Thacher School in 1916, just after the United States entered World War I. His mother insisted that Philip wait until he was eighteen years old before joining the Stanford unit of the American Army Ambulance Corps. The unit saw heavy action in France. We know from personal letters that in France Philip read Howell's *Physiology* (he was struck by Walter Cannon's barium X rays of a dog) and *Principles and Practice of Medicine* (presumably by Osler).

After World War I Philip traveled to California to see Harriet Hunt of Pasadena and Walter Alvarez. Letters between Philip and Harriet indicate they were "promised" to each other for a year before Philip left for France. Alvarez, who had once worked in Walter Cannon's laboratory gave Philip more information about Professor Cannon. Alvarez thought Cannon would be right for Philip.

After World War I Princeton's biology department was busy with high-quality science, including strong basic research in biology. E. Newton Harvey and Edwin Grant Conklin were recognized as leaders in the department. At that time Princeton had no married undergraduates, but Philip was among the first to be granted an exception (he and Harriet had married on June 29, 1922). Philip immersed himself in biology, learned how to study, and worked harder than ever before graduating in 1923 with highest honors. The next year he was a graduate student supervised by Newton Harvey, whose clear thinking and genius for experimental design had already led Philip away from medicine to physiology.

Remembering his discussion with Alvarez, Bard applied to Harvard to work on his Ph.D. under Cannon, and in 1924 he and Harriet moved to Cambridge with Virginia, their first child. Before long the question arose of a suitable project for his thesis. Cannon had determined that cats deprived of cerebral cortex display anger on slight provocation, and he termed this behavior "sham rage." Exploring the possibility of an essential central nervous system center for sham rage seemed to Cannon to be a suitable thesis topic for Bard. The result, "Diencephalic Control of the Sympathetic Nervous System," was published by Harvard in 1927. The copy in the Harvard archives is personally inscribed, "To Dr. W. B. Cannon who suggested this work and whose advice and encouragement carried it along." In the first 157 of 251 pages Bard reviewed the pertinent literature. In this review we find the most arresting feature of the entire thesis, his analysis of rage as a tenable scientific concept. The center for sham rage follows convincingly from Bard's well-planned experiments.

In 1928 Bard accepted an assistant professorship in the biology department at Princeton. While it was satisfying to be invited back to Princeton, he missed the community of scholars at Harvard. He felt wholly on his own with no one to share his interests. Cannon surmised this and kept in close touch. Every week, or more often, there were reprints or notes and letters from Cannon directing Bard to a new thought or article.

In 1929 Bard reviewed the neuro-humoral basis of emotional reactions. First, he defined emotional consciousness and realized the necessity for a connection between brain and viscera. Sympathetic and parasympathetic divisions of visceral nerves were defined and sketched. Last of all, he dealt respectfully with the James-Lange theory and joined others (Sherrington, Cannon, Lewis, and Britton) in putting it to rest.

Chandler McCuskey Brooks, after graduating from Oberlin, came to Princeton and was Bard's first graduate student. After earning his Ph.D. at Princeton, Brooks followed Bard to Harvard and ultimately to Johns Hopkins. For fourteen years Brooks collaborated extensively with Bard in variations of brain reduction experiments. The first reflexes studied in depth were placing and hopping reactions; control of this efferent system was localized by studying carefully animals with cortical ablations (1933).

In 1931 Bard found Princeton's biology department was violating promises made to him and two other assistant professors, and resigned from the Princeton faculty. Apparently conditions necessary for long-term, uninhibited research could not be met. His response was to distance himself quickly and totally from all concerned. Bard accepted right away Cannon's prompt offer of an assistant professorship at Harvard. "We are overjoyed that you are coming back," Cannon told Bard in a letter written when Harvard's approval was underway.

Harvard was happy and productive for Bard. Chandler Brooks was the first to join him there. David Rioch, a neuroanatomist, came from Johns Hopkins in 1929. Bard and Rioch studied all aspects of emotional behavior and any deficiencies in motor coordination and sensory response in four cats from which they had removed the cerebral cortex and differing amounts of forebrain. Cannon cited this report (1937) years later as a model. With Brooks's collaboration there were more studies localizing hopping and placing reactions. Brooks believes these experiments established Bard as one of the first to identify localized cortical control of a behavioral reaction (1933).

In 1933 at age thirty-four Bard was appointed professor and director of the Department of Physiology at the Johns Hopkins Medical School, succeeding William Howell. Bard thought himself too young. He had published five papers of which only three were scientific research. Bard was startled by the appointment. Those who knew him were not surprised, particularly Cannon, who saw him as a future leader. Cannon put it, "I have so much faith . . . in your ability to exert an important influence in the development of physiological science that I could not help wishing for you a position of great strategic advantage. That you will have at Johns Hopkins." Bard continued as chairman for twenty-eight years (five unwillingly as concomitant dean). Retiring from active teaching in 1961 at age sixty-three, he continued for twelve more years as professor emeritus. He returned to California in 1973.

In 1940 Bard identified the central nervous system structures necessary for individual components of sexual behaviors: arousal, mounting, and copulation. Even with huge parts of the brain removed each of these was preserved. As others were to confirm, each reaction required the presence of ovarian or exogenous estrogens. Dependence of a central nervous system reflex on peripherally produced hormones remains a helpful concept to neuroendocrinologists today.

Locating a hypothalamic center for sexual activity led Bard to his definition of centers: "Patterned responses of the type under consideration have shown certain ones are dependent on the functional integrity of one or another circumscribed part of the brain. The essential neural mechanism thus delineated may be spoken of as the center for that particular behavior pattern." The concept of centers is less important now than during Bard's time; his definition was simpler than many others.

Bard's science was careful, thorough, and honest. As well as any experiments later in his career, the brain-reduced animals reflect these special qualities. During World War II, at the request of the National Academy of Sciences' Committee on Aviation Medicine, Bard pursued a different direction and investigated motion sickness. Removal of part of the cerebellum cured dogs of motion sickness, as did division of a section of the vestibular nerve.

In the 1930s Wade Marshall, a biophysicist trained by Ralph Gerard in Chicago, brought a cathode ray oscilloscope to Johns Hopkins. Marshall's exceptional gifts were appreciated quickly, and Bard's laboratory immediately capitalized on the oscilloscope. They mapped cortical areas of several sensory modalities, using evoked electrical potentials. Elwood Henneman, Clinton Woolsey (in 1933), and Vernon Mountcastle all left surgical careers to join Bard's young department. Along with Chandler Brooks each was swept up in a whirlwind of electrically recorded cerebral localization experiments. Publications of the Bard department from this era reflect their excitement. Woolsey concentrated on cerebral cortical potentials. Bard supported unequivocally the electrical recording experiments and those doing them, although he did not take direct part in most of this work. In his well known autobiographical article, "The Ontogenesis of One Physiologist" (1973), Bard mentions abstaining from electrical recording experiments. Perhaps he realized these would be done expertly by his younger colleagues, leaving him free to concentrate on other things. These are Henneman's memories of the early electrical potential experiments: "At about that time Clinton (Woolsey) was doing a series of experiments on the cerebral cortex. Mainly he was interested in localizing touch in the . . . cerebral cortex. And he was doing a really lovely job, showing the beautiful patterns that these representations made in the post central gyrus." Henneman and Mountcastle were inspired to study thalamic patterns of electrical potentials evoked by touch, first in the cat and then in the monkey. Henneman found his way to Harvard's Department of Physiology and was its chairman twice.

In 1948 Jerzy E. Rose and Reginald Bromiley joined Bard, and Woolsey left Hopkins to become research professor of neurophysiology at the University of Wisconsin. (In 1975 the Laboratory of Neurophysiology in Madison became the Department of Neurophysiology.) Chandler Brooks left Bard's department the same year to become professor and director of the Department of Physiology of the State University at New York at the Downstate Medical Center in Long Island. Directly before leaving Hopkins Brooks spent the years 1946-48 in the laboratory of Professor John Eccles at Otago University in Auckland, New Zealand.

In 1949 Sol Erulkar joined Bard as a graduate student. Originally from one of Calcutta's B'nel Israel families, Erulkar was educated first at Oxford and just prior to coming to Johns Hopkins completed an M.A. in biochemistry at the University of Toronto. After his Ph.D. with Bard, Erulkar earned a D. Phil. Oxon., working with Fillenz on integrative mechanisms in the lateral geniculate nucleus. Bard alerted George Koelle, chairman of pharmacology at the University of Pennsylvania, to Erulkar. Starting as an assistant professor of pharmacology Sol Erulkar was a sophisticated neuroscientist at Penn. He and his science were respected internationally and also at Penn. Until his unexpected death in 1995 Erulkar often spoke publicly of his persistent, unique devotion to Philip Bard.

In 1951 Jean Marshall joined Bard's department after finishing her Ph.D. in physiology at Rochester and a postdoctoral fellowship in smooth and cardiac muscle physiology at Oxford. Marshall went on to an investigative and teaching career in the pharmacology department at Harvard and in 1966 moved to Brown University as section chairman of microbiology when the medical program was initiated.

From 1953 to 1957 Bard was dean of the Johns Hopkins Medical School simultaneously with his chairmanship of physiology. It was often too much. Fortunately others helped him handle the Department of Physiology's affairs when it was necessary. Bard retired from his chairmanship of physiology in 1961. Made professor emeritus, he continued actively with research and teaching for twelve more years. His last investigations were with temperature regulation in cats. With Jim Woods's help the indwelling temperature probes were eventually linked into the Bell telephone system; this was the most modern equipment Philip Bard ever used.

For many good reasons David Jackson, Bard's last Ph.D. student, felt Bard was a father to him. A national merit scholar, Jackson intended to enroll in a post-high school M. D. program at Hopkins, but promised money never appeared. Graduate work with Bard was possible. The tuition costs were met, clandestinely, by Bard. Jackson's research localized central nervous system cells taking up bacterial pyrogen. They called this a fever center. Medical school followed, where expenses were met by an anonymous source known only to Bard. Jackson's career bespeaks intellectual versatility and the capacity to grow. Philip Bard understood and encouraged this, just as he had with all the others.

Bard's origins were important to him; his own family was more important. Harriet Hunt Bard and Philip were married for forty-two years. Their two children, Virginia Hunt Bard Johnson and Elizabeth Stanton Bard O'Connor, currently live in California and South Carolina, respectively. There are several grandchildren. Harriet Hunt Bard died suddenly from a massive coronary occlusion in 1964. Janet Rioch and Bard were married in 1965. Janet Rioch Bard grew up in India as had David Rioch, her brother. David was an early collaborator with Bard in Cannon's department. Janet Rioch Bard died in 1975. Colleen Gillis, widow of a close friend of Harriet and Philip and of the Bard family, was married to Philip briefly before his death.

Bard permitted himself only a few extra activities. Prominent among these was the editorship of three editions of Macleod's *Physiology*. Soon after Bard contributed a chapter to the book, Macleod died. The publishers quickly sought and were given Bard's support.

Bard's commitment was unstinting once he agreed to do something outside conventional academic work. He was a respected trustee of the Rockefeller Foundation. With Chandler Brooks he was a trustee and important influence in the International Foundation in Princeton, New Jersey. For many years he was an active board member of the Thacher School and, when his term was finished, still supported the school in many special ways. He returned to California happily and often, usually with one or more members of his family.

Bard's unwavering conviction that collaborators and students could reach farther and deeper than he could is more easily understood now than during Bard's time. He cared deeply about the quality of thinking evident in his colleagues and students. His support of them and their ideas was total and permanent.

"He was equally at home with the man who took care of the animals and visiting dignitaries. Each felt he was interested in them as a person; each was treated with equal respect as human beings. None of them achieved as much as Phil Bard did and he did it with a sense of dignity and respect for everybody . . . This should be the sort of common currency of our interpersonal relationships." One of Philip Bard's legacies is confidence in those who at times lacked it in themselves.

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