



## T.W. FRASER RUSSELL

1934–2019

Elected in 1990

*“For introduction of reaction engineering principles and continuous processing to the manufacture of thin-film electronic materials and for contributions to two-phase flow.”*

BY A.M. LENHOFF AND NORMAN J. WAGNER

**T**HOMAS WILLIAM FRASER RUSSELL, the Allan P. Colburn Professor Emeritus of Chemical and Biomolecular Engineering at the University of Delaware, died November 29, 2019, at the age of 85.

Fraser was born in Moose Jaw, Saskatchewan, on August 5, 1934, to T.D. and Evelyn Russell. The family moved to Oxbow, Saskatchewan, where his maternal grandparents lived, and later to Lethbridge, Alberta, where Fraser completed high school. The young man intended to pursue a career in pharmacy, but an uncle felt that he lacked the interpersonal skills to deal with the general public. After a summer job in retail sales, Fraser agreed with this assessment and instead pursued a BS in chemical engineering (1956) at the University of Alberta. Ironically, in his later years he was beloved by a very wide circle of friends.

His summers at the British American Oil Company's refinery in Edmonton introduced him to industrial process operations and design, which became a signature strength throughout his career. During subsequent employment at the Research Council of Alberta he was one of a pioneering group who recovered a load of tar sands from the wilds by canoe. His study of the pipeline flow of this material suspended in crude oil–water mixtures earned him his master's degree from

the University of Alberta in 1958—and established a long-term interest in two-phase flows that led him to work on a broad range of multiphase mass transfer problems, from mass contactors to sewage and wastewater treatment.

He then spent 3 years as a successful design engineer with Union Carbide Canada, where his work included the design and startup of a multipurpose, continuous chemical processing unit at the company's Montreal East facility, the first of its kind in Canada.

In 1961 he enrolled at the University of Delaware and did his doctoral dissertation research, with David E. Lamb, on two-phase flow. Fraser's successful, large-scale industrial experience, design expertise, and leadership qualities earned him the respect not only of his fellow students but also of the department chair, Robert L. Pigford, who appointed him to a faculty position in 1965. Fraser spent the rest of his career at Delaware and distinguished himself professionally as an inspiring teacher, a versatile researcher motivated by chemical engineering practice, and an academic administrator. The immense respect for his abilities was evident in his appointment to a series of leadership positions: associate dean (1974–77) and acting dean (1978–79) of the College of Engineering, director (1979–95) and chief engineer (1996–2009) of the Institute of Energy Conversion, chair of the Chemical Engineering Department (1986–91), and vice provost for research (2000–05).

He was most gratified by his engagement and influence in the careers of the thousands of undergraduate and graduate students he taught. He was a consummate educator whose pedagogical expertise was equally valued by students and colleagues. He coauthored three chemical engineering texts, each bringing his unique insights and experience to enrich undergraduate education.<sup>1</sup> His educational philosophy is perhaps best captured in one of his favorite quotations, which appears

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<sup>1</sup> *Introduction to Chemical Engineering Analysis* (John Wiley & Sons, 1972); *Structure of the Chemical Process Industries* (McGraw-Hill, 1979) with James Wei and M.W. Swartzlander; and *Mass and Heat Transfer: Analysis of Mass Contactors and Heat Exchangers* (Cambridge University Press, 2008) with Anne Skaja Robinson and Norman J. Wagner.

in the frontispiece of each of his textbooks (and was prominently displayed on course syllabi and exams):

“Get the habit of analysis—analysis will in time enable synthesis to become your habit of mind.” – Frank Lloyd Wright

He was particularly passionate about the dozens of doctoral students he mentored in a program, unique and progressive in the discipline, that began as the DuPont Teaching Fellows and that he later endowed as the Fraser and Shirley Russell Teaching Fellows. The program provided a unique pedagogical experience and support for doctoral students considering careers in academia by enabling them to coteach classes under the guidance of a faculty mentor, providing the student with a realistic teaching experience and the opportunity to develop a teaching portfolio.

The impact of the teaching fellows program has been significant, with many successful academics who have come through the ranks, including in a complementary program endowed by Fraser at his alma mater, the University of Alberta, and in many similar programs adapted by former teaching fellows at their institutions.

Fraser also made important contributions to a broad range of important engineering research fields, including fundamental studies of multiphase fluid motions and semiconductor reaction and reactor engineering, with over 90 publications and 7 patents. He successfully applied these basic studies to the design and operation of commercial-scale equipment for both the photovoltaic and chemical process industries. In addition, he consulted with a number of companies, including 30 years with DuPont Engineering.

For the US National Research Council, he served on the Committee on Programmatic Review of the DOE Office of Power Technologies (1998–2000) and Committee on Chemical Demilitarization (2013–17), among others.

As a professional engineer, he was pleased to receive DuPont’s Engineering Excellence Award (2005), which he proudly displayed on his desk as he was the only awardee not

a DuPont employee. He was also one of very few academics to receive the AIChE Award in Chemical Engineering Practice (1987), among other national awards. For his teaching, he was honored to receive the AIChE Warren K. Lewis Award (2010) and ASEE's Award for Lifetime Achievement in Chemical Engineering Pedagogical Scholarship (2009).

Fraser's legendary contributions to excellence in education, research, and academic life more broadly at the University of Delaware spanned almost half a century. His extensive academic service was noteworthy for his candor, honest evaluations of merit, and immense dedication to his staff and the community more broadly. His engaging personality and sincere personal interest engendered lifelong friendship and loyalty, and his wisdom and experience garnered requests for consultation and guidance from university presidents, provosts, and administrators from all disciplines, including after his retirement in 2009. A rare honorary doctoral degree in 2010 from the university formally recognized his lifetime effort to enrich the academy that treasured him dearly.

Renowned for his refined taste in the beverage of his Scottish heritage, an evening with Fraser could refresh one's soul while heartfelt discussions revealed critical paths for solving vexing problems. Even more legendary were his lunchtime walks in the nearby forest preserve, where it was typical for him to lead groups of students, staff, faculty, or university administrators, including the president, on sojourns into the Delaware wilds.

Fraser was predeceased by his wife of 42 years, Shirley (née Aldrich). He is survived by sons Bruce (Laurie), Brian, and Carey (Melanie), and four grandchildren, as well as many colleagues, students, and friends whose lives and careers he enriched.

As noted by UD's provost, Robin Morgan: "Joining the faculty in 1964, he handily combined all the best attributes of a scholar and scientist, earning accolades for both his teaching and service, while distinguishing himself and the university in the realm of research in chemical engineering. Fraser's talent for leadership resulted in important administrative posts on campus where his expertise and insights catalyzed

meaningful change at UD. Throughout his long career, countless faculty, students, and staff members have been enriched by his keen intellect, his heartfelt and steadfast dedication to the University of Delaware, and his unforgettable impish sense of humor.”