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of North Carolina State University

By His Friends and Colleagues

It has become fashionable to question whether research reinforces teaching or vice versa. In a jumble of statistics and surveys, arguments and counterarguments, the importance of a personal example can be lost. In an era where graduate education has been criticized as overspecialized, and where graduate students may think of themselves as square pegs preparing to spend their professional lives in square holes, perhaps the message in one individual's career is too easily overlooked. In an environment where professional accomplishment is often divorced from personal satisfaction, it is rejuvenating to see first-hand the enjoyment that can be derived from a successful, productive dedication to education and scholarship.

The appearance of this article is timely, as it helps to celebrate the tenth anniversary of David Ollis' affiliation with North Carolina State's Department of Chemical Engineering, which he joined as Distinguished Professor in the summer of 1984. During that time, as the Department has grown in size and stature, Dave has set a quiet example for the faculty and students of the university. He has demonstrated that a successful faculty member does not have to make a choice between excellence in research and excellence in teaching. He has demonstrated an exceptional scientific versatility, illustrating by personal commitment the need to master new areas of technology as the pace of scientific change accelerates. Finally, he has demonstrated that a successful academic career can be a source of great personal satisfaction. Being a professor can be fun! Dave has enjoyed life at two universities besides North Carolina State: Princeton (1969-80) and the University of California at Davis (1980-84). He is fond of pointing out that his academic posts have spanned the range from "ivy" to "aggie."

Dave's twenty-five years in academe have borne out the "teacher-scholar" designation of a Camille Dreyfus Award that he received in 1973. He has taught and enjoyed most of chemical engineering's undergraduate classics and over the years has initiated new courses in biochemical engineering, bioseparations, photochemical engineering, "how to prepare and defend a research proposition," and a freshman laboratory for product and process engineering. The last four of these courses were developed at NCSU.

Table 1 shows that Dave's spirit of course creation is alive and well, and is in fact accelerating. What philosophy drives this new-course developer? "Find a (teaching) need (that you like) ... and fill it!" (with Dave's apologies to J. Paul Getty for the inserts.) The last two items in Table 1 best illustrate this point. About five years ago, the Department did a careful study of its doctoral qualifying examinations. At that time, doctoral candidates took three written exams (each lasting three hours) in thermodynamics, transport and separations, and kinetics and reaction engineering. To the (retrospective) surprise of no one, there was an almost perfect correlation between student scores on these exams and their grades in "core" graduate courses in corresponding subject areas. The qualifying exams were causing a lot of anxiety for both students and faculty but weren't providing any new information over and above what was contained in the course grades. On the other hand, when the Department examined the cases of students who were not successful in the doctoral program,
Dave Ollis and his graduate students have contributed key papers in immobilized enzymes and cells, hybridoma metabolism and antibody production, scanning microfluorimetry, photocatalyst efficiencies and kinetics, and the photocatalytic and photolytic purification of contaminated water and air streams. Over his career, Dave has graduated a total of twenty-one Master's degree students and twenty-four doctoral students.

The problems were invariably associated with research methodology: analyzing the existing literature, defining a satisfactory research problem, planning a research program, making oral presentations, answering difficult technical questions, etc. Dave's "research proposition" course was created in response to this unmet need. Now in its third year, the course is proving to be a major step toward helping doctoral students initiate a positive, effective research experience.

The course in product and process engineering is another example of filling an unmet need. In this case, the need was to give freshman engineering students some practical, hands-on experience, in counterpoint to the "trust me, someday you're going to need this stuff" approach that is typical of many freshman-level science and mathematics courses. The product and process engineering course was developed with funding from the National Science Foundation's SUCCEED (Southeastern University and College Consortium for Engineering Education). Although it is still in its trial stage and will undoubtedly undergo some refinement, the early response is enthusiastic.

Creating books also has been an important part of Dave's philosophy of filling unmet educational needs. Upon reading George Tsao's 1970 Chemical Engineering Education statement that, for biochemical engineering, "There is no satisfactory text . . . ," Dave's first offering of this course (at Princeton) produced a 400-page draft manuscript. When Dave visited the University of Houston for a seminar in 1971, chairman Dan Luss opined that his newest faculty colleague, James Bailey, "... was the fastest and most fluid writer ..." he'd seen. Jay agreed to work with Dave and write a second draft of the text—and did much more, refining the suggestion of a book into a coherently-organized, carefully-proofread manuscript, Biochemical Engineering Fundamentals, which went, eventually and happily, into widespread use.

The book's actual birth was not without surprises. McGraw-Hill editor B.J. Clark said, upon manuscript receipt, "It's 250
pages longer than the 500 pages stated in the contract. Could you drop the last four chapters without too much pain?" In an earthier vein, Elmer Gaden commented prior to publication, "Sounds like a sex manual written by two virgins!" Undaunted, but with their machos severely bruised, Dave and Jay persevered, and even Elmer eventually adopted the book.

According to Michael Flickinger of the University of Minnesota, "This book has been used to train an entire generation of biochemical engineers, not only in the U.S. but also around the world." What goes around, comes around, and it was with considerable satisfaction that Dave, grandson of a Jewish emigré from an inhospitable Czarist Russia, saw Mir Publishers request and publish Biochemical Engineering Fundamentals in Russian.

Photochemical conversions are increasingly encountered in chemical engineering research, yet instructional materials for graduate students are rare. A 1988 lecturing invitation at Ecole Polytechnique Federale de Lausanne alerted Dave to Technologie Photochimique by A. Braun (now professor at the University of Karlsruhe), E. Oliveros, and M.-T. Maurette. The translation of this book, in collaboration with Nick Serpone of Concordia University (Canada), provided Dave with a novel form of self-paced photochemistry education. The first several chapters of Photochemical Technology (Wiley-Interscience, 1991) now serve to introduce the fundamentals of illumination sources and filters, actinometry, and radiometry in his NCSU photochemical engineering course.

Dave is part of a strong departmental linguistic tradition that includes Ruben Carbonell (Spanish, Italian, Portuguese), Rich Felder (Italian, Portuguese), Benny Freeman (French), and Hal Hopfenberg (Italian). But foreign language came late to Dave, in keeping with a long-standing American tradition. As a graduate student, he produced a (probably) miserable but required translation of a French kinetics paper for his advisor, Belgian-born Michel Boudart, who remarked, "It's a delight that you Americans take an interest in language, but a pity that you begin twenty years too late!" Slow to start indeed, but Dave has enjoyed the last laugh by being invited twice to Ecole Polytechnique to lecture on biotechnology and bioseparations . . . en français, bien sur.

In Dave Ollis' world, teaching and research have always gone together, not in a competitive but in a supportive relationship. It is Ernest Boyer's proposition that research devel-

### Table 2: Examples of Ollis' Pioneering Papers

  This paper introduced the use of regular solution theory to rationalize why nanometer-sized alloy crystallites should exhibit enhanced phase stability and component solubilities. A rash of following papers used this approach for catalytic alloy surfaces.

- **"Photocatalyzed Mineralization of Trichloroethylene in Dilute Aqueous Solution," (with Anne Lorette Pruden), J. Catalysis, 82, 404 (1983)**
  This was the first paper to demonstrate total oxidation in water of a chlorinated hydrocarbon by photocatalysis at room temperature. Along with early photocatalysis contributions by Stone (England), Teichner (France), Bard (Texas), and Cary (Canada), this and related photocatalysis papers from Dave's research group led to the environmental engineering interest in photocatalytic remediation, summarized in the recent volume Photocatalytic Treatment and Purification of Water and Air (Elsevier), co-edited with Hussain Al-Ekabi (1993).

- **"Scanning Microfluorimetry of Calcium-Alginate Immobilized Cells of Zymomonas mobilis," (with Harold Monbouquette), Bio/Technology, 6, 1076 (1988)**
  This paper contained the first announcement of a new technique allowing quantitative spatial profiling of immobilized cell number density and specific growth rate.

### Two of the more important recent contributions from Dave's research group are:

  This paper demonstrates that Langmuir-Hinshelwood rate expressions can arise in photocatalysis, regardless of whether active oxidant (hydroxyl radical) and oxidizable contaminant are both adsorbed, one adsorbed and one dissolved, or both dissolved in solution at the time of reaction. This analysis, indicating mechanistic ambiguity, precipitated extensive efforts by photochemists to resolve the true location of photocatalytic oxidation steps.

  This paper provides the first confrontation between a reaction-diffusion model, derived a priori from suspension culture kinetics, and experimental fluorescence profiling of cell specific growth rate. The results compare satisfactorily with pH, buffer, and substrate bulk solution variations and demonstrate development of a new analytical tool for biochemical engineering of immobilized cells. Current work pursues structured modeling of immobilized recombinant bacteria.
ops into broader themes, which in turn are transformed into formal courses. Thus, research begets teaching, as Table 1 so nicely illustrates, when played through a natural maturation of personal development.

In research parallels, Dave Ollis and his graduate students have contributed key papers in immobilized enzymes and cells, hybridoma metabolism and antibody production, scanning microfluorimetry, photocatalyst efficiencies and kinetics, and the photocatalytic and photolytic purification of contaminated water and air streams. Over his career, Dave has graduated a total of twenty-one Master's degree students and twenty-four doctoral students. Many have gone on to distinguished careers in both academe and industrial research (e.g., Pao Chau, UC-San Diego; Hal Monbouquette, UCLA; Eiji Suzuki, University of Tokyo; Rathi Datta, Merck/Exon/CPC; Ed Wolynic, Union Carbide; Bob Kuhn, Synergén; Mina Dalili, Centacor/Medarex); Craig Turchi (NREL); and Lorette Pruder (Mobil Chemical).

Dave’s research career has been characterized by three features: 1) a deep intellectual curiosity and a broad grasp of science and engineering which has led to important contributions in three different topical areas: heterogeneous catalysis, photocatalysis, and biochemical engineering; 2) early papers which have opened new research directions; and 3) careful elucidation and characterization of catalysts—thermal, biological, and photochemical. Some examples of his early pioneering papers in each field are shown in Table 2.

In his ten years at NCSU, Dave has been part of a department with an increasing research orientation, but not at the expense of quality instruction at the graduate and undergraduate levels. He has contributed to the fine teaching tradition in the spirit of Warren McCabe and colleague Rich Felder. Dave has also helped foster the growth of the graduate program, which now numbers over seventy doctoral students.

Dave’s colleagues share some of his scientific wanderlust and aren’t much easier to put into tidy categories than is Dave. As a first approximation, they include:

- **The Biotech Bunch**: Ruben Carbonell (biosensors and bioseparations, next Head); Carol Hall (statistical thermodynamics; NCSU’s 1993 Alcoa Distinguished Research Award winner); Bob Kelly (hyperthermophilic enzymes and microorganisms); Peter Kilpatrick (bioseparations, surface chemistry); Steve Peretti (applied molecular biology, PYI)

**The Polymers and Materials Mafia**: Benny Freeman (polymer transport, PYI); Hal Hopfenberg (polymer permeation, self-described university utility infielder, ex-Head, ex-Assistant to the Dean and to the Chancellor, ex-Interim Athletic Director, and currently Director of the Kenan Institute for Science, Engineering and Technology); Saad Khan (polymer rheology); Henry Lamb (surface science, organometallic chemistry, PYI); John Setzer (polymer processing, Associate Head); Vivian Stannett (polymer gentilhomme extraordinaire, On Her Majesty’s Service, emeritus); Greg Parsons (electronic materials)

**The Environmental Club**:
- Peter Fedkiw (electrochemical engineering); Rich Felder (process synthesis and optimization); Christine Grant (transport, waste minimization); P. K. Lim (environmentally-benign synthesis, free-radical chemistry); Michael Overcash (life-cycle analysis, pollution prevention); George Roberts (reaction engineering, alternate fuels, Head); Robert Thorogood (separations)

Dave’s embrace of academic life is also evident on the homefront. With four sons, one each in law school, graduate school, college, and elementary school, and an adopted daughter yet to begin school, the Ollis factor will likely be apparent in the academic world for some time to come; he clearly supports higher education in more ways than one! Marcia, Dave’s wife of thirty years, should get credit as first author for these contributions, however.

Dave’s enjoyment of academic life is as evident today as when he began his career. His deepest professional satisfactions have included collaborations with his graduate students and his many faculty colleagues, as well as the freedom to wander in both teaching and research. Dave vividly remembers a conversation he had as a young Assistant Professor at Princeton during which his former colleague, Ernie Johnson, told him, "There is no finer post than professor." In Dave’s hands, this post has provided a wandering license for life and a paying permit to pause, postulate, and proceed in just about any research or teaching direction that struck his fancy. "Ernie, you were right: teaching is the finest post!"

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Dave and Marcia Ollis, after fifteen years of marriage, are still laughing and recently celebrated their 30th wedding anniversary. Marcia has been a social worker and currently teaches French at a Montessori school.

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