William Edward Caswell, a physicist who made important contributions to both theoretical physics and national defense technology, died tragically on 11 September 2001. He was aboard the hijacked airplane that was crashed into the Pentagon. At the time of his death, Bill was a senior scientist for the US Navy.

Bill was born on 22 June 1947 in Boston. He received both of his degrees in physics: his BS from the University of Maryland, College Park, in 1968 and his PhD from Princeton University in 1975. Bill's thesis, for which one of us (Callan) was the adviser, contained the first calculation of higher-order renormalization group quantities in non-abelian gauge theory. He was a third-generation physicist: His grandfather, Albert, received one of the first PhDs in physics from Stanford University, and his father, Randall, held an MIT physics PhD.

Bill's graduate career coincided with the synthesis of gauge symmetry and renormalization group ideas. He made several major, path-breaking contributions to that synthesis. Perhaps their apex was his calculation, in 1974, of the beta function to two-loop accuracy. As Bill's thesis adviser (Callan), and graduate student colleague and office mate (Wilczek), we observed firsthand the evolution of this work. Bill focused on his goal even before the basic one-loop result had stabilized. At the time, this effort required unusual courage and determination, since the calculation simultaneously features all the notorious subtleties of gauge invariance, overlapping divergences, and renormalization.

Bill quickly saw his way through the conceptual difficulties, but dealing with dozens of Feynman graphs, each expanding into many algebraic terms, was challenging in the extreme. Bill soon realized that a pure hand calculation would be both excruciating to perform and impractical to check. He ventured into the then-uncivilized realm of machine symbolic calculation (this was the age of punch cards, FORTRAN, and paper output), and was finally able to adapt Tony Hearn's REDUCE program to his needs. Still, each graph was a project in itself, and there were an awful lot of them. Bill kept a master list on his blackboard, and we remember his increasingly broad smile as he ticked them off one by one and closed in on the goal. Champagne was served when all consistency checks fell into place and a reliable result could be reported.
A few weeks after Bill got his final result, two other groups reported independent calculations of the same quantity, with different answers. Bill was momentarily shaken, but after poring over his calculations once more, serenely initiated correspondence with his competitors. As things developed, his confidence was justified, and all converged on Bill's original result, which was published in a 1974 Physical Review Letters article.

The impact of Bill's calculation was enormous. His result convincingly showcased both the consistency of quantum gauge field theories and the potential of computer algebra. It has, of course, also played a central role in physics. Today the interpretation of many experiments in high-energy physics requires multiloop quantum chromodynamics calculations, and Bill's result is a prime ingredient in every such calculation. It is also a critical ingredient in calculating the running of the coupling constants of the Standard Model's supersymmetric extensions, calculations that are interpreted these days as evidence for both grand unification and low-energy supersymmetry. Thus Bill's work is also crucial to our thinking about physics beyond the Standard Model. As Bill emphasized in his original paper, his calculation indicated the possibility of a qualitatively new behavior in relativistic quantum field theory, featuring conformal symmetry at large distances due to a "reliable" zero of the beta function. Such theories have been the subject of many recent investigations.

Bill made many other contributions to particle physics after his thesis, working as a postdoc at SLAC (1975-77), as an assistant professor of physics at Brown University (1977-79), and as an assistant professor of physics at Maryland (1979-83). His development, in 1978 with Peter Lepage, of new and powerful tools for dealing with higher-order effects in bound states (such as positronium and charmonium) was a particularly valuable and influential contribution.

In 1983, Bill's career took an abrupt turn when he moved to the Naval Surface Weapons Center in Silver Spring, Maryland, to work on applying artificial intelligence and nonlinear dynamics to signal processing problems. In 1985, he was invited by the navy to work as a civilian scientist on a major classified defense technology project. Bill rose rapidly to a position of overall technical responsibility for this project, ultimately directing a team of more than 100 scientists working on one of the navy's most challenging problems. His technical skills and hands-on management style won the respect of his colleagues at the same time as his kindness, good humor, and thoughtfulness won their affection. Although the classified nature of the project meant that he could not discuss it with outsiders, those who knew it well tell us that Bill made many important contributions, grounded in his skills as a theoretical physicist, to its success. Indeed, he received several navy commendations on his work, one of which cites his role in a "highly successful top priority Chief of Naval operations project of unprecedented technological complexity . . . developing a profoundly new capability for the US Navy." A long way from the two-loop beta function and a remarkable career in physics!

Bill's record of contributions to science, technology, and country was outstanding. He had much more to contribute, and his death in an outrageous terrorist attack was a terrible waste. We were proud to know him and, with his many other colleagues and friends, will sorely miss him.