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Editor's Note: With the scheduled dedication of the new Dr. William B. McLean Laboratory on 8 October 2010, the life, career, and great contributions of Dr. McLean are very well summarized in the following memoir. The author, W. H. Pickering, received his PhD in Electrical Engineering from Caltech in 1936, and was the Director of the Jet Propulsion Laboratory from 1954-1976.

WILLIAM B. McLEAN — A BIOGRAPHICAL MEMOIR

May 21, 1914-August 25, 1976

BY W. H. PICKERING, National Academy of Sciences, 1985

I FIRST MET BILL MCLEAN when we were both graduate students at Caltech; and I grew to know and appreciate him some twenty years later when he was technical director of the Naval Ordnance Test Station at China Lake, California. For twenty-five years thereafter I knew him as scientist, engineer, inventor, and leader of men. I also knew him to be modest, soft-spoken, full of gentle humor, unremittingly honest, and stubbornly persistent when right. Bill was a high principled and religious man, descended from a line of Presbyterian ministers. Both his maternal and paternal grandfathers, as well as his father and brother, were ordained ministers. He often stated that he never felt a conflict between science and religion because he believed that all of knowledge was of a common origin, and that the highest function of the human intellect was the search for truth.

He was born in Portland, Oregon in 1914, but lived the first four years of his life in Dubuque, Iowa where his father was teaching. In 1919 the family moved to the Los Angeles area and lived in Eagle Rock, where he completed his primary and secondary education. In 1931, he entered Caltech. The family moved to Santa Barbara, but Bill remained at Caltech.

His parents were both mechanically inclined. As Bill had often stated, "My mother taught me to knit, crochet, and use the sewing machine before I went to kindergarten. My father showed me how to repair automobiles, build homes, and do plumbing and electrical wiring. Everything that broke became a challenge to figure out how to repair it and make it better." This interest in "fixing things" stayed with him throughout his life. Another interest that remained with him was his love of the water. In 1927, his father bought a lot on the beach at Newport, California. Bill spent the next four summers at the beach and learned about surfboards, canoes, rafts, and "sucking air through a hose from the surface is not possible".

He entered Caltech as an electrical engineer, but, after one term, Dr. Earnest Watson suggested that he transfer to physics. He received his B.S. in 1935 and the M.S. in 1937. His interests were experimental, particularly in the design of instruments. As a graduate student, he worked in nuclear physics with Dr. Charles Lauritsen and Dr. Willy Fowler on the construction of their half-million-volt Van der Graaff generator. He completed his Ph.D. in 1939, with a thesis on the short-range alpha particles produced by the bombardment of fluorine by 350 KEV protons. During his years at Caltech, he helped support himself by working in the photo lab. He had shown an early interest in photography. In fact, in each new house, the first family priority was to set up a workbench; the second, to arrange a darkroom.

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Shortly after receiving his Ph.D. degree, Bill married La Verne Jones. LaV, as she was known, was the extrovert; Bill, the introvert. LaV shared his interest in the Presbyterian Church and outdoor recreation, particularly scuba diving. Their home reflected her pride in his accomplishments and his in her competence as a homemaker at the center of community activity. The young McLeans settled in Iowa City, Iowa, where Bill had a postdoctoral fellowship in nuclear physics for the period from 1939 until 1941. He continued to work with alpha particle counters and, as might be expected of Bill, improved the instrumentation circuitry then in use. He taught a graduate class in advanced theoretical physics for one year, which, he stated, cured him of any desire to continue teaching.

In 1941 Bill moved to the Bureau of Standards in Washington to lend his energies to the war effort. His assignment was primarily to work with proximity fuses, but he also worked on rockets, arming devices, fire control systems, and acceleration integrators. His great interest in experimentation left him feeling frustrated with the difficulty of field testing at sites many miles from the Laboratory, so that when Dr. L. T. E. Thompson invited him to join the new Naval Ordnance Test Station (NOTS) at Inyokern, he accepted. He is quoted as saying that he arrived there on July 5, 1945, with his wife and two sons, expecting to stay two months. Two months became twenty-two years; he left in January 1968.

Moving to Inyokern was a natural move for the McLean family. They were returning home to California; NOTS was an outgrowth of a Caltech war-time program; his former professors, Lauritsen and Fowler, were closely associated with its formation; but, more importantly, NOTS was a new organization established to work in a field that was of interest to Bill, and it was set up to do research and development as well as field testing. Furthermore, its first technical director, Dr. L. T. E. Thompson, was a physicist who had been chief scientist at the Naval Proving Ground in Dahlgren, Virginia. Bill felt—rightly—that Thompson would understand the

opportunities presented to the new organization and he would support the young scientists and engineers who were coming to work for him.

Bill's first assignment was head of the Ordnance Division, which soon became the Aviation Ordnance Department. Nine years after joining NOTS, in 1954, he was appointed technical director, succeeding Dr. Frederick W. Brown, who had replaced Dr. Thompson in 1951. Bill McLean remained the technical director until July 1967, when he was appointed head of the newly formed Naval Undersea Warfare Center at San Diego. His best known achievement at NOTS is the *Sidewinder* air-to-air missile, which used infrared radiation from the target airplane as its source of guidance information. It has been battle tested and proved to be very effective. It is simple, accurate, reliable, and low cost. The technical problems were solvable. The bureaucratic problems were more difficult. Bill was faced with the problem of convincing the Navy that *Sidewinder* was a useful weapon system. As a member of the NOTS Scientific Advisory Board at the time, I feel it is not too much of an exaggeration to say that Bill built *Sidewinder* in spite of the Navy. Eventually, however, his accomplishment was acknowledged and, in 1956, the Navy awarded him \$25,000. In presenting the award, the Chief of Naval Operations, Admiral Arleigh A. Burke, told the assembled group that nothing since the atomic bomb "had done so much for the Navy" as the *Sidewinder* missile.

As technical director of NOTS, Bill was known for his low-key administration. He very seldom gave a direct order to his subordinates, and he did not try to dominate his meetings. He had, however, the respect of his subordinates, and when he had something to say, they all listened. His technical understanding and his creative imagination guaranteed his leadership.

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The very fact of their isolation in a desert community, one hundred and fifty miles from Los Angeles, made the technical staff a tightly knit team. Bill was their natural leader. He understood their problems, he saw to it that they had the resources they needed, and he advised them on their technical difficulties. Although Bill had some difficulties with the Navy in Washington, the Bureaus soon came to realize that their desert facility in California was turning out first-class work, and they tried to minimize bureaucratic interference. Fortunately, the physical distance and travel time between Washington and China Lake helped.

Bill was a true experimentalist. He loved to build things. His home had a shop well equipped with good tools and cluttered with half-built projects. Because he enjoyed scuba diving at a time when very few people had even heard of the sport, he designed his own wet suit and pressure regulator. He enjoyed open-sea boating and designed water vehicles for personal use, even small submarines with glass domes for visibility. His interest led him to solve the problem of how to unload fish from boat to dockside for the commercial fishermen of San Diego. At his San Diego home, he used his swimming pool for some underwater experiments. His interest in underwater activities was reflected in the program at NOTS. Deep diving vehicles and cable controlled vehicles were designed and built. One of these, CURV (cable controlled underwater research vehicle), was used in 1966 to help recover the hydrogen bomb that was lost off the coast of Spain. Another reflection of his interest in novel ship designs was the SWATH (small water area twin hull). This craft was designed to travel at high speed with a working platform well above the sea surface so as to remain steady under almost all sea conditions. It has worked well in tests. Bill was a man who worked on problems under the sea, on the sea, and above the sea. He was a man for the modern Navy.

Those who knew him best describe him as a man who participated easily in the many social functions he attended. He was quiet, good humored, mild mannered, and shy. In his recreation, he was physically adventuresome with his skiing, boating, and diving. He was intellectually stimulated when faced with a difficult problem. He was persistent in working toward a solution to discover the truth. He regarded working on a difficult problem as fun, regardless of the time required. In the technical area, he had a gift for identifying the critical experiments needed to determine the validity of a solution. At heart, he was an inventor. He was never happier than when working on some new device or describing it to his friends. His engineering instincts were excellent. He understood the necessity of keeping clearly in mind the function to be performed by the new device and then finding a solution as simple as possible. At the time of his last illness, he was hard at work on new ideas. His interests were turning to solutions for our energy problems.

In a speech given to his church on the subject of science and religion, he stated:

My own beliefs have developed as a result of the study of as much data as I can assimilate, and my early background. The goal is always directed towards trying to find out how things behave. Man has learned to organize, codify and distribute his past experiences first as religious doctrines and then as scientific doctrines. By this process the wisdom of a few is made available to guide the actions of many and as a result the survival of groups of people has been enhanced. Before we had Science, Religion was our only guide. As Science expands, one is tempted to think that Religion must contract. However, this position does not take account of the infinite nature of the unknown. Man must have a belief in God if he is to operate effectively either as an individual or as a member of a group.

In spite of a very active life, Bill's health was not good—but few of his friends realized this. He had been a diabetic since his college days. He had a heart attack in 1968, and he had cataracts removed in 1967 and 1969. During his last illness, Bill, still the experimentalist, encouraged his doctors to try new techniques—unfortunately to no avail. His many friends and acquaintances will remember this man in different ways, but they will all remember him as a man who lived a full life. Administrator, engineer, inventor, hobbyist, family man—in each role he was successful. As an engineer and scientist he had the curiosity needed to ferret out the key factors in a problem, the wisdom to know what were the important elements in the solution, and the tenacity to stay with the problem until it was solved. As an administrator, he had the ability to obtain the resources he needed and to lead the staff that supported him. In his personal life he knew how to relax, and he particularly enjoyed using his technical skills to make his recreation more enjoyable. In his family life he was fortunate in having LaV for his wife, and they built a warm relationship together with their three sons.