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Submitted by the NAE Home Secretary

Aziz S. Odeh, one of the world's foremost petroleum engineers and retired senior scientist of Mobil Research and Development Corporation, died on July 16, 1994, in Plano, Texas, after an extended illness.

Aziz Odeh was born in Nazareth, Palestine, on December 10, 1925. He moved to the United States in 1947 to attend the University of California, Berkeley, where he received a B.S. in engineering in 1951. Dr. Odeh earned his M.S. from the University of California, Los Angeles (UCLA), in 1953 and then began employment with Magnolia Petroleum Company, which was incorporated into Mobil. He took a leave of absence in 1955 to pursue his Ph.D. at UCLA and received his degree in 1959. Dr. Odeh next worked as a reservoir engineer with Mobil Oil de Venezuela until 1961, when he transferred to the Field Research Laboratory of Mobil Research and Development Corporation. He advanced through a number of technical positions before he became manager of reservoir engineering in 1978. While managing and directing research, Dr. Odeh maintained his technical activity, which was recognized in 1980 when Mobil named him senior scientist, the company's most prestigious technical position. Dr. Odeh was inducted into the National Academy of Engineering in 1987. He retired from Mobil in 1989 but continued to work as a consultant to Mobil and a number of other organizations until his death.

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Aziz Odeh exhibited a deep respect for the fundamentals of physics, chemistry, and engineering that is rarely associated with one working in the petroleum industry. This defining quality undoubtedly was nurtured by his early work on the effect of viscosity ratio on relative permeability, for which he received his doctorate. However, Dr. Odeh was also a pragmatic engineer, as evidenced by his landmark paper "Material Balance on Equation of a Straight Line," which he coauthored with Dave Havalena while working in Venezuela. This paper quickly became a petroleum engineering standard and is still used by virtually every petroleum engineer in its original form to determine the size, future performance, recovery mechanism, and aquifer geometry of the world's oil and gas reservoirs. It also contained the scientific qualities that became synonymous with Dr. Odeh's publications—using mathematics to describe a physical system and to generate results with such clarity and uniformity that a certain elegance was apparent to the practicing engineer.

These qualities were certainly evident in his large number of papers that advanced the state of the art of well testing. Dr. Odeh's research on variable rate testing and partial penetrations and completions is recognized as a cornerstone of this technology, which is used to predict well performance and measure a reservoir's physical properties. He also published an important body of work in well testing, which focused on non-Newtonian flow, fractural systems, wellbore damage, and nonlinear testing that is widely used in petroleum engineering.

In the early 1970s, Dr. Odeh became interested in numerical reservoir simulation. Before that time, engineering analysis used electric analogs of physical models. These analog models were used to evaluate well patterns by sampling electric currents at various locations in the model and equating them to pressure potentials and fluid flow rates. With the explosion of digital computing in the 1970s and the 1980s, the petroleum engineer began using discretized approximations of reservoirs based on Darcy's Law and the usual continuity equations. The resulting set of nonlinear equations and the corresponding accuracy and stability of their solution would challenge petroleum technology for many years as simulation requirements

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became increasingly more complex. Dr. Odeh championed the development and use of the most complete and difficult algorithms—fully implicit linearizations with strongly coupled well representations—within his development group at Mobil. These techniques were at first considered to be too time consuming to be practical. However, as increasing computer power made them more palatable, their numerical stability became so attractive to practicing engineers that these algorithms became the standard in Mobil's portfolio of black oil, compositional, and thermal simulators as well as most commercial products in the marketplace.

Dr. Odeh constantly worried about the proper application of these tools. "Understanding of fundamentals is enlightening; the black box mentality is dangerous," he would often lecture to his peers and colleagues. However, he helped pioneer the use of the technology to develop major hydrocarbon resources in the North Sea, Middle East, and Southeast Asia. Reservoir simulators were used to determine realistically the facility and platform requirements, the number of wells to be drilled, and the predicted production rates and economic limits of a myriad of different oil and gas fields. The success of these applications helped make reservoir simulation a standard tool of petroleum engineering.

The development and application of reservoir simulation dominated Dr. Odeh's focus through the mid-1980s. At this point, and then through his retirement years, he turned his attention to horizontal wells. While attending a conference in the Middle East, he correctly predicted that horizontal wells were to be the dominant tools of oil production technology in the coming years. He then began research to predict and describe mathematically the performance of horizontal wells. The work resulted in an extremely complicated equation for computing the well's productivity. The real brilliance of this work (like his early work on material balance) was Dr. Odeh's reduction to a simple and easy-to-use expression similar to that for vertical wells. Again, the simplicity and elegance of this work made it an industry standard almost immediately. This body of work brought the number of papers that Dr. Odeh authored and coauthored to more than fifty.

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In addition to his induction into the National Academy of Engineering, Dr. Odeh received a number of other awards and recognitions. He began his active involvement in the Society of Petroleum Engineers (SPE) in 1960 and received its prestigious John Franklin Carll Award in 1984. He was elected an SPE Distinguished Member in 1988 and was given the Outstanding Achievement Award from the Dallas SPE Section in 1989. Aziz was fiercely proud of his heritage and worked diligently to establish the SPE in the Middle East. He was a member of the board of directors of the Abu Dhabi National Reservoir Research Foundation until 1989. He also was an adviser to the Ministry of Oil in Qatar, Mexican Petroleum Institute, Abu Dhabi National Oil Company, Oil Services Company of Iran, and Saudi Aramco. Dr. Odeh received an honorary appointment as consulting professor at Stanford University in 1988. He was also listed in *American Men and Women of Science* and *Who's Who in Engineering* and received *News Circle* magazine's Man of the Year Award in 1990.

Equally as important as his technical and professional accomplishments were Aziz's human qualities. He was completely devoted to his family. He was also a passionate tennis player. He was a teacher at heart who taught and lectured at universities, industry schools, and Mobil courses his entire career. Aziz delighted in passing on his knowledge and enthusiasm for petroleum engineering to younger people and was a guiding influence in the careers of many engineers. Aziz probably summed this up the best in a 1988 International Mobil interview where he said, "My greatest accomplishment is the young people. I brought them in from universities and trained them. They rose to the challenge." I am honored and humbled to have been one of those young people.

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