Chemical Engineering
at
The University of Waterloo

PART I: Origins (1957-2002)

Edited by R.R. Hudgins and P.L. Silveston (+Jan 2018)

G.S. Mueller replaced the late P.L. Silveston in Fall 2021

November 2022

This memoir is dedicated to all who have made, through their contributions to teaching, learning, and co-op education, the Department of Chemical Engineering at University of Waterloo the influential institution it has become.

Caveat Lector

What does a normal reader expect to learn from reading the Chemical Engineering (ChE) history project?

- A normal reader is possibly an alumnus/a, a prospective undergrad or grad student, a narcissistic faculty member, a curious person with some family or occupational connection to ChE.
- Expect to learn something of the co-op origins of University of Waterloo (UWaterloo), Engineering at UWaterloo, chemical engineering at UWaterloo, how the Department of Chemical Engineering was founded and came to operate, what co-op education is, the role co-op education plays in the degree and why UWaterloo co-op is so important that it is now (2014) the largest co-op school in North America.
- Expect to read an abbreviated history of chemical engineering research at UWaterloo, since current achievements are more important to prospective students and are available in descriptions posted elsewhere.
- Some human-interest anecdotes collected along the way, some blended into the text but mostly with “stubs” in the text and links to appendices.

Do not expect a uniform style, or the same level of detail in each section. This document was compiled from the recollections of early faculty, living Department chairs, many of whom are no longer available at the time of final editing (2022).

All other material is either inappropriate or appendix fodder, e.g.: awards to research groups; old curricula; statistical material such as growth rates.

Do not read this history if you wish to obtain detailed information about graduate studies, specific CV material about professors, or fees, or housing or lecture times, etc. Such material is available elsewhere.

Errors and Omissions

The Editors are aware that in a document compiled from so many sources as this one errors and omissions are inevitable. Please direct any suggested corrections or **minor** additions to

gerry.mueller@uwaterloo.ca

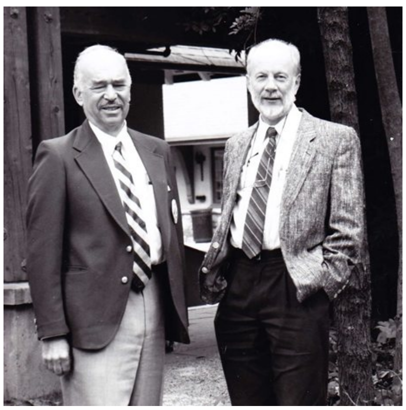
In your email, describe the location (page number, paragraph number, or context) as accurately as possible, and detail the changes you suggest, giving references, if possible.

The Editors are also interested in photographs to add to the text. Please forward any of interest to the above email address, with description, and the permission to publish by any living persons in the photograph.

Foreword

In 2018 the University of Waterloo's Department of Chemical Engineering celebrated its diamond anniversary and all the accomplishments that were achieved during the first 60 years.

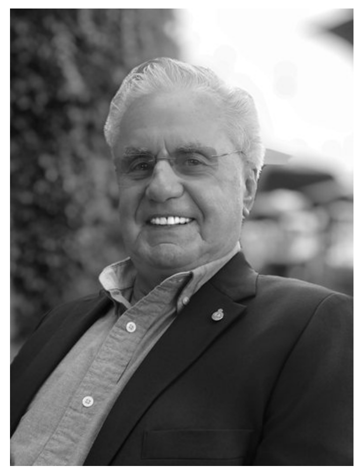
The University of Waterloo was created by a handful of businessmen who dreamt that cooperative education, which was new to Canada, could be the basis of a new university in Ontario. The Chemical Engineering department's extraordinary beginning makes it unique in the history of engineering programs. Its significant growth has been possible through the involvement and efforts of many exceptional people.



Pete Silveston & Bob Hudgins (2000)

As retired faculty, we're happy to share some stories from the exciting early days of the department. One day, others will contribute memories and milestones of their own time here.

Here, you'll find some anecdotes about the quirks and trials of everyday life that explain and provide a flavour of the times. We believe this account is factual but beg your indulgence for an occasional excursion into swagger.



Gerry Mueller (2021)

We gratefully acknowledge the many important contributions of former chairs Lou Bodnar, Don Scott, Ken O'Driscoll, Ted Rhodes, Garry Rempel, John Chatzis, and Tom Duever, and former full-time faculty members Murray Moo Young, Tom Fahidy, and Gerry Sullivan. The recent chair, Eric Croiset, encouraged all of us and provided support to publish this information.

In addition, special thanks to the Department of Chemical Engineering for providing photos; Jessica Blackwell, of Waterloo's Special Collections and Archives, for providing some valuable records; and Liz Bevan, the Department's Administrative Officer, for organizing several luncheons at which retired faculty members offered advice and anecdotes. Linda Sherwood, a research group coordinator, offered her services as an editor of early versions of the manuscript.

Important contributions about the Chemical Engineering Department's co-op experiences were made by the late Dave Copp, formerly of the Co-ordination Department; Miles Lauzon, a three-time graduate of Waterloo with co-op and business experience; and Gerry Mueller, the first undergraduate (1966) student to join the Department's faculty (1971). All these and others offered extraordinary recollections of UWaterloo's early co-op ventures.

Bob Hudgins & Pete Silveston (+Jan 2018)

Gerry Mueller

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Chapter 1 – And So it Begins

The University of Waterloo's Department of Chemical Engineering is a remarkable success, as is its entire engineering program. After the first students were admitted in 1957, student enrolment increased at a fast pace. Within ten years, the department had the highest enrolment of any chemical engineering department in Canada. Within twenty-five years, it was universally accepted as one of the leading chemical engineering departments in the country. It maintains that position to this day.

Post-War Boom

During the 1950s, Ontario, like the rest of Canada, was in an expansive and optimistic mode. The transition from war to peace was completed quickly and easily. Immigrants from Europe continued to arrive, and most chose Toronto as their destination. Branch plants of American or British companies, many established during World War II, expanded to meet international demands. The United States and Canada were prime sources of agricultural and machine products for the world. This trade brought prosperity.

At the same time, Canada was experiencing a change in its global stature as a founding member of the United Nations. Its reputation as a country dedicated to peace and co-operation was enhanced when its minister of external affairs, Lester B. Pearson, was awarded the 1957 Nobel Peace Prize for helping resolve the Suez Canal Crisis.

While the 1950s saw the political switch from Louis St. Laurent's Liberal government to John Diefenbaker's Progressive Conservative one, Canada's direction changed little. In Ontario, Progressive Conservative premier Leslie Frost focused on stoking the province's economy through fiscal policy and public investment. With universities under provincial control, Frost's interest and influence was important. He was a friend of Ontario's universities and invested in their ability to support industry.

Industry

Canada had a burgeoning chemical industry, with hubs in Sarnia, Kingston, Montreal, and along the north shore of the St. Lawrence. Potash extraction had begun in Saskatchewan; oil fields had been identified along the eastern face of the Rockies; and Canada's large pulp and paper industry, spread across the country, was healthy and prosperous. Indeed, the entire Canadian economy called for a larger and more skilled workforce. Engineers especially were in demand.

Pete Silveston, an early faculty member in Waterloo's Chemical Engineering Department, recalls having sent out many job applications upon his graduation with a BSc from the Massachusetts Institute of Technology (MIT) in 1951: he was flooded with interview requests and received more than 20 job offers. The employment situation was much the same throughout Canada.

Academia

At the same time, a grand expansion of the established Canadian universities was underway.

The federal government encouraged university growth through its financial support of returning veterans' academic studies and research grants to science and engineering departments and faculty members. Provincial governments invested heavily in their post-secondary institutions, which they recognized were engines of growth.

Higher education was dominated by the historic universities: McGill University, Université Laval, University of Toronto, Queen's University, University of Alberta, and University of British Columbia. By and large, these institutions looked to Great Britain or, perhaps, Europe for their goals and operation models. As a result, scholarship in the arts and sciences was their guiding principle.

While some Canadian institutions defied convention by having what was, at that time, a modern Faculty of Engineering and Applied Science, their reputation may have lagged those with a more traditional Faculty of Arts and Sciences. In addition, while some of those Faculties of Engineering and Applied Science had chemical engineering departments, many of those departments were associated with chemistry, rather than the other engineering disciplines. Indeed, in a few institutions, chemical engineering remained housed within chemistry department facilities until the present (2021).

During the economic and academic growth phase of the late 1950s, chemical engineering departments began to evolve. At universities in British Columbia, Alberta, Saskatchewan, Ontario, and New Brunswick, the chemical engineering departments differentiated themselves from chemistry departments. McMaster University, emerging from the shelter of the University of Toronto, moved to Hamilton and concentrated on science and engineering before including medicine later.

Of course, the many available opportunities for chemical engineering graduates in the oil exploitation, electrochemical, and pulp and paper industries inspired increased enrolment in the historic universities. They also led to the creation of chemical engineering departments in some rapidly growing smaller institutions, such as University of New Brunswick, Technical University of Nova Scotia, McMaster University, University of Western Ontario, University of Windsor, and University of Saskatchewan. All of these new departments, however, followed the historical universities' lead by adopting academic scholarship as their model.

Despite the increase in opportunities for chemical engineering education, industry remained dissatisfied as its demand for engineers still exceeded the supply. Moreover, it found that the engineering education provided by the universities was inadequate for many of industry's demands, necessitating extensive on-the-job training for new hires. Industries in all sectors were looking for graduates who could be productive more quickly.

It was into this environment that the University of Waterloo and its Chemical Engineering Department came into being.

Local Industry

The Waterloo region's strong manufacturing economy included an important rubber industry, possibly in response to rubber fabricating centres on the other side of Lake Erie, in Ohio and Pennsylvania. The Dominion Tire Plant, later known as the Uniroyal Tire Plant and then the BFGoodrich Tire Plant, was located in Kitchener. BFGoodrich had its Canadian headquarters in Kitchener and Uniroyal's was in Guelph.

Civic-minded executives of the rubber industry, including J. Gerald Hagey, National Advertising Director for BFGoodrich Canada, and Ira Needles, chairman of the BFGoodrich Canada board of directors, wanted the community to have a university with a science and engineering slant that would benefit the rubber business. This account of UW's early beginnings may be too simple. History is written by the survivors, so this interpretation of why University of Waterloo was created may be considered revisionist history as told by engineering faculty who witnessed it, i.e. your humble editor-authors. For a more diverse view of the founders' motivations, historian Kenneth McLaughlin's account presents what led the different members of the board of governors to create what became the early University. (*The Unconventional Founding of An Unconventional University (1997)*).

They eschewed an "ivory tower" institution that worshipped pure research, however. Rather, they favored one that prepared its graduates for industrial employment. Academic-Industry programs typified by 'sandwich' programs in the United Kingdom and co-op programs in the United States, such as the University of Cincinnati's almost 50-year-old program, caught their attention.

University of Waterloo

In 1956, their initiative culminated in the institution known as Waterloo College, a Lutheran liberal arts college affiliated with the University of Western Ontario. When the first engineering students, including several who would select chemical engineering as their specialty, started classes in mid-1957, the purchase of the land where the institution's first academic building would be built was still under negotiation.

By 1958 the institution had become known as the Waterloo College Associate Faculties. It was a semi-autonomous entity of Waterloo College that reported to the Evangelical Lutheran Synod of Canada. At the time, however, only non-denominational institutions could receive provincial funds. When members of the Waterloo College Associate Faculties and Evangelical Lutheran Synod of Canada disagreed on matters pertaining to the use of Provincial funding to buy land on the outskirts of Waterloo, they parted ways.

Waterloo College Associate Faculties announced the land acquisition, with provincial funds, early in 1958. The University of Waterloo had begun to function, albeit with neither a name nor a degree-granting charter. Some might have found this discouraging, but not Hagey or the Department of Chemical Engineering's first Chair, Dr. Ted Batke, who soon rectified these deficiencies.

In 1959, the Legislative Assembly of Ontario passed a bill that turned Waterloo College Associate Faculties into the University of Waterloo. It introduced Canada to cooperative education, a structured combination of classroom-based education with practical work experience.

Chemistry and Chemical Engineering Building

Construction of the University's first academic building began soon after the land purchase was announced in early 1958. Originally called the Chemistry and Chemical Engineering Building, it was soon dubbed Engineering 1 or E1. It was finally renamed the Douglas Wright Engineering Building in 1998 in honour of the first Dean of Engineering.

UWaterloo in 1962; Chemistry & Chemical Engineering (E1, now DWR) bottom, E2 middle right, Science middle left. (Credit: University Archives)

The Douglas Wright Engineering Building (DWE) housed the University's administrative offices and library; Civil Engineering's settling tanks; a few lecture rooms; some offices, each one shared by two faculty members; and, in the basement, Biology's fish tank. The basement also housed Chemical Engineering's well-known distillation column. The bottom of the 22-tray column was accessible from the Unit Operations Lab and the top poked through a mezzanine where it was accessible through the room above.

For its first two or three years, the Chemistry and Chemical Engineering Building housed absolutely every aspect of the University except for a cafeteria. The building that contained the cafeteria had an unfortunate makeshift ambiance, perhaps due to its plywood construction, that was at odds with the University's long-term plans. Indeed, the cafeteria was located near Dearborn Avenue, which was renamed University Avenue in 1963 in recognition of the institution's likely prospects.

Unlike the cafeteria, the Department of Chemical Engineering was university grade from the start, and it quickly evolved to become one of Canada's leading chemical engineering departments.

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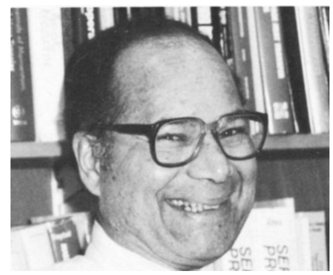
Chapter 2– Ted Batke Establishes a Chemical Engineering Department (1957-1962)

At the Department's inception, Gerald Hagey, then President of the University, and Ira Needles, then Chair of the Board of Governors, raided the University of Toronto and the Canadian chemical industry to create a core of chemical engineering teachers with the skills and experience to prepare students to work as engineers.

Ted Batke (1962)

One of their first recruits was Dr. Ted Batke, who was working as a chemical engineer for DuPont after graduating from University of Toronto several years earlier. Fittingly for a new university focused on industry needs and employment readiness, a chemical engineer took on the role of shaping the University of Waterloo's chemical engineering department.



Jim Ford (1984)

Batke's first Chemical Engineering hire was Jim Ford, who at the time had only a master's degree in Chemical Engineering, which was not exceptional for Ontario universities at the time. His second was Louis (Lou) E. Bodnar, an early example of the unconventional ways some of the initial departmental faculty were recruited. Bodnar was originally a chemist (BA and MA from the University of Saskatchewan, PhD from McMaster University) on the chemistry faculty at the Royal Military College in Kingston. He was encouraged to gain some background in chemical engineering and did seven semesters at the University of Texas in Austin, completing all the requirements for a master's degree in chemical engineering, but never actually graduated. Because of the prestige of that University's Chemical Engineering Department, he had several invitations to job interviews all over the U.S.A., one of which took him near the Canada-U.S. border. His mother was at that time in Waterloo, working at St. Paul's college as Residence Director, and she persuaded him to visit her in Waterloo. There he met with friends from Saskatchewan, Ken Friar and Arthur Beaumont, both now faculty in the Department of Mathematics. Those two persuaded him to meet with the Dean of Engineering, Doug Wright, who convinced Bodnar to stay over an extra day to meet with Ted Batke and President Gerry Hagey. At the end of that meeting he was offered a job as an Associate Professor on the spot; which he accepted and turned down three other offers from U.S. companies. Together Ford and Bodnar planned a curriculum that would provide students with a well-rounded education in chemical engineering, including the technical and employment skills that industry needed.

Lou Bodnar (1963)

Early Curriculum

A unique feature, at least for a Canadian engineering faculty, in the early years UWaterloo offered a cooperative pre-engineering year of studies, which was effectively the equivalent of the Ontario Grade 13 curriculum. It was available to students from within Ontario who had either not completed Grade 13, graduated in another Canadian province with Grade 12 as the final high school year, or had been out of formal education for some time. Students enrolled in this course could prepare for degree studies while still earning some income, some even with their previous employers. Those who successfully completed this pre-engineering year, with a better than 60 percent average and no failures in any course were guaranteed admission to any of the degree Engineering programs at UWaterloo. (As a measure of the value of this remedial program, we note that a few high-scoring students from it were actually admitted to studies at other engineering schools that better fit their needs and circumstances.)

UWaterloo's undergraduate chemical engineering curriculum (including teaching laboratories) were conventional for their day; their quality was excellent. Although the curriculum has been modified over the past sixty years, much of the original course content (and certainly the course sequencing) would be recognizable today.

In its first years, the Department taught its essential subjects of mass and energy balances, chemical kinetics and reactor design, fluid mechanics, unit operations such as distillation and heat exchanger operations, some advanced mathematics, process control, and process design.

In addition to their technical courses, chemical engineering students were required to obtain a passing grade one non-technical elective course in each of their eight terms of the program. Two of these had to be selected from courses offered by the English department. The remainder could be from the broad areas of the liberal arts and social sciences, or from a limited selection of science courses.

Science courses with a major overlap with the engineering curriculum, for example Introductory Chemistry, Physics, or Mathematics, were unacceptable. Topics that expanded the future engineers' perspective, such as Introductory Botany, Zoology, or Astronomy, were encouraged. Thus the course-load each term consisted of five required or elective technical courses and one elective non-technical course.

Cooperative Chemical Engineering

Cooperative education started with the inception of the engineering program at Waterloo. The first students began their education with a three-month academic term on campus followed by a three-month work term in industry. They alternated terms in this way until they had met the requirements of their degree.

Three-month terms, however, proved to be unworkable. They forced most students to relocate four times each calendar year. Moreover, the short academic term seemed breathless for students and professors alike.

After trying this arrangement for three years, UWaterloo adopted a four-month term, and at the same time terminated the pre-engineering year. It was considered a more reasonable interval and also more in step with the semester-based rhythms with which most universities operated. The four-month term has remained the co-op standard ever since.

Thankfully so, because the transition from an annual schedule that included 4 three-month academic terms to one that included 3 four-month academic terms was complicated for those cohorts that were already underway – and for those who had to organize their classes. During his role as Chair, Lou Bodnar's office bulletin board was covered with file cards that showed the curriculum of each chemical engineering class as it progressed through the terms. Gerry Mueller was one of those affected, transitioning to the four-months system after the 1B work term, having about 6 months earlier watched the Convocation ceremony of the 1st Engineering graduating class, whose entire studies were on the three-months system.

Sequence

Each cohort of students began in a Fall term and, if all went well, finished four and two-thirds of a year later, at the end of the Winter term. This co-op program was two-thirds of a year longer than most conventional degree programs.

Each academic year was broken into halves, known as A and B that had their own set of courses. First-year students could choose the 8 months (in 1st year) A stream, which began with back-to-back Fall and Winter academic terms on campus, or the 4 months (in 1st year) B stream, which began with a Fall academic term on campus followed by a winter work term. The table below illustrates those two streams:

Plan	Stream	Fall	Winter	Spring	Fall	Winter	Spring	Fall	Winter	Spring	Fall	Winter	Spring	Fall	Winter
Chemical	A (8)	1A	1B	•	2A	•	2B	•	3A	•	3B	•	4A	•	4B
Chemical	B (4)	1A	•	1B	•	2A	•	2B	•	3A	•	3B	•	4A	4B

Table 1: Academic and Work Term Sequences

Even after the switch to four-months terms, the fast pace, challenging schedule, and stressful requirements of UWaterloo's engineering program forced students to mature quickly. Just like today, each work term meant that most students had to find a new place to live in a different city, acclimatize to new surroundings, and be accountable for their performance in the real world. Each academic term, those same students had to find a local place to live, prepare résumés, fill out applications for co-op jobs, and participate in employer interviews on top of their demanding studies and final exams.

Some of the first chemical engineering students succumbed to the pressure and dropped out of their studies or transferred their credits to other universities. By the beginning of the 1960s, however, the majority of chemical engineering students that got through first year eventually obtained their Bachelor of Applied Science. Even so, some successful graduates required more than the minimum four and a half years to get their degree, and a few dropped out altogether.

Living Rough

In the early days, the co-op program provided a convenient way for students of modest means to finance their university years. Nevertheless, an occasional student had to live rough during the academic terms.
More …

Engineering Specialty

In the start-up phase of the UWaterloo co-op program, all students looking for work term experience had the same opportunities for employment, regardless of their academic focus.

Work terms and their associated requirements were admittedly rather casual. That changed after 1958, when Bert Barber was hired to organize the engineering co-op program. He developed the program into a smoothly operating professional system – for students and employers alike – in which co-op coordinators found discipline-specific job leads, students worked and wrote work term reports, and employers completed evaluations.

Barber established a roster of industries that were willing to hire engineering undergraduates for one academic term at a time, based on interviews. Students in general were expected to commit to an employer for two terms, provided the employer found them satisfactory and invited them back. Taking his cue from the experiences of American co-op schools, he hired a cadre of coordinators to act as liaisons between academia and industry.

The coordinators were licensed Professional Engineers. Each was assigned a territory within which to find jobs across all disciplines for up to one hundred students at a time, including those in each year of an engineering degree. Coordinators would often help interested employers write job descriptions that were then posted on special bulletin boards in the engineering corridors that were reserved for cooperative job notices.

Coordinators sent student résumés to employers and arranged interviews on campus. After the interview sessions, employers would rank the students, and students would rank the employers. Until the process was taken over by computers in the late 1970s, the coordinators matched the results to find the best combination of choices. Generally, students got their first choice of jobs about 50 percent of the time, although employers' choice of students were given preference.

To prepare first-year students for employment, the coordinators conducted orientation lectures which students were required to attend. These lectures dealt with issues of safety, résumé writing, interview preparation, and practical advice regarding on-the-job conduct. They helped students be readily accepted by their new colleagues and bring credit to themselves and the university.

Coordinators visited each student on the job usually once per work term to assess their performance and the appropriateness of the work they were doing. Sometimes, students would complain that they felt underutilized, or that it took weeks to be noticed. If the work seemed to lack sufficient challenge for a student's academic level, the coordinator would suggest that the employer upgrade the work.

On returning to the University from a work term, students were required to submit a technical report on the work they had done, or on some aspect of it, which was graded, and required a passing grade. In the early years coordinators graded the students' work reports; however, grading eventually became a faculty duty because faculty were better able to provide students with appropriately critical technical feedback.

On return to campus, coordinators met with students to review their performance, as assessed by their employers, and discuss the prospect of their return to the employer for a second work term, which was expected if the employer wanted it.

Invariably, some students remained without a co-op position after the interview and matching phase. The coordinators helped those students find jobs. Chemical engineering students were sometimes placed with UWaterloo laboratories in jobs that were partially subsidized by the Faculty of Engineering. As a result, most undergraduate chemical engineering students found a placement every work term.

A Model Program

Other schools have envied the UWaterloo co-op engineering model.

In the early days of UWaterloo's co-op engineering program, a group of engineering professors from the University of Western Ontario came to learn how it worked. They concluded that their university could not afford the extra costs associated with the co-op infrastructure and the summer teaching load that it necessitated. Likely no school could afford to deliver a co-op engineering program without charging a co-op fee in addition to normal tuition fees.

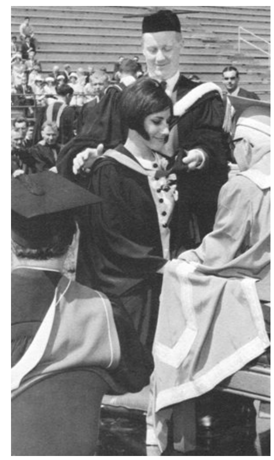
By the early 21st century cooperative programs in all faculties and departments abound at the University, and at other Canadian universities. Ironically, Wilfrid Laurier University, the successor to Waterloo College, from which University of Waterloo was born out of a rejection of the cooperative education model, now has a prominent “Cooperative Education” building on Waterloo’s King Street!

Administrative Challenges

The UWaterloo co-op program was an oddball amongst the regular Canadian university programs for a long time. That status caused some unexpected administrative challenges. For instance, while the Canada Student Loans program accepted Waterloo co-op students, any change in the expected pattern of work and academic terms triggered a notice for loan repayment. For a while, many unwitting co-op students had to scramble to make necessary last-minute changes to their loan paperwork.

Employment Discrimination

In the first decade or so of the program, women were often turned away from co-op jobs in chemical plants with the excuse that most of the plants’ washroom facilities were for men only. Happily, this difficulty and others have been resolved, and the enrolment of women entering the field of chemical engineering is no longer influenced by such pretexts.



Gabriellla Casonato, the first woman to graduate from Engineering (Civil) at UWaterloo (1966)

By the early to mid-1980s women’s registrations in first year Chemical Engineering reached nearly 30 percent, and then declined. By 2019, women again comprised 30 percent of the undergraduate and 40 percent of the graduate students in the Department of Chemical Engineering. In the earlier years there was a dearth of qualified female applicants because the Ontario school system did not graduate them; as one engineering educator pointed out, some of the decisions required for a student to eventually be able to apply to an engineering program are made as early as the transition from public school to high school. That’s when students make decisions which determine their later ability to choose the mathematics, physics and chemistry courses required for engineering studies admission, and young women are encouraged to choose more “female-oriented” choices. There are efforts in the Ontario education system to move these choices to later in the high school years; how successful these will be is too early to be determined.

Work Term Advantages

Work terms provide students with valuable, first-hand experiences that they often can’t find elsewhere. In chemical engineering, where the equipment and scale of work is often large, a work term might provide students with their only opportunity to experience the environment and atmosphere of a plant and put into practice the concepts they learned in class. As one student remarked, “We just don’t see distillation columns in our regular daily life.”

In addition to the chemical engineering skills they learn on the job, work terms allow students to assess their employers while demonstrating their own various competencies at the same time. One industry executive who had employed 25 or so Waterloo co-op students could recall only one whose job performance was less than satisfactory. On the contrary, most students were keen and hardworking, and they made significant contributions during their work terms. Not surprisingly, many employers offer their co-op students full-time jobs well before they graduate.

Some students were assigned significant responsibilities on their later work terms. One third-year chemical engineering student, for example, found herself on a work term in northwest Ontario, where she was responsible for bringing back on stream part of a paper mill that had been inactive for several years. It was shortly after the 1990 recession and her first employment with the paper company. She read all the equipment manuals, consulted with experienced employees, and put into practice the things she had learned in class. By the end of her work term, she had the mill operating again. Naturally, the company was delighted to have her return for her next work term and offered her a permanent job upon her graduation.

About Co-op at Waterloo in 2018

- The largest post-secondary co-op program of its kind in the world
- 19,800 co-op students enrolled over three semesters in 120+ programs
- 6,700 employers hire UWaterloo co-op students
- More than 2,600 co-op work terms in 60+ countries in 2015/16
- Total earnings of co-op students amounted to $253 million in 2015-16
- 87 percent were employed in jobs related to their program of study 6 months after graduation, compared to 69 percent of Ontario graduates
- 79 percent of Waterloo co-op students made an annual income of more than $50,000 two years after graduation
- Huge resources and a large, experienced coordination staff
- Administered in Canada's largest building completely dedicated to co-op and career services

Benefits of the Waterloo Co-op Program (2013)

In 2013, the following pitch was used to inspire students to consider enrolment in Waterloo's co-op program:
Gain up to two years of paid work experience to add to your résumé.
More …

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Chapter 3 - Louis Bodnar Builds the Chemical Engineering Faculty (1962 -1964)

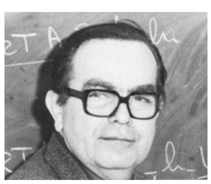
When Ted Batke became University of Waterloo's Vice-President Academic in 1962, Lou Bodnar became the Department's Acting Chair. His contribution to Waterloo's chemical engineering program was considerable despite his short tenure as Chair of the Department.

He helped guide the process of hiring the people who would develop and evolve the academic and technical aspects of the department, as well as the industrial relationships that supported the co-op program and the research aspects that were crucial to the success of the students.

During his two years as Acting Chair, Bodnar worked with Batke to hire Don Scott as the incoming chair as well as several other well-connected and talented chemical engineers, some of whom joined the Department after Scott had assumed the Chair:

- Harold Heatley, a retiree with a background in applied math, known for his doctoral thesis on the Toronto Function, in 1961;
- David C.T. Pei, holder of bachelor's degrees from McGill and Queen's and a PhD degree from McGill University in heat transfer;
- Kurt Enns, who had three degrees in chemical engineering from University of Toronto as well as a bachelor's degree in law;
- George A. Coulman, with a doctorate from Case Institute of Technology, was in process control;
- Robert R. (Bob) Hudgins, with degrees from University of Toronto and Princeton University, with an interest in reaction kinetics controlled by heat and mass transfer;
- Carl E. Gall, with degrees from Toronto and Queen's, who was still completing a doctoral thesis under the supervision of Rutherford Aris of the University of Minnesota.

David Pei



Kurt Enns

Carl Gall

During this hiring spree, Jim Ford took leave to pursue doctoral studies in Toronto, before returning to the department in 1965.

Because UWaterloo's compulsory undergraduate co-op was completely novel on the Canadian academic scene, faculty joining this adventure had to accept a certain amount of career risk. Despite that risk and Waterloo's early growing pains, many good people lent their skills to support the department's development.

Evolving Curriculum

Most faculty members could teach the basic chemical engineering courses, including mass and energy balances, thermodynamics, kinetics and reactor design, fluid mechanics, and unit operations such as distillation and heat exchanger operations. Carl Gall and George Coulman handled the more specialized math and process control courses. Pete Silveston, having worked on process development for several years at Standard Oil of New Jersey (now ExxonMobil), taught process design. Harold Heatley taught engineering economics, and terrorized students with a 5 ft slide rule, capable of considerably more significant figures than their customary 12” slide rules.

Orientation Courses

Before the unsuspecting students realized what was happening, Professors Bodnar, Ford, and Enns had introduced two chemical engineering orientation courses, ChE 100 and 101, taught in 1A and 1B respectively. Indeed, even the Registrar’s Office was unaware of the change: the new courses were absent from the 1960 edition of the undergraduate calendar.

These two courses were intended to accomplish two important things:

1. Distinguish chemical engineering students from those other engineering neophytes whose curricula included just one single chemistry course.
2. Establish fluency with units of measurement and offer practice with the conservation laws of mass and energy in chemically reacting systems.

Chemistry Courses

Bodnar whose background included teaching chemistry at the Royal Military College of Canada before transitioning to chemical engineering, was involved with the chemistry-related aspects of the chemical engineering degree. He organized the chemistry program that was taken by all first-year engineering students, taught one or two divisions of the program, created all of its several weekly tutorial quizzes, and produced mid-term and final exams.

He hired UWaterloo students as teaching assistants (TAs) and to run most of the tutorials. Interestingly, Bodnar preferred hiring undergraduate students from any other department over graduate students from the Chemical Engineering department. He felt that second-year undergraduates who had just finished taking the course they wanted to TA were more committed, available to work for less money and, best of all, more involved with the faculty than graduate chemical engineering students who may have taken the course many years previous.

During his tenure, Bodnar proposed that the Department of Chemical Engineering take over from the Department of Chemistry the teaching of engineering students’ first-year chemistry courses. This change was eventually instituted, several years after Bodnar moved on from his role as Acting Chair.

Strict Protocols

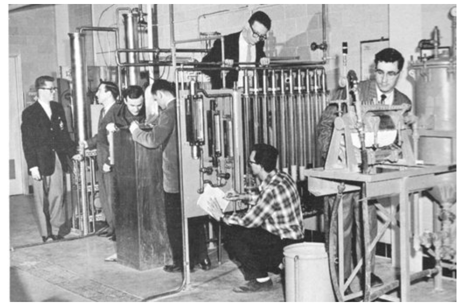
In their classes, students were forced to adopt the strict Bodnar protocol for submitting answers to problems: rule margins on all sides of each page, write their name legibly in a specific box, write the problem number in another box, number all pages, and so on.

Many first-year undergraduates found such formalities a nuisance at the start. Yet, once they accepted the instruction, these requirements became the accepted standard for course assignments and labs in all years, even in graduate studies. Not only was this a laudable engineering practice in documentation, but it was essential to reduce chaos for the markers.

Bodnar recognized that the discipline was appreciated: “After attending several Chemical Engineering reunions, I am surprised how many graduates have thanked me personally for the ‘line calculation’ protocol, a procedure in which both quantities and units are included in the calculations, which they still use. Some indicated that it was most useful thing they learned as an undergraduate.”

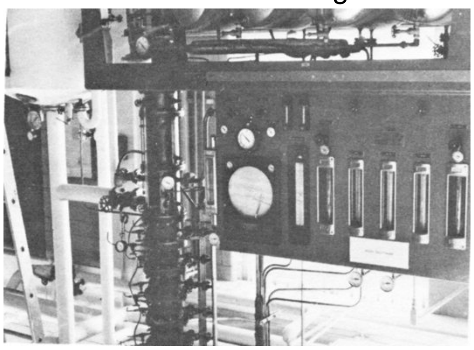
Laboratories

To meet Provincial curriculum requirements, the department needed to provide labs for every academic year of students. In those early years, faculty had to assemble their laboratories quickly, sometimes in the face of unexpected challenges.



ChE Lab (1962)

The creators of the undergraduate lab got a big surprise when the folks from what is now the Alcohol and Gaming Commission of Ontario weighed in on their equipment.



ChE Distillation Column (1982)

The distillation column which is used for experiments related to basic elements of chemical engineering involving the physical change or chemical transformation of a liquid material, was an important part of the curriculum. As the first step in the manufacturing process, distillation is used to separate liquid mixtures. Distillation columns are perhaps best known for their role in the petrochemical industry, but they are widely used in industry for the manufacture of all manner of things.

On the day that students were erecting the new distillation tower, a photographer from the Globe and Mail newspaper was on campus, capturing the excitement of the new University. Shortly thereafter, on May 2, 1961, the newspaper featured a photo of three fourth-year chemical engineering students working on the distillation tower. It was captioned, innocently enough, “Distillers”.’

The next day, the President’s Office received a call from Liquor Control Board of Ontario to advise that the university could not operate this equipment without a license. The distillation column, as it happens, can also be used to make moonshine.

Alcool

It would seem that the folks at the Liquor Control Board knew a thing or two about human nature. Gerry Mueller, a faculty member from 1971 to 1988, studied at Waterloo in the early sixties (Class of ’66). He recalls the days when the now legendary column was fairly new.

Once each term, Willie Stachel from Chemical Engineering Stores ordered about 40 gallons of what was known as Alcool from Seagram’s warehouse in Waterloo. The Alcool, which was 40 percent ethanol in water, was also sold by the Liquor Control Board of Ontario as a cheap substitute for vodka.

The Alcool was dumped into the reboiler, and the still was fired up on total reflux, which should ensure that no liquid is lost from the system. To learn how the distillation process works, students from various lab classes would run the still, take small samples from ports on every second plate, analyze them for ethanol, plot graphs, do efficiency calculations, etc. At the beginning of next term, another drum of Alcool would be ordered, and the cycle would repeat.

Because these purchases of Alcool were made free of excise and other taxes, being for educational purposes, they were reported to the “revenuers.” Over time, they began to wonder how a distillation column running on total reflux and losing only micro-samples was using about 16 gallons of pure ethanol every three months or so.

It turns out that the students, being engineers, were using the sampling tap on the top plate to withdraw large 'samples' of what was essentially pure ethanol (the azeotrope with water). They used it as party fuel in various concoctions, such as the popular "Purple Jesus" and other more colorfully named concoctions, involving grape juice and other diluents, usually anything sweet that was handy.

Sadly for Mueller, by the time he got to do labs on the column, the revenuers, in a move introduced by killjoy Bob Hudgins, had stopped buying ethanol/water in favour of a denatured ethanol/methanol mixture, which the column could not separate sufficiently to produce potable ethanol. The days of free party fuel were over.

Bob insists that the change was made for educational reasons. When using an ethanol/water mixture, much of the change of composition within the distillation tower occurs quickly, across just a few trays. With the ethanol/methanol mixture, the change in composition occurs more gradually across the entire tower. Although the new mixture provided fewer opportunities for fun than the old one did, it demonstrated the distillation process that had been taught in theory class better than the old mixture did.

"Rabbi" Bodnar

Lou Bodnar lived on a farm, and his regular work outfit included a rotating set of trousers with matching Harris Tweed jackets and Kodiak boots.
He arrived to teach a third-year chemical engineering class one winter morning to find a student
More …

Gerry Mueller Reminisces

Professor Gerry Mueller, a member of the Faculty between Fall 1971 and Summer 1988 (and one additional term as an Adjunct in Winter 1989) also attended University of Waterloo as an undergraduate from January 1962 to June 1966 . He shares some of his experiences below.
More…

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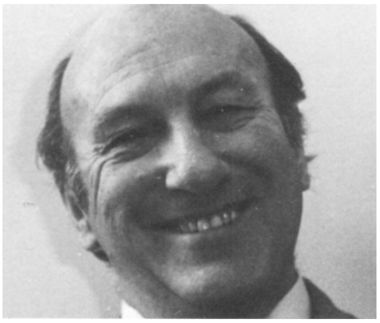
Chapter 4 – Donald Scott Builds the Department (1964-1970)



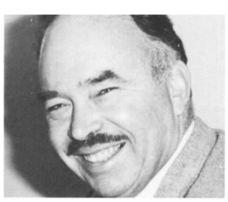
Don Scott (1984)

Donald (Don) Scott served as chair of the Chemical Engineering department between 1964 and 1970. He was recruited by Dean of Engineering Doug Wright in 1963, on the advice of Ted Batke and Lou Bodnar.

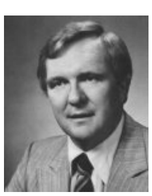
Before coming to Waterloo, Scott had been an outstanding researcher at UBC, which had one of Canada's leading chemical engineering departments. In his role at Waterloo, Scott aimed to create a research environment for and forge a commitment to world-class achievement. His vision included research activity that reflected both engineering fundamentals and Canada's industrial needs, namely transport phenomena, reaction kinetics and reactor design, process control, polymer science, extractive metallurgy, and biochemical engineering.

During the 1964-65 academic year, Scott expanded the department with the addition of the following people, some of whom had actually been hired during Bodnar's years as Acting Chair, but who did not come on strength until Scott had taken over:

- Peter L. (Pete) Silveston, who completed BS and MS degrees at MIT, and his Dr.Ing. at Technical University of Munich, with several years of experience at Standard Oil in New Jersey, and had been a colleague of Don's from chemical engineering at UBC;
- Edward (Ted) Rhodes, a promising young PhD and faculty member from University of Manchester whom Don recruited during his sabbatical in UK;
- Robert Y.-M. (Bob) Huang, with a BSc degree from National Taiwan Univ. and an MASc and PhD from Toronto, was appointed to give the department a presence in polymer science and engineering;
- Tomas Z. (Tom) Fahidy, with BSc and MSc degrees from Queens and PhD from University of Illinois, who specialized in advanced mathematics and process control. He replaced George Coulman who had returned to the US;
- John J. Byerley, with BASc and MASc degrees from Univ. of Toronto, and PhD from University of British Columbia. He was the first person in a nascent extractive metallurgy group;
- G. Alan Turner, with a BSc degree from London and PhD from Manchester, was recruited by Don Scott from the University of Manchester as a senior appointee, who lent the new department world-class expertise in heat and mass transfer in packed beds;
- Park M. Reilly, whose BASc degree was from Toronto and PhD from Imperial College London, the latter degree in Statistics (he viewed himself as a Bayesian) and taught statistics and basic calculus.



Pete Silveston



Ted Rhodes

Bob Huang

Tom Fahidy

John Byerley

Alan Turner

Park Reilly

Faculty Recruitment

In the early days of UWaterloo, faculty recruitment was conducted quite differently from the way it is now. Personal relationships, industry contacts, and serendipitous associations were influential. They helped the department acquire highly reputable chemical engineers who would go on to share their knowledge and experience with students. The excitement surrounding Waterloo's new approach attracted keen and qualified engineers from across the country and across the Atlantic.

For a time the UBC Chemical Engineering Department was riven by dissension among faculty members. This unfortunate circumstance for the University of British Columbia worked in Ontario's favour, making it easier to attract talented faculty to its relatively unknown university. In fact, just before leaving UBC, soon-to-be chair Don Scott persuaded his junior colleague Pete Silveston to join him in Waterloo's Chemical Engineering department. Pete, who had been so disillusioned by the UBC research environment of that time that he had decided to return to industry, settled back into academia quickly and stayed at Waterloo for the remainder of his career.

Later that same year, at the meeting of the Canadian Society of Chemical Engineering Conference in Sarnia, newly hired Pete Silveston chatted with Park Reilly, principal chemical engineer with Polymer Corp. (soon to be renamed Polysar). Out of this informal conversation in Polymer's hospitality suite, Reilly agreed, with his corporation's blessing, to teach statistics to Waterloo graduate students as a volunteer adjunct professor.

So began Reilly's regular commute between London and Waterloo – once every third week – to spend six hours lecturing to graduate students before returning home that evening. Within a year, he joined the department as a full-time professor teaching statistics in the upper and graduate years and basic calculus to first-year students. The UWaterloo innovation of adding basic statistics to the chemical engineering curriculum was soon copied by other chemical engineering departments across Canada.

Serendipitous Incident of a Statistician

Park Reilly recalls leaving Waterloo with his wife, Veva, as his chauffeur following a long day in which he had developed a fever and was feeling wretched.
More …

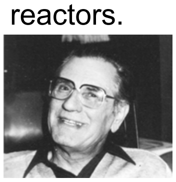
Even before embarking on his new role as chair of Waterloo's Chemical Engineering department Scott continued his recruitment efforts in early 1964, when he was on sabbatical at Cambridge University. At one point, Scott invited Ted Rhodes, who was finishing his PhD at the University of Manchester Institute of Science and Technology, to meet him at Cambridge for a talk. Because Scott had no private office, the two sat on a fire escape staircase at the rear of the Chemical Engineering building and discussed the future prospects of the University of Waterloo. There and then, Scott – who was not even an official Waterloo faculty member yet – offered Rhodes a job at Waterloo. He must have been convincing: Rhodes went home to inform family and friends that he was emigrating to Canada. By 1976, Rhodes had become chair of Waterloo's Department of Chemical Engineering.

Department Expansion

During 1965, members of the Department did a lot of thinking about whether to expand and, if so, to what extent. Various scenarios were discussed over lunches and at departmental meetings. On the one hand, if nothing changed the department would graduate 25 undergraduate chemical engineering students a year at steady state. On the other hand, there was plenty of demand for co-op engineering students and graduates, and The Government of Ontario (popularly known as Queen's Park), Ontario's university funding source, was committed to the growth of post-secondary education. The Department decided to expand.

With approval from Dean of Engineering Doug Wright, Scott began a new round of interviews to fill out the research groups he had planned and meet the department's teaching demands. Many prospective candidates were interviewed over faculty lunches and, consequently, many new people joined the department in 1966 and 1967:

- Harmon Ray, who arrived in the department fresh from graduate study at University of Minnesota. His research and teaching contributions were largely in process dynamics and process modelling. He became a major user of the IBM 360/75 equipment at the university in the five years he spent here;
- B.M.E. (Ben) van der Hoff, with degrees of Ing. from Amsterdam and Ir. from Delft, who was recruited from Polysar in Sarnia to strengthen the teaching and research in polymer engineering;
- George D. Fulford, a Jamaican who was a BSc and PhD graduate of Univ. of Birmingham with important industrial experience in the bauxite industry, was hired to strengthen the extractive metallurgy interest in the Department. With John P. Catchpole, he had published (1966) an important collection of dimensionless groups relevant to chemical plant design;
- Murray Moo-Young, another UK-educated Jamaican, with BSc and PhD degrees in London and a MASc in between at Toronto, who came on the faculty to put biochemical engineering into place. In so doing, he abandoned his budding career as a folksinger;
- Charles M. (Charlie) Burns, with BASc and MASc degrees from Toronto and PhD from Brooklyn Polytechnic Institute, who added strength to the polymer program;
- Kun Soo Chang, with BSc from Hanyang Inst. Tech. in Seoul and MSc and PhD degrees from Northwestern Univ., who specialized in process control and modelling of chemical reactors.


Ben van der Hoff


Murray Moo Young


Charlie Burns


Kun Soo Chang

With this new group of researchers, polymer engineering, biochemical engineering, and modelling of chemical processes were now recognized as areas of strength in the department's research activities.

By 1968, Scott also boosted the department's research capacity in extractive metallurgy:

- John R. Wynnyckyj, with a BEng from Mc Gill Univ. and holder of a PhD from what is now called the Department of Materials Science & Engineering at University of Toronto, was added to the extractive metallurgists; a year later, two more metallurgists who had their names on many patents, arrived from senior positions in US industry;
- Donald R. (Don) Spink with a BS degree from University of Michigan, an MS from Rochester, and PhD from Iowa State University, and

- Don H. Baker, Jr. with a MSc from University of Arizona in their mineralogy and mining area;
- Garry Rempel, with BSc and PhD degrees from UBC, who had a strong background in inorganic chemistry, was hired as a replacement for Don Baker who returned to industry;
- Francis Dullien, with a Dipl. Ing. From Budapest Technical University and MASc from UBC, who had completed a brilliant PhD in transport phenomena under Les Shemilt's direction at UBC before spending a year as one of Don Scott's post-doctoral researchers at UBC. One of the publications arising from this collaboration became listed on the Citation Index some years later as a major contribution to the mechanism of gas flows in porous solids. Dullien continued this field of research at UWaterloo and gained international recognition;
- Edward (Ted Rhodes), with three degrees from Univ. of Manchester, who joined the transport phenomena group, began a collaboration with Don Scott in the area of multiphase flow and boiling heat transfer that lasted for many years. Some of the 27 graduates of the transport group became well-known in university circles.


John Wynnyckyj


Don Spink


Garry Rempel


Francis Dullien

Near the end of his tenure as Chair of the Department Scott added three further faculty members, bring the Department's strength to 27, one short of 28, at which it remained for almost the next two decades:

- Campbell W. (Cam) Robinson, in 1968, with a BASc from UBC and PhD. from the University of California-Berkeley, with research interests in biokinetics, was added to the developing biochemical engineering group;
- Jeno Scharer, a Hungarian immigrant, obtained a BSc and PhD degrees at the University of Pennsylvania. After that, he worked at the US government biological warfare research lab at Fort Detrick, Maryland, joining UWaterloo in 1969. His broad knowledge of bioengineering and mathematics made him invaluable to the bioengineering group; so invaluable that he delayed his own promotion to professor by decades, finally achieving that rank in 1996;
- Ian F. Macdonald, in 1969, with a first degree from Nova Scotia Technical College and a PhD from the University Wisconsin, who had a strong background in fluid mechanics and complemented the department's expertise in transport phenomena.


Cam Robinson


Jeno Scharer


Ian Macdonald

Extra-Curricular Activities for Profs

In his first semester of teaching (1964), Bob Hudgins had a class of about 7 students in 3A. One evening he got a phone call from one of them asking if three of them could come over to his apartment. He agreed. Soon, in walked the trio and sheepishly admitted that they had recently ***More …***

Cocurrent Gas-Liquid Flow Conference, 1968

Only three months after Rhodes arrived in Canada, he returned to the UK to attend an international two-phase flow conference in Exeter. A large proportion of attendees were involved with nuclear energy and had great interest in multiphase heat transfer as it related to nuclear reactor safety. There were also many people from the oil and gas industry who were interested in multiphase pipeline flow, as well as wet steam flow as it related to the early research on oil recovery from tar sands.

As a result of their involvement in two-phase flow research, Don Scott and Ted Rhodes hosted an international conference on *Cocurrent Gas-Liquid Flow* in Waterloo in 1968.

Coal Research at Waterloo

Because the coal in Ontario is poor quality lignite, the province is a coal consumer rather than a coal producer. Accordingly, it may be remarkable that Waterloo emerged in the eighties and nineties as one of Canada's major coal research centres. And it did, thanks to Chemical Engineering faculty members' specific research interests.

Pete Silveston kicked off the activity in the late 1960s with an ill-fated study of the use of bituminous coal as an adsorbent for polluted water. Several years later, he returned to the idea of using coal as an adsorbent, this time collaborating with a brilliant Japanese postdoctoral scholar, Kenji Hashimoto. The topic was the development of porosity during gasification. Hashimoto applied population balances for the study in one of the earliest applications of this technique in chemical engineering literature. Publications of this work established Hashimoto's reputation as a researcher and Waterloo's reputation as an innovator in coal research.

The UK Atomic Energy Agency adopted the Waterloo work on the development of porosity during gasification. It invited Silveston to their laboratory to help them apply the population balance technique to the radiolytic gasification of graphite, which was a serious problem with the UKAEA gaseous atomic reactors. Several of Silveston's graduate students extended population balance techniques to coking, thus establishing contact with the Federal Department of Energy, Mines and Resources and the Canadian steel industry. Both groups were interested in predicting the properties of Canadian coking coals and suggested that Waterloo take on this task.

As a result, a coal research laboratory was established in a third-floor laboratory of Engineering 1. The laboratory was supported by contracts with the Department of Energy, Mines and Resources. Stelco seconded their senior coal scientist, Paul Readyhough, to work with the Waterloo Coal Research Laboratory for up to one day each week.

Several graduate students completed related graduate theses in the laboratory, but most of the contract research was handled by postdocs and short-term professional researchers. They created, among other things, laboratory tests to assess the coke quality of Western Canadian bituminous coals. A notable success was the further development of the Plastofrost technique for measuring the cokeability of bituminous coals. The work was published in coal journals rather than in the chemical engineering literature.

Several years after the coal research laboratory was established, Scott joined Silveston in directing the lab and began several studies of gasification and devolatilization in fluidized beds.

Off-Campus MASc

With the attachment of Park Reilly to the department as an adjunct professor who commuted to Waterloo from Sarnia to teach statistics, an interesting question arose: Should the Department of Chemical Engineering consider teaching off-campus in Sarnia, where several chemical companies had incentive programs for their employees to continue their education? The idea had been proposed by Professor Ab Johnson, then at McMaster University, but seemed to have been stalled, perhaps by some traditional indifference to teaching off-campus.

Reilly sampled some opinions at several Sarnia-based companies, including Polymer Corporation (later renamed Polysar), Imperial Oil, and Dow Chemical, and declared that there was indeed much interest in graduate level education – if graduate courses were made available in Sarnia. As an incentive, the companies agreed to reimburse employees the cost of each course for which they received a passing grade.

In turn, Waterloo established the first Canadian off-campus MASc degree in chemical engineering; it involved six graduate-level courses and an original research project. Throughout each fall and winter semester, classes were taught by a member of Waterloo's Chemical Engineering department who travelled to Lambton College in Sarnia one evening each week.

Following Waterloo's lead, University of Toronto and McMaster University's chemical engineering departments also experimented with off-campus programs, but their efforts quickly folded.

The courses taught in Sarnia by Waterloo's Chemical Engineering faculty were essentially the same as those taught at the main campus, and they were taught by faculty involved in graduate teaching on campus. For the faculty, off-campus teaching was considered equivalent to on-campus work. Some on-site help was made available for some courses, particularly those in statistics and process control. Dr. Walter Petryschuk, at that time an employee of Polysar Inc., served as a teaching assistant, helping to mark assignments for several terms.

Students in the off-campus program could base their original research project on work they had to conduct as part of their job. In such cases, the student's company had to agree to release the material used in the research project. The paper had to be read and approved by a Waterloo faculty member and, moreover, the report on the project had to be publicly available.

Flights of Fancy

Generally, Waterloo faculty preferred to teach on campus because teaching in Sarnia involved a large time commitment – five to eight hours of driving, depending on the weather, and an occasional overnight stay in Sarnia. Pete Silveston was an exception.
More …

The off-campus program expanded from Sarnia to Oakville's Xerox Research Park for a few years, but stagnated in the nineties when, it seems, the chemical industry's focus on research and process innovation declined in favour of increasing capital gains for stockholders. Eventually, enrolment in Waterloo's off-campus Chemical Engineering program decreased significantly: Sarnia had only a handful of students and Oakville had almost none. Lack of participation meant that the Department was losing money on the off-campus program, so it was eventually phased out.

Research Organization

One of Don Scott's enduring legacies as Chair was his contribution to the Department's research structure. It has changed over time, of course – several activities and groups have been added to his original set of research groups and several of his originals have been removed – but the foundation was solid and it supported great work. Most of Chemical Engineering's research groups had several faculty members, including some professors who were members of multiple groups and/or centres.

Chemical Engineering Research Groups, Past and Present

The following research groups have worked within Waterloo's Department of Chemical Engineering at one point or another:

Unit Operations

- Heat and mass transfer in packed and fluidized beds
- Fluid dynamics and heat/mass transfer in 2-phase flow
- Fluid dynamics and heat/mass transfer in 3-phase flow (trickle beds)

Reactor Engineering

- Reaction Kinetics
- Periodic Operation of Reactors
- Gas-Solid Reactions (Gasification)
- Reactor Dynamics

Polymers

- Polymerization Kinetics
- Polymer Properties
- Polymer Properties and Characterization
- Reactive Modification
- Production Technology

Process Metallurgy

- Electro-Metallurgy
- Hydro-Metallurgy
- Ion Exchange
- Magneto-Electrolysis
- Modelling of Electro-Chemical Process Dynamics

Biochemical Engineering

- Cell Culture
- Tissue Culture
- Fermentation Engineering
- Waste Treatment

Applied Statistics

Applied Mathematics

- Reactor Stability
- Reactor Dynamic Behaviour
- Control Theory and Practice
- Modelling and System Dynamics

Water Treatment

- Computer Modeling
- Clarifier Dynamics

Coal Research

Often each of these groups held their own research discussions and/or seminars, and the faculty within them had their own graduate students. While the general practice was to have a single supervisor for each graduate student, some students were jointly supervised. For example, Bob Hudgins and Pete Silveston jointly supervised the students in the Reactor Engineering Group, including those students working on clarifier dynamics.

An Awkward Moment in Catalysis

The Silveston/Hudgins kinetics/catalysis team gave an early paper at a symposium at McMaster University in the late 1960s. In it, they presented results of a model for selectivity of butane isomers from the hydrogenation of butene-1 based on their
More …

Curriculum Changes

As Don Scott increased the number and type of research activities taking place in the department, many new graduate-level courses were launched.

Waterloo's undergraduate Chemical Engineering program remained fairly static during Scott's tenure. Some courses were offered during different terms, some had their course numbers updated, and several general engineering courses were replaced by chemical engineering equivalents. There was also some change in course content. For instance, instruction in slide rule use vanished from the first-year program in the late seventies. Until it was replaced by digital programming instruction in the 1980s, students got by with a combination of slide rules, calculators, and the Mathematics Faculty's IBM computer.

Slide Rules, Electronic Calculators, and Ted Rhodes

In the late sixties and early seventies, a slide rule class was a necessity for all first-year chemical engineers. There were computers, but they were slow, fed by punched cards, and available only to graduate students and professors. For some years, Park Reilly gave several special lectures on slide rule manipulation. For his lessons, Reilly used a large horizontal wooden slide rule whose length exceeded his height. It was hoped that the two-metre-long prototype would help make its scales visible to several hundred frosh in a lecture hall.

In the late seventies, the Hewlett-Packard hand calculator arrived! Ted Rhodes, who was department chair at the time, welcomed a deputation of fourth-year undergraduates into his office. Two young brainiacs, Gerry Sullivan and Jerry Lerman (who later became chief of anesthesiology at Toronto Sick Kids Hospital), were among them. The delegation proposed that the department purchase such a calculator for the fourth-year room.

Consequently, $680 was found in the meagre departmental operating fund to purchase the machine. It was installed by John Wassing, a senior lab technician who was also a deft hand at fixing professors' junky cars. With said calculator firmly affixed with irreversible security screws to the front desk of the fourth-year room, members of the class took turns using it.

Once electronic pocket calculators arrived, students abandoned slide rules almost overnight. Only professors continued to use them for a few more years.

How quickly an inferior technology is driven out by a superior one! Does anyone remember how to use a slide rule?

Restlessness on Campus

The late 1960s saw the rise of the student power movement in the US, fueled by the Vietnam War. Sit-ins were popular in the US, and Canadian students sometimes used this nonviolent form of protest to express their frustrations and encourage change.

At one point, Waterloo students (mainly in Arts) staged a sit-in outside the administration building to urge that they be given more of a say in the grading of their courses. They adamantly refused to leave until their demands were met. Being inexperienced, however, they held their protest outside. In the winter.

In the middle of the first day of the sit-in, President Hagey phoned Chemical Engineering Professor Bob Huang for advice on what to do. "The temperature is going below zero tonight. Do nothing," he replied. Sure enough, the protest had ended before morning.

In that cold-war era, Huang, with a mixture of cheek and cheer, referred to himself as "Chairman Huang." He was an important presence on campus as chair of the Faculty Association and had earned both respect and notoriety through his confrontations with President Hagey over salaries and benefits for faculty members.

Some other student-led efforts for change were more successful than the winter sit-in. In the classroom, for example, students demanded better communication and teaching from their professors. In response, the Faculty Association sponsored seminars intended to help faculty members improve their teaching methods. The Association sponsored workshops University-wide for several years, until the University assumed leadership by creating the Centre for Teaching Excellence.

Background

In the first 10 years after its founding, applicants to the University from Ontario did so with final year high school (Grade 13) grades that reliably presented the applicant's performance on a set of final examinations that were uniform across the Province and marked uniformly. For each Grade 13 subject, the final examination was set by a university professor specialized in that subject, who also provided detailed marking instructions that included possible solutions and possible incorrect solutions, and the points to be awarded or deducted for partial solutions or errors. That professor, and a selected group of high school teachers of that subject were then put up in Toronto at government expense and marked all the papers that had been written. When a marker came across a solution or error not included in the instruction the professor would be consulted, and modified the marking instructions to include that case, and the modification would be distributed to all markers. An upper tier group of markers would sample the marked papers of the lower tier, remark, and if necessary change grades assigned, communicate the changes and reasons to the lower markers, who would then re-mark papers that needed the grades reviewed. It was a complex system, with every effort made to ensure that marks would accurately represent the student's performance on that examination, no matter what school that student was from. While a one or two point difference in a subject might not be significant, a five-point difference almost certainly was, and as the requirement for university admission was 9 Grade 13 subjects, an applicant's average of those was a good indicator of their academic capabilities.

In the late 1950s and early 1960s the admissions requirements to Engineering at University of Waterloo were a minimum of a 60% Grade 13 average. In practice, few applicants were admitted at the bottom of the 60 to 70% range, but the early classes had most of their students with admission averages in the mid-60s and lower 70s; a grade 13 average of 75% or higher guaranteed a 1st year tuition scholarship, and 80% or more (an Ontario Scholarship) brought one a 4-year tuition scholarship as long as an average above 70% was maintained (as well as $400 from the Province of Ontario; in those days fewer than 5% of Grade 13 graduates had Ontario scholarships). University of Waterloo, the new engineering school in the Province, was offering incentives to excellent students to come and study there, with the predictable results that its early graduates turned out to be excellent engineers, and quickly raised the University's reputation as an Engineering school. Also predictably, admission standards rose, and soon University of Waterloo Engineering, and Chemical Engineering especially, had higher admission requirements than many other Canadian engineering faculties.

In 1967 the Province of Ontario Ministry of Education abandoned the centralized Grade 13 examination system. For a few years it continued with a centrally set examination for Grade 13 subjects, all marked locally in each high school, with that grade being the only grade submitted to universities. After a few years, term work would be combined with the final examination mark, and not long after that, the uniform examination was abandoned by the Province. Thereafter, each school board in Ontario, and in effect each high school, assessed how they were going to determine the graduating grades and an average that would be submitted to the universities.

In parallel with these changes in the evaluation system, the Province moved to a centralized university applications system; students would apply to universities, and programs within universities with a limit of three applications, to the Ontario Ministry of Education. The time frame for these applications moved to earlier in the Grade 13 year, and thus the grades on which the universities had to base their admission decisions became "estimated" grades submitted by the schools based on, effectively, a term and a half, with the proviso that if the applicant didn't at least pass the year, any admissions would be cancelled.

Another parallel trend in the high schools also let "good" students, those who had achieved a minimum term work average (and the minimum gradually decreasing), be excused from writing final examinations in all high school grades. The result was that, across the entire Province a Grade 13 average from one school was not comparable to that from another school, and there were many university applicants who had written few or no final examinations ever. Another implication of this policy was that the submitted "interim" Grade 13 average became the final average.

Despite this, the Faculty, and the Department, continued to admit most of its 1st year students (there were always special procedures for mature students and out-of-province or out-of-country applicants) based on their submitted Grade 13 grades only. Basically, the Faculty and Department admitted students based on their grades, using some statistical methods to account for the likelihood of an applicant registering based on their choices of universities and programs, which effectively established a "cut-off" Grade 13 grade below which an applicant would not be made an offer of admission.

Smoking During Class

During the sixties, when the popularity of smoking cigarettes was peaking, social mores dictated when and where people smoked. Smoking was simply not done in class, but that slowly started to change as students began to feel entitled to exercise their personal freedoms.

At first, a few students began smoking in the back row, where they felt comfortable enjoying their cigarette while the professor taught the class. The practice caught on and soon students were smoking during lectures regardless of where they were sitting. Some lecture halls that could seat upwards of one hundred students experienced a significant change in air quality over the course over a three-hour class. To justify their actions, students noted that professors smoked just about anywhere, so why shouldn't they?

Indeed, the students were right. One popular professor of creative English, for example, chain-smoked his way through lectures to a full auditorium. In Chemical Engineering, a typical departmental meeting might include half a dozen smokers, each lighting a cigarette or two per hour. By the end of the meeting, the room was filled with a smoky haze.

It was an age of permissiveness until a number of committees put the option to smoke to a majority vote. The activity was gradually stubbed out. By the mid-seventies, smoking in committee meetings and classrooms and during student examinations had practically ended.

Prophecy in Don Scott's Office

In 1965, Don Scott, then chair of ChE, was visited without notice by some men from General Electric Research Center in Schenectady, NY. They wished to discuss key components of technology for the next 30 years. They were convinced that, by that
More …

Tenure Policy

The students' dissatisfaction and vocal objections resonated among the professoriate. Universities across Canada were hiring at an astonishing rate, and professors were becoming critical of their conditions of employment. Under Chairman Huang, the Faculty Association was flexing its muscles about teaching loads and salaries.

Within Chemical Engineering, Huang was also a champion for many faculty members who were dissatisfied about having little opportunity to share the decision-making process with the department chair. The department also included dissenters who either failed to recognize or were indifferent to the fact that a department chair faces pressure to acknowledge, promote, and boost the salaries of star performers or risk losing them.

Until the late sixties, Waterloo had had little time to concern itself with a tenure policy for its faculty members. But with many departments now maturing, the Faculty Association pushed for a proper policy. Particularly opposed to tenure were a few senior faculty members in Engineering and Mathematics who denounced tenure as antithetical to robust scholarship. However, after considerable dispute, a tenure policy was adopted at Waterloo in the 1970s.

Stay Awhile

In 1967 then Assistant Professor Tom Fahidy picked up his office mail one morning and found a letter of formal appointment to associate professorship. Pleasantly surprised, he walked into Don Scott's office to thank him and asked if this meant that he now also had
More …

In 1969, on Don Scott's recommendation, Archie Sherbourne, then Dean of Engineering, appointed Don Spink as Acting Chair so that Don Scott was free to serve as Acting Dean in 1969-70. In that year, Scott persuaded the University to hold the first convocation for the Faculty of Engineering only. The following year, Scott was on sabbatical leave after completing his two terms in administration, and Ken O'Driscoll arrived from the State University of New York (SUNY) in Buffalo, NY, to assume the Chair of Chemical Engineering.

Visiting Professor with Tenure

Pete Silveston developed an early reputation as a traveller. Colleagues joked that he was the University's only visiting professor with tenure. His talent at travel inspired Bob Hudgins to pen the following bit of doggerel. Bob notes that since he wrote this stenos,
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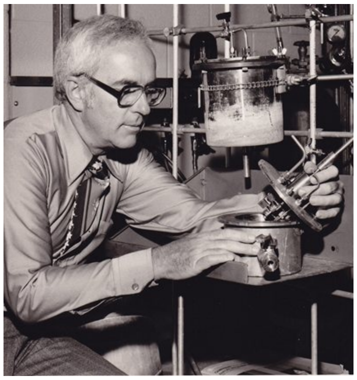
Chapter 5 – Ken O'Driscoll Builds Polymer Research (1970-1976)



Ken O'Driscoll

In 1970, Chemical Engineering's new Chair, Ken O'Driscoll, inherited an excellent departmental structure for research and a somewhat fractious group of 28 professors.

Some faculty were disappointed to see Don Scott leave his position as Chair, especially after his tremendous achievement of building the department from 6 professors to 28 in only 6 years. Others were unhappy that Scott's replacement was brought in from 'outside,' rather than being appointed from within the department. To allay these feelings of dissatisfaction, O'Driscoll introduced a change of leadership style. He viewed the chair as a "first among equals;" a person who made decisions in a transparent style that allowed colleagues to know and understand his reasons.

Initially, O'Driscoll saw no reason to change the research group structure that Scott had established. He simply began a series of chats with each of the department's 24 professors to learn about their accomplishments and aspirations as researchers.

During his administration, O'Driscoll's main changes involved

- Separating the roles of administrative assistant and secretary to the chairman, and
- appointing two associate chairmen, with a shared personal secretary. One of the new associate chairs took on responsibility for the undergraduate program, while the other managed the graduate program.

These changes worked quite well, and a similar organizational structure exists today.

Ruth Verch, who had performed as both administrative assistant and secretary to the chairman, virtually from the beginning of the department, became the administrative assistant. Jim Ford became associate chair for the undergraduate program, while Dave Pei became associate chair for the graduate program.

Only one new faculty member arrived during Ken's tenure as Chair:

- Gerry Mueller, a Waterloo BASc graduate in 1966 and a former president of the students' Engineering Society and of the university-wide Federation of Students, with a PhD from the University of Manchester's Control Systems Centre, and two years at Sir George Williams University's Mechanical Engineering Department, was hired in 1971 to replace Harmon Ray who had left for University of Wisconsin, bring the faculty strength to 28.

Gerry Mueller

From that point forward, the professorial structure of the department remained unchanged during Ken O'Driscoll's six years as chair.

Decisions

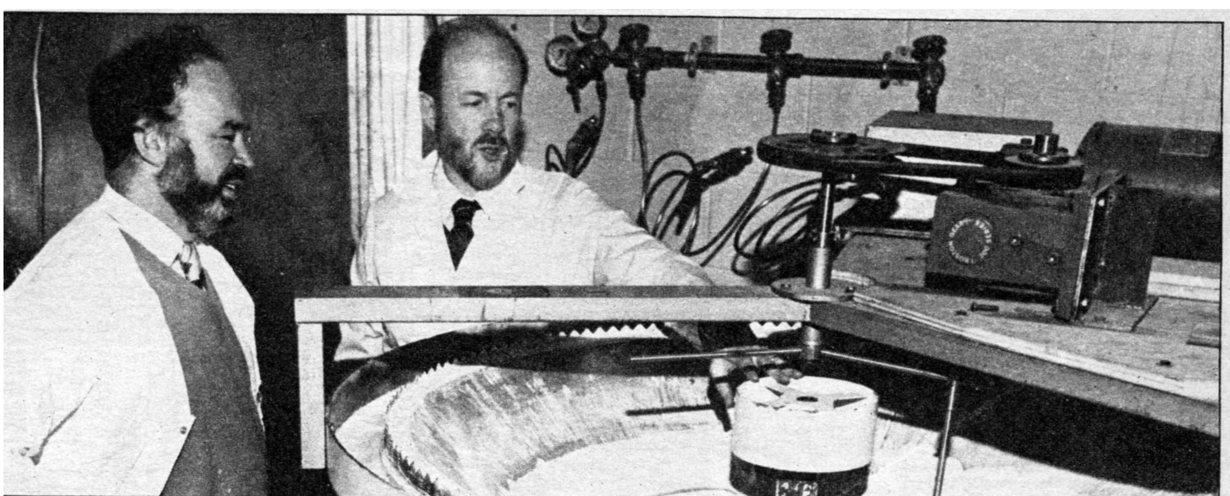
Throughout his tenure as chair, Ken kept in his office a large poster that bore this quotation by author and theologian Harvey Cox: "Not to decide is to decide." It served as his reminder of the chair's responsibility.

By the early 1970s, the explosive growth in the Chemical Engineering department enabled Waterloo to share with the University of Toronto and the University of Alberta the honour of graduating the most chemical engineers of any institution in Canada each year. This accomplishment continues. With enrolment under control, the Chemical Engineering department, like the Faculty of Engineering as a whole, turned its attention to research.

One of the largest research programs, involving two-phase flow in pipes, was conducted under the joint direction of Don Scott and Ted Rhodes. After organizing an international conference and publishing the conference papers in a book, this team began receiving direct financial support from industry, which was a rare occurrence in academia during the 1970s.

Elsewhere, Tom Fahidy was conducting a vigorous program examining electrochemical processing. Alan Turner, with just a few research students, was undertaking meticulous experiments on fluid flow and transport processes in packed beds. John Byerley and Kurt Enns launched a program focused on ion exchange processes. The reactor engineering group discovered that periodically flushing a catalyst bed with an inert gas at the proper flushing frequency increased reactor productivity.

Research on periodic operation of reactors occupied the attention of Bob Hudgins and Pete Silveston up to their retirement at the end of the 20th century. Their team also became involved in clarifier behaviour after noticing that an abrupt increase in solids loading or flow rate caused density currents. Placing baffles in a clarifier apparently offered better performance, but this was never proven in an actual plant, and the project eventually terminated from lack of funding. The photo below shows a laboratory model of a baffled clarifier.



Peter Silveston, left, and Robert Hudgins test a laboratory model of their sewage settling tank.

Pete Silveston and Bob Hudgins, bearded per the fashion of the day, viewing their laboratory clarifier unit. This photo has been copied from a 1982 issue of the "Today Magazine," which was a syndicated weekend supplement that appeared in many Canadian newspapers. The brief article accompanying the photo was titled "Don't Make Waves" and describes the researchers' use of baffles to trap density currents or density waves.

Creative Grading

Tom Fahidy, now a Distinguished Professor Emeritus and Fellow of the Royal Society of Canada, Chemical Institute of Canada, American Institute of Chemical Engineers and Electrochemical Society and Canadian Academy of Engineering, had been teaching for
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Institute for Polymer Research

While chair duties had cut into O'Driscoll's research, polymers, which were his focus, became a major departmental activity. So, in 1977, when he was no longer chair, O'Driscoll joined with Alf Rudin of Waterloo's Department of Chemistry to form the Copolymer Group that later morphed into the Institute for Polymer Research (IPR) under their shared direction.

The IPR included several other chemical engineering professors interested in polymers, including van der Hoff, Burns, and Huang, as well as several others from chemistry. Their research and development interests spanned polymer science, polymer engineering, and polymeric materials, ranging from monomer/polymer synthesis, polymer production technology, polymer property characterization, polymer processing, and reactive modification of polymers.

The IPR celebrated thirty years of official Institute status in 2014. It continues to conduct applied and fundamental research in areas of vital interest to the plastics, coatings, adhesives, and elastomers industries. Nearly 100 researchers work in such diverse fields as molecular weight characterization, thermal characterization, emulsion polymerization, polymer processing, polymerization kinetics, copolymerization, reactive extrusion, polymer-based catalysts, polymer photochemistry, and development of new monomers and polymers.

Over the decades of its existence, the institute has facilitated collaboration on industrial research projects with companies in Canada, the US, Europe, and Asia.

Several years after its inception, IPR helped to create with the chemistry department a joint graduate program that led to further growth in polymer research at Waterloo, including participation in Ontario's Centre of Excellence program, which provided funds for a lot of necessary equipment.

Alumni Presence in Tokyo

Y. "King" Horiguchi was one of the first Japanese graduate students to join the Chemical Engineering department in the early 1970s. He undertook with Pete Silveston and Bob Hudgins PhD work dealing with surface migration on a catalyst support.
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Gerry Sullivan: Co-op Interviews – A Blood Sport

During the early 1970s, Gerry Sullivan was in the second year of chemical engineering at Waterloo. He studied chemical engineering operations, chemistry, and calculus with Professors Hudgins, Rempel, and Reilly respectively.
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Mueller et al. - Our Men in Havana

In 1972, Gerry Mueller, a young Assistant Professor of Chemical Engineering, found himself in a meeting with the Dean of Engineering, Archie Sherbourne, and two other Deans of Engineering (Toronto and UBC), a representative from Canadian University Service Overseas (CUSO) who was that organization's "Field Officer" in Cuba, a representative from the Canadian International

Development Agency (CIDA), and the "Educational Attaché" from the Cuban Embassy. CIDA had been tasked by Ottawa with developing graduate education assistance programs in Cuba where CUSO was already running small-scale educational projects. The Cuban request was for assistance with re-starting a graduate program in Engineering at the University of Havana's new Technology campus, Ciudad Universitaria Jose Antonio Echeverria (CUJAE – a Spanish acronym pronounced Ku-Hi). After the Cuban Revolution, the country had lost almost all its engineering faculty.

The Cubans realized that any credible engineering graduate studies program would have to be based on North American technology and science. Likely, the isolation brought about by U.S. foreign policy would require their technological education to be updated. The proposal was simple: would the three Canadian universities partner with CUJAE, with CUSO acting as the overall project manager and find educators for CUJAE's course needs, with CIDA providing generous funding. Also, the students in the program would need to be able to do research in facilities not available in Cuba, and Canadian labs and supervisors would have to be found in the future.

Partly because of Waterloo's co-op program that staggers its professors' teaching duties throughout the calendar year, Mueller was selected as the volunteer for the trial Cuba program. As he put it, "No" was not an acceptable answer. Dean Archie Sherbourne of Waterloo gave the orders: "Here's $2000 (1970 funds); with that you have to get yourself to Cuba and back and pay for everything you need to teach your course. The usual undergraduate textbooks are available in Cuba but anything at the graduate level is not. You will have about 20 students, their English is fairly basic so you'll need to provide written notes. All your expenses in Cuba will be covered. Any money left over is yours. And we want a report, with recommendations, whether this can work, or not."

So, Mueller arrived in Cuba in January 1973 for a one-month sojourn of teaching graduate level Process Dynamics and Control, which ended with a recommendation to the three deans that the project should continue (being officially named the CUSO-CUJAE Project).

As the University of Waterloo "Coordinator", he was tasked with finding professors for the Cuban departments of Mechanical, Electrical, and Industrial Engineering. Mueller had a nodding acquaintance with the first two and ended up learning a lot about the third. He developed the parameters of what was expected, and what would be given to professors who taught in the project; this was not a difficult task. Typically, perhaps after consultation with deans or department heads, he would phone someone, and tell them that he had an offer that would be difficult to refuse. Go to Cuba for a month, during later Fall, Winter, or early Spring, all expenses paid plus a generous honorarium; teach three hours in the morning, your afternoons are your own, you will live in a mansion, with your own bathroom, a cook and housekeepers, there will be two VW Beetles at the disposal of whoever is in Cuba during your time (at most 3 others), once a week you will dine at some historic Havana restaurant (Copacabana, La Bodegita del Medio, La Floridita), and at least for one weekend you will be at a Cuban resort, probably Varadero, but also some others in the mountains near Havana.

For invitees this was a great hit (as it were). As Mueller noted: "Hell, I had to beat them off with a stick!" While a significant number of engineering professors from Waterloo participated, only one other from Chemical Engineering, Park Reilly, taught Probability and Statistics in Cuba.

In the last two years of the CUSO-CUJA Project, Cuban students started coming to Canada, to work in the labs of professors with whom they had developed a research project. Typically, they would come for 3 or a maximum 4 months. Sometimes they would be billeted with the professor supervising them (who would be paid room and board), but most often we would try to accommodate them in student residences. For practical purposes, only professors at the three primary universities participating (UBC, Toronto, Waterloo), would be able to supervise, because at other universities there would be no infrastructure in place to deal with their needs and problems. At Waterloo at least, because of the co-op programmes, residence space was available in the Winter and Spring terms, therefore a fair number of Cubans would come in January! Mueller became adept at wheedling winter clothes and boots fromwho his colleagues.

An overarching worry, however, was getting Cubans here and back. Having to fly them through Mexico City, to Toronto or Vancouver, they would be overflying the United States. Whenever we had a group, coming up or going back, Mueller would be fervently praying that the CP Air flight would not have a mechanical failure that would require landing in the U.S., because the Cubans would promptly be arrested as illegal aliens! And none of us knew how that would end! As with many a worry, that circumstance never occurred.

The program lasted for some six years and produced a significant-number of excellent Cuban graduate students capable of becoming teachers at university level and conducting graduate studies themselves. In the early 2020 CUJAE ranks in the 1001-1200th range of world universities, which, given the handicaps under which Cuba functions, is commendable.

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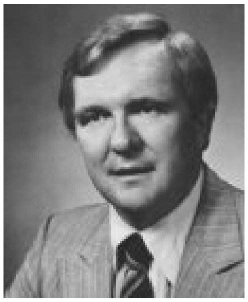
Chapter 6 –Ted Rhodes Targets Excellence (1976-1987)



Ted Rhodes

Ted Rhode's three and a half terms as the chair of Chemical Engineering were happy years for himself and the department. Don Scott's design of the department into research groupings and Ken O'Driscoll's astute management came to fruition in terms of huge outputs of research findings, high-quality graduate courses, increased competition for admission of talented and innovative graduate students, and smart and enthusiastic undergraduate students. The department's reputation for excellence was growing. So many people applied for the limited number of undergraduate places in chemical engineering that many of them had to be turned away.

External Changes Force Revisions to Admissions Policies

The Problem

Lou Bodnar (1984)

By the late 1970s Louis Bodnar had become Director of Admissions for the Faculty of Engineering (although by that time Chemical Engineering had also made its Associate Chair-Undergraduate Studies the Admissions Officer for the Department). Effectively, Bodnar did the admissions work for the general first year program, while the Department did the admissions for its own first year, which differed from the others by two specialized courses, ChE 100 and ChE 101, in the first and second term of Year 1 respectively.

In probably later 1982, after offers of admission had been mailed out. Bodnar received a telephone call from a father expressing surprise that his son, who had an average of 80 percent, had not received an offer to study in engineering. Bodnar could only explain that the cut-off was greater than 80 percent. A day later, the principal of the applicant's school called, and Bodnar gave him the same explanation. The principal's response was: "but my school has higher marking standards than a lot of other schools." Bodnar could only admit that, while that may be true, he had no power to change the requirement.

While high demand for spaces in the undergraduate engineering programs forced the Faculty to turn away large numbers of prospective students, it also provided some helpful reassurance that the Faculty was on the right track in providing students with the education they wanted. On the other hand, alarmingly high first-year attrition rates experienced in the Faculty and Department were not encouraging. They prompted careful consideration about causes of the problem and possible solutions.

From comments like the one from the principal whose school had high marking standards to evidence that some high schools did a better job than others of preparing students for the rigors of engineering studies, it became clear that the University needed to reassess the way it evaluated applicants.

When Bodnar expressed to the Dean of Engineering, Bill Lennox (Dean from 1982 to 1990), his opinion that the Faculty could be doing better than using only the interim average for admission, Dean Lennox suggested that Bodnar take on the job of making it better. Bodnar accepted the challenge to develop a system that would grant admission to those students who had the best chance of success, After consultation across the Faculty and the University, Bodnar introduced what became known as the Frunch Factor and identified other challenges to the admissions policies of the time.

Frunch Factor

The Associate Dean-Undergraduate Studies of Engineering, George Soulis, and Bodnar created a process that used data from about 600 Ontario high schools to analyze the performance of first year students and determine if there was, indeed, an obvious difference in the way high schools were grading their students and, if so, what effect this had on first year university grades. Named after the '**F**reshman C**runch**' phenomena, which sees a student's first-year grades drop below what they had received in high school, their calculations became known as the Frunch Factor.

Effectively the Frunch factor is calculated as the average grade drop for a student from a school (from which some minimum number had come into Waterloo Engineering over the past five years) between their submitted Grade 13 estimated average and their average at the end of 1st year. It is computed as a rolling average, over five years, with later years being weighted more heavily than earlier years. There were other complications, to take care of anomalies, but the principle is obvious.

When the Faculty of Mathematics joined the Faculty of Engineering in implementing the process, the rate of data accumulation more than doubled. Bodnar recalls that the University of Toronto also adopted the process, but did not share their data, and that Queen's University expressed interest in using it. The final Frunch factor is applied to each applicant based on their high school and offers of admission are based on that adjusted grade. In practice only about 80% of first year students were admitted on that "frunched" basis, the rest were selected on criteria for mature students, out-of-province applicants, and for Ontario applicants eventually on evaluating a questionnaire they submitted. Details may be found below.

Ontario Scholars

In the 1950s, the Ontario Ministry of Education gave Ontario Scholar awards to students with an average of 80% over seven of their grade 13 courses. In the early 1960s, only three percent of graduating students were Ontario Scholars. By the early 1980s that percentage had risen considerably, and now, in the early 2020s, it is around 60%. In parallel, the Ontario government has reduced the original $400 (in 1960 dollars) to $100, and now to just a certificate.

On another visit to Dean Lennox about admissions, Bodnar explained that Waterloo's current admissions guidelines were denying admission to about 500 Ontario Scholars and 50 applicants with averages above 90 percent who wanted to attend popular programs like Electrical Engineering. Just from a public relations point of view, this could not be supported, but it was more than that, it was a waste of human potential.

Supporting Success

Lou Bodnar recognized that all engineering students faced an onerous study schedule, and he was determined to help them succeed. He noted that the Dean of Engineering at the University of Toronto addressed each incoming class with this advice: "Look to your right and look to your left. One of you won't be here next year." If you ran a factory with this attrition of product, Bodnar noted, you would be fired. In the sixties, however, Waterloo's engineering attrition level was no better: the first-year failure rate was at least 35 percent.

To address that problem, Bodnar implemented new admissions requirements, including higher admission averages and first-week preparedness tests in mathematics and physics. Based on results in these test, the student's program was modified to remedy deficiencies with special lectures. He also suggested that the faculty consider more than just a prospective student's marks.

Personal Information Forms

Bodnar suggested that, in addition to the Frunch factor adjusted average, University of Waterloo Engineering should consider students' personal characteristics. Peter Roe, the Associate Dean-Graduate Studies, investigated how some American schools handled their admissions requirements and used that information to produce an 18-question 'Personal Information' form that all applicants submitted.

As standard practice, Bodnar for the Faculty, and the Chemical Engineering Associate Chair-Undergraduate Studies read all of these forms, looking for evidence of:

- Commitment (e.g., plays competitive sports)
- Entrepreneurship (e.g., took the initiative to start small businesses, e.g., lawn mowing)
- Leadership (e.g., started a youth group supporting a political party)
- Other evidence of ability to succeed academically

About 20% (less those admitted from out of province or mature students) would be made offers of admission based on this evaluation.

Recipes for Success

Bodnar's curiosity about student grades and achievements extended beyond the Frunch Factor analysis and personal information forms. He was interested in learning what made some people more successful than others in their studies. Sometimes, the facts produced interesting conclusions.

Once he noticed that a summer class of civil engineers, who had an admission average of 80%, had 1B grades higher than those of the mechanical engineers, who had an admission average of 86 percent. He was surprised.

This had never happened before, and he wanted an explanation. The only clue was evidence of one keen civil engineering student with excellent organizational skills. She regularly organized her classmates with: "OK you guys, we're going over to Pete's place tonight to work on Physics problems." It seemed that her enthusiasm and persuasiveness benefitted the entire class.

Mature Students

Bodnar introduced the following rules for those applying to engineering one year or more after high school graduation:

- one year after finishing high school graduation: repeat calculus and algebra
- two years after high school graduation: repeat calculus, algebra and physics
- three years after high school graduation: repeat calculus, algebra, physics and chemistry

He made these onerous chores palatable by guaranteeing, in writing if desired, admission to applicants who met a specified minimum average in their courses.

The pace in engineering is fast, he noted. To succeed, students must have strong foundational knowledge. Without it, they won't understand the professor's lectures, won't have time to catch up, and will quickly become discouraged, which leads them to quit. Repeating high school courses also gets mature students back into a study mode, which is a discipline that few can turn on overnight.

In many universities, the failure rate of mature students in first-year engineering far exceeds the rate among the rest of their class. At Waterloo, however, mature students often outperformed their classmates.

Bodnar’s Creative Admissions

Bodnar, as Director of Admissions for the Faculty of Engineering, not only created policies of mature student admissions, he also was creative in individual cases, unlike the practice at other Ontario universities at the time.
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Teaching Excellence

Undergraduate teaching has always taken paramount importance in the department. Each year, students are asked to assess their teachers and share their feedback. In the past, these assessments were considered alongside colleagues’ input to determine salaries and promotions. These processes were an important integral part of the departmental culture.

Park Reilly (1986), Alex Penlidis (1994), and Mark Pritzker (2016) have all received the Distinguished Teacher Award from the University’s Centre for Teaching Excellence.

One of the consequences of initiating student assessments of teaching competence was that a small minority of faculty members received consistently negative reviews. While this created a problem for the affected faculty member, it created an even more difficult problem for the incumbent chair. The problem could be addressed on a case-by-case basis only, and there were no easy solutions.

Research Activities Flourish

When Rhodes took over the chairmanship in 1976, exciting research in all of the various groups of the department continued to bear fruit. Many professors and their graduate students were making important new discoveries and developing new technologies.

For example, in polymers, Garry Rempel was attracting support from industry for his work on rare metal catalysis in polymerization. In bio-chemical engineering, Murray Moo Young’s group was developing new processes for making animal feeds from cellulose of all kinds. Gerry Sullivan’s group was developing instrumentation and process control systems for both coal-fired steam generators and grain dryers. Bob Hudgins and Pete Silveston, who had pioneered the periodic operation of chemical reactors, had received inquiries from several corporations.

This is just a small sampling of the large number of new technologies that were emerging at the time. It seemed as if new discoveries were being made every week.

Commercialization of Innovative Ideas

In the 1970s, there was much discussion across Canada about the need for universities and industry to collaborate and for researchers’ inventions to be transferred to Canadian companies that would then capitalize on the innovation, for the good of the country.

At that time, a crown corporation called Canadian Patents and Development Limited (CPDL), established in 1948, managed the commercialization of intellectual property that resulted from research subsidized by government funding. In the end, the fortunate inventor whose work was commercialized would receive only a minor share of any net profit that his/her research generated. Not surprisingly, chemical engineering researchers were hesitant to get involved with this organization, despite the quality of their inventions.

Waterloo Centre for Process Development

Recognizing that the department's many wonderful inventions might never be put to good use under the existing commercialization process, Ted Rhodes began looking for new ways to transfer the technology to the outside world. There were many obstacles, however, including the

- lack of patents to protect the technology,
- absence of funds to acquire patents, and
- time for and knowledge about marketing to and negotiating with external entities that could derive commercial benefit from the technologies.

Peter Melnichuk

Thus, in 1977, it was with considerable excitement that the department accepted a $1 million grant from the Government of Canada to create the Waterloo Centre for Process Development (WCPD). The centre, based in the Chemical Engineering Department, had the sole purpose of enabling the development, protection, and transfer of new technology from the department to industry. It attracted a voluntary advisory board of senior research executives in industry and appointed a manager, Peter Melnichuk.

After several years, when Melnichuk moved to a new role, E.B. (Ted) Cross was appointed manager of the WCPD.

Ted Cross

Cross was recommended for the position by Pete Silveston, who had worked as a consultant to the small chemical company in Sarnia, Ontario, that Cross co-founded and operated. The successful company was based on technology licensed from academia, and Cross demonstrated a keen understanding of the relationship between industry and academia. He was superbly fitted for the position at Waterloo.

With Cross' expertise, the WCPD supported a new phase of product commercialization through patents, licensing, and industrial research grants. In addition to providing chemical engineering professors and students with expert advice on patenting their inventions, the WCPD provided previously unavailable financial support to cover the costs associated with the patent process.

Professors had assistance to make contacts with industry and license their intellectual property. The WCPD also negotiated industrial research contracts, many of which assigned intellectual property rights to the professors who had used their expert knowledge to solve industrial problems.

During this period, WCPD negotiated 18 international licenses with the private sector. License fee earnings amounted to $2 million, and the business activity increased since then.

In recognition of this success, Excellence Canada, created by Industry Canada, awarded WCPD three Canada Awards for Business Excellence:

- 1984: Silver with Envirocon Limited for the SCP Bioconversion Process
- 1986: Bronze with Canadian Farm Tec Systems for computer-assisted grain dryer control technology
- 1987: Gold with Polysar Ltd. for an improved hydrogenated nitrile rubber catalyst system

With assistance from WCPD, The Department of Chemical Engineering developed 25 technologies that were protected by more than 103 patents. Twelve of these technologies were licensed to industry for commercialization.

Furthermore, WCPD entered more than 100 research contracts with industry and 6 of those led to licenses that provided the inventors and University a share of the potential post-commercialization benefits.

Research and development flourished enormously during this time. The research groups were strengthened by the addition of promising new young professors:

- Gerry Sullivan (1981), with a PhD from Imperial College, who had been a classmate of Peter Douglas and John Chatzis at UWaterloo, and after his PhD worked at Imperial Oil installing advanced computer control and scheduling optimization applications
- John Chatzis (1982), who was also a Waterloo graduate and brought expertise in flow in porous material
- Ray Legge (1986), a plant biologist by training from University of Calgary with a PhD in biology from UWaterloo, added his knowledge of biology to biochemical research
- Alex Penlidis (1986) completed a 5-year diploma in chemical engineering at Aristotle University of Thessaloniki, with a PhD from McMaster University, brought proficiency in modelling of polymeric reactions.


Gerry Sullivan


John Chatzis


Ray Legge


Alex Penlidis

These new faculty members helped form the Advanced Process Control and Simulation group, whose environment and culture attracted industrial support for the department. For example, IBM made a $2 million donation of hardware and software comprising their ACS - Advanced Control System. Only two other universities world-wide received similar donations Purdue University (USA) and Imperial College (England). That system was used for both research and undergraduate teaching of advanced process control.

Biochemical Engineering Thrives


Murray Moo-Young with Toyoshi Hirose, his 1st Graduate Student

When Waterloo's Department of Chemical Engineering was organized and during its first decades, there was little biotechnology activity in Canada. This picture changed rapidly.

One of Waterloo's foremost research groups was related to biotechnology. It originated with Don Scott, who brought three bio-oriented faculty members into the department, starting with Murray Moo Young in 1967. Jeno Scharer arrived the following year, and Cam Robinson joined them in 1970. Their combined expertise in transport phenomena, rheology, and biokinetics laid a solid foundation for the group's teaching and research.

Cam Robinson and Jeno Scharer developed an effective undergraduate program that consisted of electives for a biochemical engineering option: applied biosciences, fermentation engineering, and food processing. The team also organized a slate of graduate level offerings.

During its first decade, the biochemical group developed various associations, including one with UNESCO. Indeed, UNESCO sponsored the research group's microbial resource centre. By the end of the decade, the group had trained more than 35 visiting scientists and engineers from several developing countries, including India, Nigeria, China, Cuba, Iran, Yugoslavia, and Malaysia.

Biochemical Engineering Research Group in the 1980s [Jeno Scharer-front row, 4th from left; Cam Robinson-middle row, 3rd from left; Murray Moo Young, 3rd row at right]

After 1976, the biotech group's most noteworthy milestone was its leap into industrial research contracts and consulting. The impetus was provided by the Waterloo Centre for Process Development, which generated sufficient funds from industry and government sources to enable the development, design, and installation of a semi-commercial plant in Vancouver for the manufacture of proteinaceous animal feed based on a process invented in the group.

About this time, the undergraduate chemical engineering curriculum was revised so that Waterloo became the first Canadian university to have biotechnology as a core course in its chemical engineering program.

By the end of the Rhodes years and in the bio group's third decade, Cam Robinson became the director of a new campus-wide organization called the Biotech Research Centre. Shortly thereafter, an NSERC Industrial Research Chair in Biochemical Engineering was established in the department and occupied by Murray Moo-Young. The creation of this chair enabled the department to hire a new faculty member: Ray Legge brought the in-house bioscience expertise necessary to help the group modernize its activities.

The development of Waterloo's biochemical activity in the Faculties of Engineering and Science was matched by the growth of the bio and medicinal industries in Canada. When Garry Rempel assumed the chairmanship of Chemical Engineering, the department's team of biochemical faculty and graduate students vied to be the largest research group in Waterloo's Chemical Engineering department and, indeed, in all of Canada's academic institutions.

While some of Waterloo's early chemical engineering graduates went to the US to improve their career prospects, many biotech grads found excellent employment opportunities in Canada, at companies such as Connaught Laboratories, Apotex, Biomira, Molson Brewery, and Canada Packers, to name a few.

Flora Ng

ChE Welcomes First Female ChE Professor in 1987

Before he left the University of Waterloo in 1987, Ted hired Flora Ng from a senior federal government research position at Energy Mines and Resources, Ottawa, to join the department as an associate professor. Flora was the first woman to be hired as a chemical engineering faculty member.

An Expensive Free Computer

Ted Rhodes and Gerry Sullivan visited London, England, with the goal to secure a gift of hardware and software from IBM for the Department of Chemical Engineering. After two days of negotiation that ended with a $2 million donation, the Waterloo contingent
More...

Ted Rhodes Answers the Siren Call of Industry (But Not for Long)

In the fall of 1986, Ted Rhodes announced at a departmental meeting that he would resign to pursue a new industrial role with Polysar Ltd., formerly known as Polymer Corp. and before that as the Government-owned Canada Development Corporation.
More….

Curriculum Development

By the end of the 1980, the Faculty of Engineering had developed a structure for an options program. This allowed a student to pursue a program of courses leading to relative expertise in an area of engineering or engineering applications. This option would appear on the student's transcript, but not on the degree awarded.

Of course, a student had to receive permission from the ChE Undergraduate Chair to pursue an option. Since an option always meant carrying at least one extra course in an on-campus term, the Undergraduate Chair had to consider whether an extra course could lead to failure in the regular program courses.

The Engineering options in 1991, for example, were Mathematics, Physics, Computer Science, and Statistics; while those in Applications were Water Resources and Management Science. Additional options were Studies in Society, Technology and Values, and International Studies in Engineering.

The Faculty of Engineering decided not to implement a major-minor program because of the difficulty of harmonizing a co-op timetable with a non-co-op one. For a ChE student to pursue a minor would require several additional on-campus terms and would fit in poorly with the Co-op system. It is rarely attempted. However, other Waterloo programs do offer such major-minor structures.

For those students pursuing just the regular ChE program, some breadth of study is necessary to function successfully as an engineer. It is also required by the Canadian Engineering Accreditation Board. The non-technical course package, one elective course per term, from a large list of courses in Arts or some Sciences, was devised to meet this goal.

Cheaters Do Not Prosper

In the late 1970s and early 1980s, when cheating during exams became in vogue, faculty members developed their own strategies to fight back.
Tom Fahidy created two exams: A and B. Without mentioning his strategy, he
More..

An Experiment in Chemical Engineering Entrepreneurial Education

In 1974, following a review of university-level graduate engineering programs by an Ontario Engineering Accreditation Board, it was suggested that one university add a graduate course in business, process economics, or management. Because such a course had not been traditionally available to engineering students, its appeal and likely chances of success were unknown. Since Waterloo is closest to the industry, they suggested that UWaterloo do it. Co-op made it a good fit.

Ted Rhodes, then chair of the department, thought that UWaterloo might be an ideal place to offer such a course, so he asked Don Scott if he would be willing to undertake an experiment. Scott thought that such a course might add some degree of practicality to students' research, so he agreed. This was a trial to explore how a course in entrepreneurship would be received.

Graduate students recognized that, should their research lead to useful ideas or inventions with potential commercial value, they needed the background knowledge to assess the idea, or to know what do with it or where to go with it. They were particularly interested in courses that might help them sell ideas or set up businesses based on their ideas.

The entrepreneurship course was offered for the first time in the winter semester of 1975. It was intended as a graduate offering but, as an afterthought, was made available as an elective for senior year undergraduates as well. The first class assembled for this new course included 5 graduate students and 45 fourth-year seniors, which was about three-quarters of the graduating undergraduate class.

The course's popularity led to students from other engineering departments asking to enrol and requests for it to be held in the evenings to simplify scheduling. With those changes in place, 130 students enrolled in the second offering of the class in 1976. This was unmanageable for what was partly a seminar course. Therefore, enrolment in the third offering, in 1977, was limited and preference was given to chemical engineers. Nonetheless, 73 students were enrolled and a number were turned away.

The course designers acknowledged that students needed to learn more than could be taught in a one-semester course. Therefore, they covered a range of subjects in a once-over-lightly way. Many called it an "awareness" course. They aimed to give students the information they needed, with no large gaps of ignorance, to start a new small business or sell a new idea.

At the time, teaching entrepreneurship to engineers was a novel concept in Canada, and no textbooks on the topic existed. With the aid of a grant from the Department of Industry, Trade and Commerce (under Minister of Trade and Commerce of the day, Jean Chrétien), Don Scott, with the help of a management consultant named Ron Blair, produced for the course a text called "The Technical Entrepreneur." It was ready for use in 1978.

The course incorporated guest lecturers for special areas, as much as possible. For example, patents were discussed by patent agents, venture capital was taught by a venture capitalist, business plans were presented by management consultants, etc. The small business community provided exceptional support for and contributions to this course.

In the fifth year that chemical engineering offered this course, the dean of engineering acknowledged the strong student demand and made it available to other engineering departments.

Students in the co-op system understood the range of their educational needs, including small business enterprise and innovation. Their demand for courses to give them the entrepreneurial background they needed to move their research to market was almost entirely responsible for expanding the definition of an engineering education at Waterloo.

Another Experiment in Education—Self-Paced Learning

Fads regularly sweep into Canada from the United States. They flourish on our soil for a while before, eventually, being adopted or fading away. This pattern happens in fashion, to be sure, and, oddly enough, in engineering education as well.
More…

O'Driscoll Works "with" Xerox

In the fall of 1979, Ken O'Driscoll received an unusual invitation to become a manager at the Xerox Research Centre (XRC) in Mississauga. The position was offered by an old friend, Bob Marchessault, who was then VP and director of the research on materials in
More…

Chemical Engineering – a female fave!

During Rhodes' tenure as chair, he made considerable effort to attract female undergraduate students into a department that had been strictly male. The number of women in chemical engineering increased as a result, but progress was slow. It was the turn of the century before the department had a cohort of women large enough to represent a normal ratio of the sexes. This under-representation was common in Canada. As late as 2014, female students represented less than 35 percent of the chemical engineering students in Canada.

In the fall of 2017, 43% of the first-year students in Chemical Engineering were women. Even as late as the seventies, women in engineering were ground breakers in a discipline that was not welcoming to women. Perhaps the mere lack of facilities for women in the department was a good indicator of both the mindset of the time and the challenges that women needed to overcome. DWE had one keyed washroom for female staff and graduate students. Even more than ten years after the University began, female undergraduates had to walk from DWE to the engineering building next door to find a ladies' restroom! A small group of female undergraduate students spoke with Rhodes directly to address that problem. In response to their request, the department converted one of the men's restrooms into a ladies' restroom. A few guys who had trouble adjusting to the loss of their monopoly grumbled at the change.

Peter Douglas Returns "Home"

Every several years a group of remarkably talented students finishes the ChE program. In 1974, Pete Douglas, was a member of such a group. He stayed on in the Department to take MASC and PhD degrees under the tutelage of Francis Dullien and Don Spink.
More…

Bob Hudgins—Interim Chair 1987

When Ted Rhodes left in 1986, the search for a new chair began and concluded with the selection of Garry Rempel. However, since Garry was on sabbatical leave for the period 1987 to January 1988, Bob Hudgins agreed to serve as interim chair during 1987.

Chemical Engineering Artists

There was a fateful Faculty members' New Year's Eve (year unknown) party at the Faculty Club. A few drinks had been imbibed and all was getting merry, to say the least. Rhodes was enjoying dancing with Mrs. Ethel Fahidy when a proposition was made. As a New Year's
More…

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Chapter 7 – Garry Rempel Brings Waterloo's Chemical Engineering Department an International Reputation (1987-1997)

Gary Rempel

In the seventies, Waterloo had achieved a reputation as one of Canada's leading chemical engineering departments. In the late eighties and early nineties, members of the department looked for recognition on a world scale. For this, the sense was that the department needed at its helm someone with an established international reputation.

Garry Rempel's pioneering work on hydrogenation of nitrile rubbers, begun in the early 1980s and applied industrially in the following years, generated much favorable publicity for his research team. That image reflected positively onto the chemical engineering department.

By the late 1980s, Rempel's work on the production of high performance elastomers via processes catalyzed by transition metal complexes had been granted a number of patents. Having won several prestigious awards and established himself as a major world figure in academic polymer research, Garry was the obvious choice for the chairmanship. He took over this role when Ted Rhodes left the university for industry.

Retirements

Rempel took on a department in a state of flux. With much of its initial hiring having taken place in a short time, it experienced waves of multiple retirements in close succession.

The first wave of retirements took place before Ted Rhodes left his role as chair.

- 1983: Ted Batke, the department's first chair, formally retired.
- 1985: Ben van der Hoff
- 1985: Alan Turner

A year after Rempel assumed the chairmanship, the second wave of retirements began.

- 1988: Don Spink took early retirement to lead Turbotak, a company he co-founded with Francis Dullien to exploit Dullien's gas cleaning technology.
- 1988: Gerry Mueller left the Department after ordination in the Anglican Church of Canada but returned in Winter 1989 as an adjunct professor. Thirteen years later he returned to Renison University College as Chaplain and Lecturer in Religious Studies. Mueller finally retired from UWaterloo in 2006, but then did a further year as an adjunct professor supervising international study seminars with a social work professor.
- 1989: Park Reilly formally retired, but continued teaching, consulting with industry and counselling graduate students as though no milestone had been reached.
- 1989: Don Scott formally retired, but he maintained research activity in the department for some years afterwards.
- 1990: Incapacitated for almost a decade by illness, Kurt Enns finally resigned. Sadly, he died as a recluse the same year.
- 1991: Brian Jacobsen, who was collaborating with Gerry Sullivan on systems engineering projects as an adjunct professor, died tragically in his sleep.

- 1991: Gerry Sullivan resigned to take on the CEO position of Dantec Systems Corporation, a company founded on nonlinear process control technology developed in the department. Gerry later served on the Board of Governors (1999- 2005)
- 1992: Carl Gall retired.
- 1992: Dave Pei retired and several years later returned to his family home in Shanghai.
- 1992: Kun Soo Chang resigned after 25 years to accept a professorship at Korea's Pohang University. He became Dean of Engineering at that university some years later.
- 1994: Don Scott formally retired, but he maintained research activity in the department for some years afterwards. The university recognized his accomplishments and service by ceremoniously designating him a Distinguished Professor Emeritus.
- 1994: Louis Bodnar retired.
- 1995: John Wynnyckyj retired.
- 1996: Jim Ford retired after many years of service.
- 1996: Ken O'Driscoll retired and was awarded the title of Distinguished Professor Emeritus shortly after his retirement.
- 1997: Pete Silveston became a Distinguished Professor Emeritus two years after retirement.
- 1998: Cam Robinson, Francis Dullien, and Bob Huang retired.

The Burgess Shale

Once posted on the door of the retirees' room:

Welcome to the Best of the Burgess Shale*

Beneath a slump of papers and old notes
More…

The department certainly needed new academics to keep its teaching and research viable.

The first three positions were filled while Rhodes was still chair, leaving Garry to fill three positions in his first two years in the position, which he did to the great benefit of the Department:

- Peter Douglas, a UWaterloo graduate and member of one of chemical engineering's stellar classes, was lured back to Waterloo in 1988 from an appointment at Queen's University that he took up after completing his PhD at Waterloo under the tutelage of Francis Dullien and Don Spink.
- Tom Duever, another three-degrees graduate of Park Reilly and Ken O'Driscoll's star research students, was hired as an adjunct and became a full-time faculty member in 1989.


Peter Douglas


Tom Duever

- In 1988, a NSERC Industrial Research Chair in Biochemical Engineering was established in the department for Murray Moo Young .
- Creation of this Chair brought in Ray Legge as a faculty member as a complementary hire. Ray Legge (1986), a plant biologist by training from University of Calgary, with a PhD in biology from University of Waterloo, added his knowledge of biology to biochemical research.

In addition to retirements, the Faculty of Engineering, recognizing growth in the graduate program, granted the department the following additional positions:

Flora Ng

- Flora Ng, who completed a BSc in University of Hong Kong, studied catalysis at University of British Columbia where she completed a PhD. She left a senior federal government research post in Ottawa to join the chemical engineering department as an associate professor in 1987.
- Mark Pritzker, who came to UWaterloo with a BEng from McGill University, a MS from University of California in Berkeley and a PhD from Virginia Polytechnic, was recruited from a position in the US to supplement the research activity in electrochemical engineering in 1990.
- Rajinder Pal arrived with a BTech from Indian Institute of Technology, Kanpur. He completed a PhD in the transport group in 1987 under Rhodes and Scott. He was appointed assistant professor in 1991.
- Bill Anderson, a three-degrees UWaterloo graduate, was hired in 1993 to address environmental aspects of biochemical engineering.

Additional retirements (Francis Dullien, Ken O`Driscoll and Pete Silveston) opened up more positions late in Garry's tenure as chair. These were

- Hector Budman, with three degrees from the Technion-Israel Institute of Technology, filled the process control and simulation position that opened with Gerry Mueller's departure in 1994.
- Costas Tzoganakis, with a Dipl. Eng. from Aristotle University of Thessaloniki and a PhD from the strong polymer group at MacMaster University, he added significantly to the polymer engineering group, beginning in 1990.
- João Soares, with BSc and MSc degrees from universities in Brazil, and a PhD from a graduate of the polymer group at McMaster University in polymer engineering, he was appointed an assistant professor, also in 1994.

Hector Budman

Costas Tzoganakis

João Soares

Honors Accrue

Many of the department's professors served their professional organizations in leading capacities.

Ted Rhodes was president of the Canadian Society for Chemical Engineering in 1988-89. Rhodes also served as founding chair of the Ontario Centre for Materials Research and, during his career in industry, as chair of the Canadian Chemical Producers Association R&D Committee, president and director of the Society of Chemical Industry, and a member of the Governing Council of the National Research Council.

The table below lists the awards collected by the department's faculty between 1973 and 2015:

Faculty Member	**Year**	**Honour**
Don Scott	1971-72	President, Canadian Society for Chemical Engineering (CSChE)
Don Scott	1973	First Canadian to be granted Fellowship in the American Institute of Chemical Engineers (AIChE)
Murray Moo Young	1973	CSChE-Syncrude Innovation Award
Ted Rhodes	1978	CSChE-Syncrude Innovation Award
Don Scott	1988	R.S. Jane Lecture Award
Ted Rhodes	1988-89	President, CSChE
Ken O'Driscoll	1992	Chemical Institute of Canada (CIC) Macromolecular Science & Engineering Award
Alex Penlidis	1993	CSChE-Syncrude Innovation Award
Garry Rempel	1994	CSChE-Award in Industrial Practice
Francis Dullien	1995	Fellow, Royal Society of Canada
Murray Moo Young	1997	Natural Sciences and Engineering Research Council of Canada (NSERC)-Industrial Research Chairs (IRC) Award
Murray Moo Young	1997	Fellow, Royal Society of Canada
Thomas Z. Fahidy	1997	Fellow, Royal Society of Canada
Garry Rempel	1997	CIC Macromolecular Science & Engineering Award
Raj Pal	1998	CSChE-Syncrude Innovation Award
Garry Rempel	1998	CSChE-R.S. Jane Medal
Garry Rempel	2000	CIC-Catalysis Award
Garry Rempel	2002	Fellow, Royal Society of Canada
Garry Rempel	2013	Queen Elizabeth II Diamond Jubilee Medal
Garry Rempel	2015	Member, Order of Canada

Table 2: Professional and Society Awards 1973-2015

A Traveller's Life

A researcher's life includes many opportunities for travel.
While many chemical engineering faculty members could vie for the title of Most Travelled over the years, Pete Silveston owned that title while employed at UWaterloo.
More…

If the facts are against you, baffle them with science!

According to Tom Fahidy, many moons ago Kun Soo Chang was charged by police in Guelph with dangerous driving. He was exiting a clover leaf to enter a main artery and the cop thought that he did not leave enough room for a car coming up behind him.
More…

Cheating prior to the smartphone

In the late 1970s or early 1980s, when cheating during exams became fashionable to some, faculty members developed their own strategies to fight back.
Tom Fahidy created two exams: A and B. Without mentioning his strategy, he distributed the
More…

Tragedy fueled by Alcohol

Not all anecdotes are lighthearted. The following is truly tragic. You may not wish to read any further.
On New Year's Eve 1992, one of our married third-year ChE students consumed nearly a litre of champagne and half a bottle of scotch at his apartment. Shortly after midnight, he left the
More…

Plagiarism Detection Before Internet Searches

As a PhD comprehensive exam committee member in the mid-eighties, Professor Tom Fahidy was wading through a poorly written proposal when he suddenly read a paragraph of impeccable style and excellent scientific material, but without any reference(s).
More…

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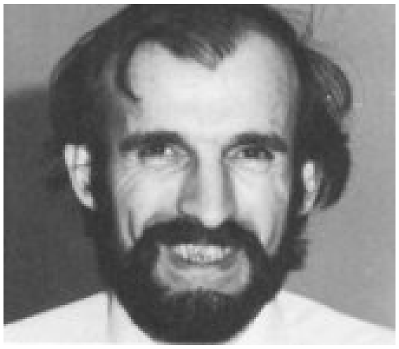
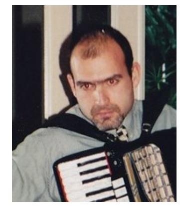
Chapter 8 – John Chatzis Keeps ChE Vigorous (1997-2002)



John Chatzis

John Chatzis took over the department chairmanship one year after the University instituted a Special Early Retirement Program. The 1996 initiative encouraged several chemical engineering faculty members to retire early: Cam Robinson, Francis Dullien, John Byerley, and John Wynnyckyj were some of them. As the result, Chair Chatzis had many positions to fill.

The challenge also provided an excellent opportunity to revitalize the department's research groups;



Mario Ioannidis

- 1997: Mario Ioannidis, with a BASc from University of Patras, completed his PhD at UWaterloo under the direction of John Chatzis after which he joined the department to replace the Dullien and Macdonald vacancies.
- 1998: Eric Jervis, having completed all three degrees at UBC, was a tissue specialist and added strength to the bioengineering group.

Eric Jervis

Pu Chen

- 1998: Pu Chen, who completed a BSc, MSc at Nanjing University in China, and MASc and PhD degrees at University of Toronto, arrived with surface chemistry experience. He was hired as an assistant professor and immediately cross-appointed to the Department of Physics.
- 1999: Eric Croiset, with Engineer Diploma, and Diplome d'Étude Approfondie as well as a doctorate in Combustion Sciences, all from University of Orléans, France was hired as an assistant professor to replace Pete Silveston in the reactor engineering group.

Department Chair John Chatzis roasts Pete Silveston at Pete's Retirement Party (1999)

- 1998: Christine Moresoli arrived with BASc and MASc degrees from McGill University, and doctorate from École Polytechnique Fédérale de Lausanne. She was the second woman professor in the chemical engineering department and her interests were in enzyme reaction engineering and diffusion in membranes.
- 1999: Michael Fowler was hired as a lecturer to boost the teaching effort in Environmental Engineering. He was completing his PhD at Royal Military College of Canada on Fuel Cell Reliability, having done a BEng there in 1986 and MS (Engineering) in 1988. He completed his PhD in 2003 and was appointed associate professor.

Mike Fowler

- 2001: Xianshi Feng replaced Bob Huang in polymer research area. His background is equivalents of BASc at Hebei Univ. of Science and Technology, and master's degrees, one in industrial chemistry from Dalian Institute of Chemical Physics, the other from University of Ottawa, and a PhD from UWaterloo.

Leo Simon

- 2001: Leonardo Simon was hired as a replacement for Charlie Burns' position in polymers. Leo's bachelor and master's degrees in chemical engineering were from the Federal University of Rio Grande do Sul, Brazil, as was his doctorate in materials science.
- 2001: Ali Elkamel took over Tom Fahidy's teaching areas. Ali did double bachelor degrees in mathematics and chemical engineering at the Colorado School of Mines, then a master degree at University of Colorado-Boulder, , with his doctorate at University of Colorado-Boulder.
- 2004: To satisfy the terms of establishing an NSERC Chair for Polymer Research filled by Alex Penlidis, Neil McManus was hired as a research assistant professor. His PhD was from the University of Edinburgh.
- 2004: Similarly, the NSERC Industrial Chair on Rubber Technology held by Garry Rempel enabled the hiring of Dr. Q. Pan from China to fill the Industrial NSERC Chair requirement. She was the preferred choice of Garry Rempel. Although creative in research, her teaching was poorly received by students and she was eventually denied tenure, leaving in 2008. UWaterloo has always insisted on good teaching as well as research from its faculty.

Cross Appointments

Don Scott began the practice of making cross-appointments from other university departments and hiring adjunct professors to supplement graduate level teaching and research. John Chatzis continued this effective and department-enriching strategy. Accordingly,

- 1994: Bernie Glick came to the Department from Biology to work with the bioengineering team.
- 1998: Maurice Dusseault was cross-appointed from Earth Science to supplement the Dullien and Chatzis work on oil field hydraulics.
- 1998: Ali Lohi, from Ryerson University 9now Toronto Metropolitan University), was appointed an adjunct professor in our department to conduct collaborative research with Bob Hudgins and Pete Silveston.

Students

In UWaterloo's early years, most international students came from Europe or, through the Canadian Commonwealth Scholarship Program, from Commonwealth countries. By the late nineties, Chinese students dominated the graduate student population in Canada and the United States.

By the Chatzis chairmanship, the mix of students studying chemical engineering had changed radically. Although many of the top students academically went on to graduate work, many highly qualified graduates went directly into industry, often recruited in their final work terms by the companies that employed them during their co-op terms. Consequently, Waterloo had to recruit graduate students from other Canadian universities and overseas institutions.

At the beginning of 2000, the recruitment of students from other Canadian universities' departments was limited by the strong competition from Canadian and American universities. A flood of high-quality graduate students with scholarships from Iran materialized. Indeed, the majority of students entering Waterloo's graduate program came from overseas.

Changes

Two major changes took place during John Chatzis' term of office: the restructuring in undergraduate operations and the development of the nanotechnology engineering program.

Specifically, the Department of Chemical Engineering had established one stream of chemical engineering students in parallel with another stream of environmental engineering (ChE version). Although Environmental Engineering (ChE version) had been duly accredited and offered for several terms, interest from prospective students was weak, thanks to the lure of the dot-com bubble at the time.

The second change had to do with nanotechnology at the university.

With the Environmental Engineering program experiencing low enrolment numbers, the Department of Chemical Engineering sought another way to expand its role at Waterloo. John Chatzis is credited with the vision to have started the Nanotechnology Engineering (NE) program as an interdisciplinary effort involving three departments: Chemical Engineering, Electrical and Computer Engineering, and Chemistry. The NE program draws strength in teaching and research from its three member departments and is administered by an appointed director and a board.

This decision to create the NE program was well-received in the department. Once the new program was approved by the Faculty of Engineering, the Environmental (ChE) program was withdrawn and replaced by Nanotechnology. The curriculum was changed to two streams—regular Chemical Engineering and the new Nanotechnology. That change heralded a brighter future for the department and, with it, an expansion of faculty numbers and graduate students in the years ahead. Tom Duever took up the challenge to fine-tune the nanotechnology curriculum and filled several new faculty positions for the new program.

A Long-term Tragedy from the Solution of the Alcool Problem

From the beginning, the department has been supported by chemical engineering technicians who operated our machine shop and analytical labs and prepared our teaching laboratories. Everyone was surprised when one of them suddenly lost his sight over a weekend.
More…

Teambuilding

During the Chatzis tenure, many activities were initiated to bring together faculty, staff, students, and retired faculty. These activities included an annual Christmas Dinner off-campus with recognition of recently retired faculty and of faculty who had won honours in teaching and research. As well, an annual picnic, with a barbecue and games, at Waterloo Park was held for everyone connected with Chemical Engineering. These activities continued well into Tom Duever's tenure as chair.

A Canoe Trip from Hell

Pete Silveston and Bob Hudgins took their research students on occasional canoe trips on local rivers. Pete, an avid paddler, promoted the canoe trips among foreign academics as "an introduction to Canadian culture."
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A plug for modified lecturing

Having read about and listened to professors and lecturers who had modified the lecture method, Bob Hudgins decided in mid-career to do a similar thing. So, in subjects that required ***More…***

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CHAPTER 9 – ENTREPRENEURSHIP IN THE DEPARTMENT

Perhaps UWaterloo was somewhat ahead of other Canadian Universities in faculty-initiated commercial ventures. Since our history article concerns only the first 50(ish) years, we have consciously listed only the entrepreneurial activities based on research that began before the year 2000 approximately.

The multi-year participation of Mike Fowler's ranking undergraduate design teams in the North American student design competitions has certainly aided in reinforcing the Department's entrepreneurial efforts, but is mostly outside the scope of the first 50 years

The following pages list those entrepreneurial activities known to the Editors, with as much detail as was made available to us.

Much more detail of the early commercial ventures can be found on the website of Dun and Bradstreet. For information on Dantec Corporation, please consult the Canadian Trade Index.

Explanation of Headings

1. **Trade Name**
    a. The name or company under which this activity was commercialized and marketed
2. **Principal Researchers**
    a. **Names of the principal researchers and commercializing faculty members**
3. **Approximate Years Active**
    a. **The periods over which activity took place**
        i. **Years in parentheses are years during which research to preliminary to commercialization too place**
        ii. **Years not in parentheses are years during which there was commercial activity**
    b. **The Editors have little of this information, and readers are encouraged to supply more data, and to correct misinformation**
4. **Process Description**
    a. A brief description of the engineering involved
    b. The Editors relied mainly on descriptions provided by others, and would welcome corrections and further brief details.
5. **Measures of Success**
    a. A brief description of the commercial success (or otherwise) of this activity
    b. Again, the Editors relied on information provided by others, and this may not be complete, and **would welcome further information**
6. **Results**

a. A brief summary of the activities and development of the commercial aspect of the activity

b. Again, further information would be welcomed

Noticeably missing, with a few exceptions, are URLs for websites of the companies arsing from the research and commercialization activity. If any can be provided, the Editors would include them in further versions of this chapter.

Undoubtedly also missing are any number of other research that resulted in commercial activity. The Editors can only plead that they had to work with what was provided to them, and would welcome further material, organized similarly to these listings.

Trade Name: Cyanil

Principal Researchers	Kurt Enns and John Byerley, in cooperation with Clare Beingessner of B&W Heat Treating (Kitchener)
Approximate Years Active	Early 1970s to Mid 1980s
Process Description	Electrolytic destruction of cyanide and thiocyanate solutions which arise in gold mining and metal heat-treating. Recovery of gold from gold mining effluent.
Measures of Success	After laboratory studies at UWaterloo, a pilot plant was built and successfully operated at B&W Heat Treating. Two commercial units were built and installed in the Cleveland and Detroit areas by Cyanil (jointly owned by Byerley, Enns, and Beingessner). In 1975 Byerley, Enns, and B&W Heat Treatment were awarded the Chemical Institute of Canada Environmental Improvement Award. In the early 1980s a pilot plant in the UWaterloo laboratories successfully demonstrated the recovery of gold from cyanide and thiocyanate in gold mining effluents, with the further advantage of demonstrating that recovered cyanide could be recycled for further gold extraction.
Results	Weak environmental regulations and enforcement by various levels of government in the late 1970s and early 1980s meant that there was little interest in investing in this successful technology.. As a result further operation of Cyanil became uneconomical. In time B&W Heat Treating was sold to an American company, and with the death of Kurt Enns in 1990 research at UWaterloo ended.

Trade Name: WATCRAP

Principal Researchers	Pete Silveston of UWaterloo and Tony Bryson of University of the Witwatersrand in South Africa

Approximate Years Active	1970 to 1974
Process Description	Computer simulation program based on the waste treatment models using FORTRAN
Measures of Success	In 1973-1974, workshops were presented to about 100 attendees in sanitary engineering from major municipalities in Canada. No follow-up occurred.
Results	The WATCRAP program was never put into practice. Yet, some 20 years later, computer simulation of municipal sewage plants was in routine use in Canada using systems and models far more sophisticated than those embodied in WATCRAP.

Trade Name: Turbosonic Inc.

Principal Researchers	Francis Dullien and Don Spink with Peter Douglas as a graduate student
Approximate Years Active	1976 to 1990s
Process Description	Experiments on spraying a fine water mist into a whirling stream of dust-laden air
Measures of Success	Key to system performance were the spray nozzles that Don had obtained from Sonics Environmental Systems, a U.S. company.
Results	The company established a process development activity that resulted over the following years in a novel wet electrostatic precipitator for sub-micron particulates, an evaporative gas cooler, a turbo-venturi scrubber as well as a semi-dry absorption scrubber. From a staff of just 2 or 3 in 1976 to the 1990s when Don relinquished the presidency, TurboSonic grew to a company of over 40 employees with annual revenues rocketing wildly between $ 10 and $ 24 million. Following Don's departure from the company, it appears to have been absorbed by Dürr Megtec, a global supplier of environmental solutions and engineered products, https://www.durr.com/en/company/locations/megtec-turbosonic-inc

Trade Name: Nutech Energy Systems (now Airia Brands Inc, London, ON)

Principal Researchers	Francis Dullien
Approximate Years Active	?

Process Description	Flow in porous media, pore structure, industrial gas cleaning
Measures of Success	Two books: **Porous Media**: Fluid Transport and Pore structure. Academic Press, 1979 (Still in press, standard textbook in universities around the world) **Introduction to Industrial Gas Cleaning**. Academic Press 1989. Several patents licensed to Nutech Energy Systems, now Airia Brands, as the basis for industrial and home air cleaning systems.
Results	Successful technology transfer through patent licensing to Nutech Energy Systems, now Airia Brands, maker of industrial and home air cleaning and heat/energy recovery systems. https://aeroventic.com/companies/airia-brands

Trade Name: Resource Transform International

Principal Researchers	Don Scott and associates: research engineer Dr. Jan Piskorz; technician, Peter Majerski; and research associate Dr. Desmond Radlein
Approximate Years Active	1992 - present
Process Description	In the decade following his organization of the entrepreneurship course (described in Chapter 4), Don Scott put some of his ideas into practice. He translated a decade of research on fast pyrolysis of various biomass materials into a continuing business, now named Resource Transforms International (Ltd) or RTI. Together with his research co-workers Jan Piskorz, Piotr Majerski and Desmond Radlein, Don co-founded in 1992 an R&D company developing processes as well as products employing fast pyrolysis of natural materials.
Measures of Success	Products ranged from renewable oils to exotic chemicals, flavours and sugar-like compounds.
Results	Don actively managed the company for several years after its founding. His retirement from UW shortly after the founding of his company required him to leave his UW research space and move into “incubator” facilities in Waterloo. The initial focus of the fast pyrolysis work was on the production of a hydrosugar, levoglucosan, by pyrolysis of cellulose, a promising, it seemed, intermediate for the pharmaceutical industry. But significant market demand for this chemical did not materialize, so Don’s

co-workers turned to other products. As a result, they developed and patented other technologies such as an improved biomass pyrolysis processing (subsequently sold to the Dynamotive Corporation), and the production of natural wood smoke condensate (licensed to Kerry Foods in the USA). They also built a processing unit for the high-temperature fragmentation of glucose to yield hydroxyacetaldehyde as a main product, the commercial production of which has continued at the RTI premises since 2001.

Although Don withdrew in the late 1990s from active participation in the company, he continued in an advisory role. The company remains profitable and still operates out of the Waterloo Baffin Place facility. Its current president is Jan Piskorz and its chief engineering magician for equipment design and operation is Piotr Majerski. R&D continues to be an important function of the company. They found a market for this material and have remained in this business ever since.

Don Scott, Dorothy Scott, Desmond Radlein, Jan Piskorz, and Franco Berruti at the Baffin Place facility.

Trade Name: Dantec Systems Corporation

Principal Researchers	Gerry Sullivan and Peter Douglas
Approximate Years Active	1985 to present
Process Description	Installation of a nonlinear model-based control system to control the moisture content of commercially dried corn more effectively
Measures of Success	Over 80% of the commercial corn drying facilities in North America adopted the technology resulting in over $1 million royalties to the university
Results	Technology formed the basis of a new company – Dantec Systems Inc that used the approach for drying applications in pet food, breakfast cereals, cookies and many other industries

Gerry Sullivan, Gerald Dubrick, President of Dantec, Doulas Wright, UW President, Ted Cross (right), Executive Director of Waterloo Centre of Process Development. Presentation of royalty cheque for grain drying control systems.

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Contributors

Bob Hudgins, Pete Silveston, Dave Copp , Tom Fahidy, Gerry Mueller, Murray Moo Young, Ken O'Driscoll, Louis Bodnar, Don Scott, Ted Rhodes, Miles Lauzon, Garry Rempel,

Acknowledgments

Nick Richbell, Head, UWaterloo Library-Special Collections & Archives

Jessica Blackwell, UWaterloo Library-Special Collections & Archives

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APPENDICES

Chemical Engineering Faculty from 1957 to 2014

Note: The years under headings "Starting" and "Ending" columns were collected from UWaterloo calendars. Since calendars are published annually, these dates may differ occasionally from the dates referred to in narratives offered by departmental chairs.

Surname	Initials	Starting	Ending	Duties during tenure and/or upon leaving
Abuhkadeir	N.W.	2011		Assist. Prof.
Anderson	W.A.	1993		Prof.
Aucoin	M.G.	2007		Assoc. Prof.
Baker	D.H.	1969	1971	Assoc. Prof.
Batke	T.L.	1957	1983	First Chemical Engineering Prof., Chair; Vice-President UW; 1982 Dir. Gen. Studies; Adjunct Prof.
Bodnar	L.E.	1960	1994	First Acting Chair; Assoc. Prof. Emeritus; Adjunct Prof. Eng. UG Off. 1995-1997
Budman	H.M.	1994		Prof.
Burns	C.M.	1967	2002	Prof.; Prof. Emeritus
Byerley	J.B.	1965	1998	Prof.; Prof. Emeritus
Chakma	A.	2005	2009	Prof.; Cross-Appt. Environ. Stud.; Vice Pres. Acad.
Chang	K.S.	1967	1992	Prof.; Prof. Emeritus
Chatzis	I.	1983		Prof.; Chair
Chen	P.	1999		Prof.; Cross-Appt. Physics
Chen	Z.	2008		Assist. Prof.
Chou	C.P.	2005		Prof.; Cross-Appt. Biology
Chu	P.	2004		Assoc. Prof.; Chemistry Cross-Appt.
Coulman	G.A.	1962	1964	Assist. Prof.
Croiset	E.	1999		Prof.; Chair
Doig	I.D.	1967	1968	Visiting Prof.
Douglas	P.L.	1986		Prof.
Duever	T.A.	1989		Prof.; Chair
Duhamel	J.	2003		Chemistry Cross-Appt. Biology
Dullien	F.A.L.	1968	1998	Prof.; Distinguished Prof. Emeritus
Dusseault	M.	2000	2006	Earth Sci. Cross-Appt.
Elkamel	A.	2004		Prof.
Enns	K.	1962	1990	Assoc. Prof.
Epling	W.	2006	2012	Assoc. Prof.

Fahidy	T.Z.	1964	2003	Prof.; Assoc. Dean Grad. St. 1992-98; Distinguished Prof. Emeritus
Farquhar	G.J.	1986	1996	Prof.; Civ. Eng. Cross-Appt.
Feng	X.	2000		Prof.
Foldvari	M.	2007		Prof.; Cross-Appt. Pharmacy
Ford	J.D.	1960	1961	Lecturer
Ford	J.D.	1964	1996	Assoc. Prof.
Fowler	M.	1999 2003		Lecturer Assoc. Prof.
Fulford	G.D.	1967	1970	Asst. Prof.
Gall	C.E.	1964	1994	Assoc. Prof.
Glick	B.R.	1994		Biology Cross-appt.
Gu	F.	2008		Asst. Prof.
Heatley	A.H.	1961	1966	Prof.; Prof. Emeritus
Henneke	D.	2006	2013	Asst. Prof.
Holden	D.A.	1986	1990	Assoc. Prof.; Chemistry Cross-appt.
Huang	R.Y-M.	1965	1998	Prof. Emeritus
Hudgins	R.R.	1964	2002	Prof.; Acting Chair 1987; Prof. Emeritus
Ioannidis	M.	1997		Prof.
Jervis	E.	1998	2013	Prof.
Jones	L.	2003	2007	Asst. Prof.; Cross-Appt. Optometry
Legge	R.L.	1986		Prof.
Macdonald	I.F.	1971	2004	Prof.
McManus	N.W.	2004		Res. Asst. Prof.
Moo-Young	M.	1967	2001	Prof; Distinguished Prof. Emeritus
Moresoli	C.	1998		Prof.
Mueller	G.S.	1971	1988	Assoc. Prof.
Nazar	L.F.	2009		Prof.; Cross-Appt. Chemistry
Ng	F.T.T.	1987		Prof.; University Prof.
O`Driscoll	K.F.	1970	1996	Prof.; Chair; Cross-Appt. Chemistry; Distinguished Prof. Emeritus
Pal	R.	1991		Prof.
Pan	Q.	2004	2008	Assoc. Prof.
Parker	W.	2005	2007	Assoc. Prof.; Cross-Appt. Civ. Eng.
Pei	D.C.-T.	1962	1992	Prof.
Penlidis	A.	1986		Prof.
Pritzker	M.D.	1990		Prof.
Ray	W.H.	1966	1970	Asst. Prof.
Reilly	P.M.	1965	1967	Adjunct Prof.
Reilly	P.M.	1968	1989	Distinguished Prof. Emeritus
Rempel	G.L.	1970		Prof.; Chair; University Prof.
Rhodes	E.	1964	1988	Prof.; Chair

Robinson	C.W.	1968	1998	Prof.
Rudin	A.	1968	1990	Chemistry Cross-appt.
Scharer	J.M.	1969	2006	Prof.; Prof. Emeritus
Scott	D.S.	1964	1994	Prof.; Chair; acting Dean 1969-70; Assoc. Dean Grad. St. 1980-83; Distinguished Prof. Emeritus
Silveston	P.L.	1963	1998	Prof.; Distinguished Prof. Emeritus
Simon	L.	2005		Prof.
Soares	J.P.B.	1995	2013	Prof.
Spink	D.R.	1969	1988	Prof.; Acting Chair 1970; Prof. Emeritus
Sullivan	G.R.	1980	1990	NSERC-DuPont Assoc. Prof.
Tam	K.C.	2007		Prof.
Tsui	T.	2007		Assoc. Prof.; Cross-Appt. Mech/Mechatronics Eng.
Turner	G.A.	1965	1985	Prof. Emeritus
Tzoganakis	C.	1990		Prof.
van der Hoff	B.M.E.	1966	1985	Prof.
Werker	A.G.	2001		Asst. Prof.; Cross-Appt. Civ. Eng.
Wynnyckyj	J.R.	1968	1998	Prof.; Prof. Emeritus
Zhao	B.	2008		Asst. Prof.

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The First Six Chairs

Figure 1: The First 6 Chairs

T.L. (Ted) Batke 1st Chairman 1958-62 Later: Vice-President, Academic	**D.S. (Don) Scott** Chairman 1964-69 Acting Dean 1969-70 Assoc. Dean 1980-83	**D.R. (Don) Spink** Acting Chairman 1969-70
L.E. (Lou) Bodnar Acting Chairman 1962-64 Later: Director of Admissions, Faculty of Engineering	**K. (Ken) O'Driscoll** Chairman 1970-76	**E. (Ted) Rhodes** Chairman 1976-1985 Later: Director of Research, Polysar Ltd. President: Nova Scotia Technical University

Photo Credit: Central Photographic, University of Waterloo 1976 07 04

Next Six Chairs

The Editors believe that a group photograph of the Department Chairs following Rhodes exists but have been unable to locate it. Anyone able to help with this, please contact

gerry.mueller@uwaterloo.ca

Anecdotes

The Batke Years

Living Rough

In the early days, the co-op program provided a convenient way for students of modest means to finance their university years. Nevertheless, an occasional student had to live rough during the academic terms.

One fellow, who evaded the rounds of security guards for some weeks, lived in a second-floor lab with a couch in it. For a winter fridge, he dangled bits of bologna on strings outside the window.

Another student found a similarly creative solution to his housing challenges. He was discovered when he won an academic scholarship. To notify him, the undergraduate officer searched through the student handbook to find his address. It was listed as "Parking Lot C," which, in those days, was available for use at no charge. The student parked his station wagon in the unpaved lot and slept there at night throughout most of the spring and fall terms. The cold became too much by mid-November, when he had to find warmer lodgings.

Return

Benefits of the Waterloo Co-op Program (2013)

In 2013, the following pitch was used to inspire students to consider enrolment in Waterloo's co-op program:

Gain up to two years of paid work experience to add to your résumé.

Help pay for your education: Waterloo co-op students earn on average from $37,000 to $77,000 by the time they graduate.

With four to six work terms, you can test drive a variety of careers before you graduate. See what you like – and what you don't!

By alternating work and study terms, you'll be able to explore new career areas as your interests and goals shift.

Build contacts with employers that can lead to a great career when you graduate.

You'll learn how to write a résumé, how to present yourself well at an interview, and how to conduct yourself on the job – all skills you'll need when you're starting your career.

You'll have exactly the same number of school terms as students who are not in co-op, but with up to two years of paid work experience!

Because you alternate school and work terms, you'll see how your classroom learning is used in the workplace, and you'll discover that what you learn on your work terms provides an extra dimension to your school work. The combination adds enormous value to your university studies.

Co-op students tend to have smaller student loans than other students and are more successful at paying them back.

Graduates of co-op programs typically earn 15 percent more upon graduation than graduates of non-co-op programs

Return

The Bodnar Years

"Rabbi" Bodnar

Lou Bodnar lived on a farm, and his regular work outfit included a rotating set of trousers with matching Harris Tweed jackets and Kodiak boots.

He arrived to teach a third-year chemical engineering class one winter morning to find a student at the blackboard, having just finished writing "The Louis Bodnar Look-Alike Contest." Somewhat abashed, she scooted to her seat.

Bodnar observed the entire front row of men wearing trousers, Harris Tweed jackets, and Kodiak boots. He gave them a thumbs-up, a big smile, and delivered the lecture. Determined not to be outdone, he arrived at the lecture two days later dressed in a formal black suit, appropriate shirt and tie, black flowing opera cape, and homburg hat, carrying a gold-headed cane. Without comment, he delivered the lecture and left with a smile and the challenge: "It's your turn next."

Walking back to his office, he ran into Tom Schmidt from Engineering Photographic. His face lit up with the question, "What on earth are you up to?" Bodnar explained, and Schmidt insisted on bringing him to the studio, where he produced this photograph.

In a telephone conversation with Gerry Mueller in Fall 2021, Bodnar explained the look he had been aiming for was that of a rabbi.

Return

Gerry Mueller Reminisces

Professor Gerry Mueller, a member of the Faculty between Fall 1971 and Summer 1988 (and one additional term as an Adjunct in Winter 1989) also attended University of Waterloo as an undergraduate from January 1962 to June 1966 . He shares some of his experiences below.

Admission

Shortly after starting undergraduate studies at Royal Military College, I developed a condition (almost certainly misdiagnosed) that deemed me unfit for active military service, and in early December 1961 I was medically discharged.

After hearing from a friend that a new engineering school in Waterloo was admitting students to a January 1st year, I hitchhiked to Waterloo. There I found the University – all of three buildings, one of which was still under construction. At the Registrar's Office, the Registrar, a young red-headed kid named Al Gordon, perused my Ontario Grade 13 marks and admitted me to Chemical Engineering, with a full tuition scholarship for the first year.

Registrar Al Gordon

About five weeks into the 1A term, an official letter arrived from the University, informing me that in order to complete admission, I would have to complete the enclosed admissions application! Those were the blessed days of Waterloo muddling along without worrying much about bureaucratic ways.

As far as the military were concerned, it seemed the Reserves were less fussy, and I was within a year commissioned as an Infantry officer; however, as it turned out the military could not deal with a co-op student/officer who needed to change regiments every 4 months, and thus I spent the rest of my undergraduate years on the Supplementary list, and it would have taken a shooting war to bring me back from that.

Lusty Dusty

At that time, all students had to take two terms of English. The course content was similar to what we had covered in Ontario high school: some Shakespeare, some classical novels, some poetry, and some modern literature.

Our instructor from the then nascent English department in the new Faculty of Arts was Alvin Dust, a man with an infinite supply of sexist jokes, anecdotes, and attitudes. He wouldn't last a week today, but we students thought him hilarious. Behind his back we called him 'Lusty Dusty!'

Calculus

In mathematics, we learned differential calculus in 1A and integral calculus in 1B. Our instructors from the new Mathematics department were Ralph Stanton and Arthur Beaumont. Both worked on the assumption that engineering students were mathematical cretins, the result being that they lectured clearly and simply and with lots of examples and handholding. Thus we students learned a heck of a lot of calculus!

Raiding Party

Sometime during the 1B term, a few of us near the top of the class at the end of 1A were subject to a 'raiding party' from engineering faculty members from the University of Toronto. It was made known to us that, by continuing at a questionable university in a questionable program that involved industrial experience, we were risking "hopelessly compromising our future engineering careers." Our unanimous reply was the sixties' equivalent of "blow it out your ear."

Co-op Lessons

My first and second co-op terms were at Brockville Chemicals, a new plant that produced nitrogen fertilizers. It was located near Maitland, Ontario, between a Dupont plant and an Air Liquide plant, both of which used by-products. Brockville Chemicals was funded by a group of

Belgian diamond miners who had been persuaded of the prime opportunity afforded through the supply of fertilizers to Canadians.

Various American consultants and constructors hired local labour to build the plant. Once it was finished, the owners made the mistake of hiring those same local labourers to operate it. At the same time, they signed onto the University of Waterloo co-op program as a source of cheap labour, hiring four students each term. I was one of them.

By the end of two terms at Brockville Chemicals, we had learned about as much as there was to be learned, none of it insignificant:

● If you are installing a valve that needs to be manually adjusted, it had better be accessible. Having to climb 20 feet up a portable ladder to a pipe rack is not "accessible".

● If you install a gauge that is not read out in the control room, but needs to be read nevertheless, somehow you have to be able to get to it. A pressure gauge on the side opposite the ladder on a distillation column is of no use. Cue the mirror on a long stick!

● If some piece of equipment needs to be swapped out regularly for maintenance, it has to be accessible. There also must be a feasible way of getting it to the shop!

● Pipe runs that don't connect anything to anything are not dangerous, but they do cost money.

● I also learned that people working at seemingly menial jobs may be doing so for reasons that have nothing to do with the enterprise objective. Thus, a journeyman pipefitter that I worked with neither aspired to become a master pipefitter nor cared about the company. He worked there only because it paid him enough to write poetry!

At some time during my 1B work term, we were informed that Waterloo was switching the co-op program from three-month terms to four-month terms. Hence, we would continue as originally scheduled, except that our stream would have to do the final academic year as 4A in Fall 1965, immediately followed by 4B in Winter 1966,

While back on campus for 2A, we informed the Coordination Department, as it was called, that we didn't want to return to Brockville Chemicals because the company was exploiting students as cheap labour and offering no opportunities to learn.

At that time, few employers saw co-op as a way of partnering in engineering education. In its efforts to build the co-op program, Coordination seemed more concerned with protecting employers than ensuring learning opportunities for students. We were told that we had to return or we would be removed from the co-op program.

At this time, some of us played the U of T card: either we don't go back to Brockville Chemicals and we do enter the job search pool, or we take U of T up on their offer and enter their program. Those threats was effective.

Change of Direction

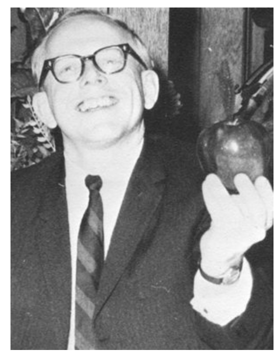
With 2A completed, I headed off for a work term with Procter & Gamble in Hamilton. I worked in their Methods department, which we would now call a Systems department. In all, I spent three terms at Procter & Gamble. The experience taught me a great deal about "systemic" thinking and, in retrospect, shaped my future engineering interests.

First of all, I was exposed to digital computing and programming, which was, at that time, arcane magic. I learned to program in what was a state-of-the-art language called IBM Autocoder. With that experience, Procter & Gamble asked me to look into something totally new, called FORTRAN. By the end of that work term, I was the company expert in writing FORTRAN programs.

Back on campus, the only computer available was an IBM 1710, which was a 1620 with a process control interface. It could, in fact, compile FORTRAN, but there was no way the owners (the Math department) would let an engineering undergraduate at it. Thus, it was back to the slide rule until, somewhere in about 3B, the miracle of WATFOR arrived, with its cafeteria style execution. You handed in your program and data deck and by the time you walked 10 feet or so to the printer your run was ready to pick up. By then I had been programming at Proctor & Gamble for a year in total time and was the handy go-to guy for help with computing issues.

The Perks of Small Classes

Class sizes were small in those years. By the time third year came, the B stream was down to 16 and the A stream class had 6 students, for a total of 22 potential graduates in the Class of '66. That led to fair amount of closeness between undergraduates and faculty members. Everybody was pretty well on first-name terms for all but the most formal occasions. It also led to the faculty knowing pretty well who the "characters" were and their part in the class dynamic.



Dean Doug Wright at a Student Function (1966)

One of our liked-but-irritating class members, Ed Boyko, had a habit of voicing an opinion, right or wrong, on just about everything. In response, the class usually responded with a chorus of "Shut up, Boyko!" One day, in a 3B class taught by Lou Bodnar, Ed had been particularly vocal, to an ever-increasing chorus from the class. Finally, when Ed voiced yet another opinion, and before anyone else could say anything, Lou exclaimed, loudly, "Shut up, Boyko!" while continuing to write his lesson notes on the board.

Particularly Elegant Ted Batke at Grad Ball (1965)

Another time, Ted Batke, by then VP Academic, was teaching when he announced that he would be in Florida for our next couple of lectures. Boyko mouthed off that he hoped he would "think of us while **laying** on the beach." Without missing a beat, Ted, elegant as always in his conservative grey suit and white shirt, asserted that "Mrs. Batke would not allow that" and suggested that Mr. Boyko needed to learn the distinction between the verbs "to lay" and "to lie."

Creative Housing

There were no residences in those years, so most students lived either in a small apartment in the city or in one of the many rooming houses surrounding the universities.

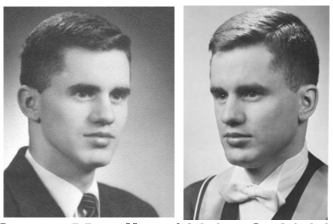
One class member, Jim Steward, lived rent-free at the Mitchell Animal Hospital, at what is now Highland Road and Westmount Road. In lieu of rent, he was to make sure that the animals boarded there were ok overnight and on weekends. Bill Menheere boarded at Lou Bodnar's farm, a bit west of there, also on what is now Highland Road.

On Friday, Saturday and Sunday nights, our class had unique party opportunities at the animal hospital, as there was no one to disturb in or around the building. And if the party ran out of beer, as it occasionally did, Bill could run over to Lou's and "borrow" a case or two.

That worked well, until the Sunday night when someone decided it would be a fun idea to lock Jim into one of the large animal cages and leave him there, to be found when the staff came in the next morning, while we all went home.

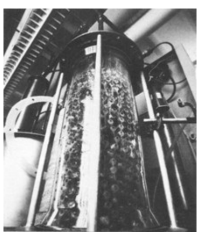
Alas, it had not been well thought through – Jim lost his place to live, and the class lost its party venue.

Research Project



Gerry Mueller (1965 & 1966)

During 3B, Jim Ford asked if I would be interested in working for him on a research project during my last work term, before the 4A/B year. The pay was considerably less than Proctor & Gamble were offering me to return for a fourth work term, but the time and gas money I would save by working locally made it doable, and so I accepted. The project itself was interesting enough, but beyond that, I learned that research could be fun. That summer persuaded me that I should consider graduate school and teaching.



Glass Marble-filled Stripping Column

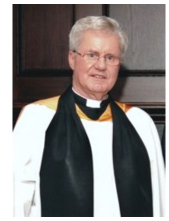
During 4A/B I applied for an Athlone Fellowship and went off to the University of Manchester Institute of Science and Technology for an MSc and PhD in their Control Systems Centre. But for the Summer before the Department hired me to redesign several laboratory rigs and develop new lab experiments. The one I remember best is a gas-liquid stripping column that I believe is still in use, filled with every glass marble I could find in Kitchener-Waterloo.

After completing at Manchester in 1969, I returned to Canada for two years in the Mechanical Engineering Department at what was then Sir George Williams University, now Concordia. In the fall of 1971, I re-joined the University of Waterloo Chemical Engineering department.

In the Winter term of 1972 Jim Ford came to me, announcing it was pay-back time, and that there was a student in my 3B class in Thermodynamics that was expected to hire as a research assistant for the Summer, to turn him on to research and graduate studies, just like had been done for me. That was Doug Lloyd, who is now (2021) an Eminent Emeritus Professor of the University of Texas at Austin, and a world-wide recognized authority on permeable membranes.

Another Change of Direction

Eventually, I went badly wrong (for an engineer). I left the department in 1988 for full-time Anglican parish ministry, initially in Cambridge, then Mississauga, and Scarborough .



The Engineer as priest

After 13 or so years of that, I came back to Waterloo to be Chaplain at Renison University College, Anglican chaplain to the Universities of Waterloo and Wilfrid Laurier, and a lecturer in Religious Studies, teaching Anglican History and Thought.

That was more than full circle. It allowed me to do the two things I loved most of all: teaching and caring for and about people.

Return

The Scott Years

Serendipitous Incident of a Statistician

Park Reilly recalls leaving Waterloo with his wife, Veva, as his chauffeur following a long day in which he had developed a fever and was feeling wretched.

Before they reached London, Ontario, one of their car tires went flat, and they pulled over on Hwy 401. As they pondered what to do next, another car came to a stop ahead of them and backed up. Its driver offered help.

The driver was Bob Rosehart, a student in Reilly's graduate statistics course, who spotted them as he passed. Rosehart gallantly changed their tire, to the Reilly's enduring gratitude.

Rosehart went on to a distinguished career that included roles as President of Lakehead University and President of Wilfrid Laurier University, as well as Acting Principal of Renison University College, an Anglican College affiliated with UWaterloo.

Return

Extra-Curricular Activities for Profs

In his first semester of teaching (1964), Bob Hudgins had a class of about 7 students in 3A. One evening he got a phone call from one of them asking if three of them could come over to his apartment. He agreed. Soon, in walked the trio and sheepishly admitted that they had recently got parboiled at a local pub and on their walk home had pilfered the IN and OUT signs from the beer store. The signs had been discovered by one of their landladies who, not wishing to be a custodian of what looked like hot property, turned them over to the police, along with the name of the rooming student.

The police, aware of a couple of recent student pranks (BEER written huge on the water reservoir; chickens released into the Theatre of the Arts) but still unseasoned at dealing with student antics in sedate Waterloo (population about 20,000), were not amused. Rather than acknowledging the return of the signs and warning the suspects not to repeat this foolishness, the police charged them with "theft over $50."

A fledgling Co-op coordinator was alerted since it would be hard to find a co-op employer for an individual in trouble with the law.

Bob agreed to act as a character reference for them in court. At their court appearance, the judge asked about the previous employment of the accused and chuckled when one confessed to having recently worked as a sign maker. Happily, the judge understood that a criminal record would make their professional lives difficult. He let them off with a reprimand and a suspended sentence, to everyone's relief.

Return

Flights of Fancy

Generally, Waterloo faculty preferred to teach on campus because teaching in Sarnia involved a large time commitment – five to eight hours of driving, depending on the weather, and an occasional overnight stay in Sarnia. Pete Silveston was an exception.

Like several Waterloo faculty, including chemical engineering professor Alan Turner, Silveston belonged to the University's Federation of Students Flying Club. He had earned his pilot licence using one of the club's four planes. One of them, a Cessna 172, could be used by club members for a low cost.

Silveston convinced the department to reimburse him for the cost of the Cessna rental; thereafter, he commuted to his weekly Sarnia lecture by airplane, flying from the airport in Waterloo to the one in Sarnia. The one-hour flight was traffic-free and pleasant, he claimed. Besides, he collected flight time at no cost to himself.

Silveston also used the flying club's Cessna to attended research meetings, braving the stressful experience of landing his small plane at busy international airports, including Toronto, Ottawa, Buffalo, and Philadelphia.

Silveston's flying ended several years after the closure of the departments' off-campus program when, during a hard landing, he shattered the landing gear of the University's Cessna. Subsequently, the flying club rescinded his membership for flying a plane on which, it turned out, he had not been certified.

Return

An Awkward Moment in Catalysis

The Silveston/Hudgins kinetics/catalysis team gave an early paper at a symposium at McMaster University in the late 1960s. In it, they presented results of a model for selectivity of butane isomers from the hydrogenation of butene-1 based on their laboratory data.

However, during discussion of the paper, their results seemed a little doubtful to Bob Anderson, the avuncular professor of catalysis at McMaster.

Anderson rose gradually from his seat, cleared his throat and said in his customary slow murmur, "I don't think you can study kinetics when your system is at equilibrium."

Could Anderson be right? How could they have missed it? Finally, after an uncomfortable silence, the pair thanked him for his incisive observation.

The Silveston/Hudgins team resolved to go back to the lab and never to attempt kinetic studies at equilibrium again.

Return

Prophecy in Don Scott's Office

In 1965, Don Scott, then chair of ChE, was visited without notice by some men from General Electric Research Center in Schenectady, NY. They wished to discuss key components of technology for the next 30 years. They were convinced that, by that time, the world would be controlled by 15 to 20 giant corporations, one presumably being General Electric (GE).

Don dismissed them, suggesting that they were off-base because the free world enjoyed a well-developed system of democracy. Reflecting now on this incident, he notes how perilously close we are to their prediction.

Return

Stay Awhile

In 1967 then Assistant Professor Tom Fahidy picked up his office mail one morning and found a letter of formal appointment to associate professorship. Pleasantly surprised, he walked into Don Scott's office to thank him and asked if this meant that he now also had tenure.

Don looked up from the bunch of papers he was reviewing and stared at Tom briefly while savouring the naivety of the question. His answer: "Tom, think for a moment. If we didn't want you to stay, would we want to promote you?"

Return

Visiting Professor with Tenure

Pete Silveston developed an early reputation as a traveller. Colleagues joked that he was the University's only visiting professor with tenure. His talent at travel inspired Bob Hudgins to pen the following bit of doggerel. Bob notes that since he wrote this stenos, typists, draftsmen, and dictation machines have all become extinct and fax machines almost so.

Silveston's Leaving Town

The fax machine is humming
As his typist adds a noun,
The draftsmen's brows are fevered 'cause
Silveston's leaving town.

His desk is soon chaotic
And his plants are turning brown.
His limo driver idles ere
Silveston's leaving town.

No chair could ever curb him;
No dean would turn him down.
Whenever there's a conference
Silveston's leaving town.

Now the corridor's deserted
While cassettes recite his sound:
It's The Voice of the Departed.
Silveston's now left town!

L'envoi
Enjoying perfect silence,
You're in your dressing gown.
Uh-oh, the phone — it's cheerful Pete:
"My slides! Quick! Mail them down!"
Return

The O'Driscoll Years

Creative Grading

Tom Fahidy, now a Distinguished Professor Emeritus and Fellow of the Royal Society of Canada, Chemical Institute of Canada, American Institute of Chemical Engineers and Electrochemical Society and Canadian Academy of Engineering, had been teaching for about a decade when he received some unusually negative feedback from a student.

The student had submitted his final exam booklet empty, aside from the insults he had used to fill the first page. The mildest one invited Fahidy to "join the human race."

Fahidy showed the exam to Ken O'Driscoll, expecting one of his famous witty remarks.

O'Driscoll read the page carefully before solemnly announcing: "Give him ten. Five for clarity and five for brevity."

Return

Alumni Presence in Tokyo

Y. "King" Horiguchi was one of the first Japanese graduate students to join the Chemical Engineering department in the early 1970s. He undertook with Pete Silveston and Bob Hudgins PhD work dealing with surface migration on a catalyst support.

Upon his graduation, he returned to Japan where he joined the family company, which supplied industrial gases to industry in northern Japan. He soon took over the presidency of this company and grew it to become a major industrial gas supplier in the country.

King's business achievements were recognized by the award of a Japanese order presented to him by the Emperor of Japan. In addition to his business career, Horiguchi helped found the first Japanese Waterloo alumni club and served for several decades as president of that group.

Return

Gerry Sullivan: Co-op Interviews – A Blood Sport

During the early 1970s, Gerry Sullivan was in the second year of chemical engineering at Waterloo. He studied chemical engineering operations, chemistry, and calculus with Professors Hudgins, Rempel, and Reilly respectively.

It was co-op interview time, and all the students were eager to apply their newly acquired skills in industry. On any given day, the interviewees could be spotted easily. They were lugging around suit bags to handle a quick wardrobe change before an interview, which took place in the Math and Computer (M&C) building.

Peter Douglas and Sullivan noticed that their good friend Jerry (Jerrold) Lerman was sporting a suit bag. Jerry was looking to score a co-op job with Canada Packers, who had a plant near his home in Toronto. They also noticed, however, that Jerry appeared particularly stubbly.

This was years before scruff was fashionable; budding chemical engineers were to appear well groomed. Unfortunately, Jerry forgot to shave that morning. He roomed at the far end of Kitchener, and he did not relish the long public transit commute back to his room to enhance his appearance.

Peter Douglas offered a solution. On the lunch break, Jerry could go to Peter's Conrad Grebel residence room, use Peter's razor, and be back in class with plenty of time to spare for his 3 pm interview. Peter never thought to mention that he had only a straight razor. This was important, because Jerry had only ever used a safety razor.

Peter gave Jerry a crash course in the use of the straight razor, but it turned out to be one of the few courses in which Jerry did not excel. With every stroke of the razor, a tiny rivulet of blood appeared on his face. With engineering ingenuity, Peter produced tiny bandages. Jerry returned to statistics class with at least 12 bandages adhered to his clean-shaven face. The plan was to allow a two-hour healing period and remove the bandages just before his interview.

They all wished Jerry good luck as he left for the M&C building. When his name was called for the interview, he dashed into the washroom and pulled off all the little bandages. He hurried to the interview room and introduced himself to the Canada Packers personnel. By then, evident to all but Jerry, a dozen tiny beads of crimson were slowly forming and starting to trickle down his face. The shocked evaluators quickly ended the interview. Needless to say, Jerry performed no heat and material balances for Canada Packers that work term.

After graduation in 1974, Jerry went on to medical school at the University of Toronto, graduating in 1978 followed by a further 4 year residency in anesthesiology, and a one year fellowship in research pediatric anesthesiology at the University of California-San Francisco. He was Chief of Anesthesiology at Toronto's Hospital for Sick Children and Clinical Professor of Anesthesiology for nearly 20 years until moving to Buffalo, where he continues in practice and teaching. He is also co-author of seminal textbook in pediatric anesthesiology. Fortunately, skill with a straight razor is not a requirement for anesthetists.

Return

The Rhodes Years

Bodnar's Creative Admissions

Bodnar, as Director of Admissions for the Faculty of Engineering, not only created policies of mature student admissions, he also was creative in individual cases, unlike the practice at other Ontario universities at the time. In a telephone conversation with Gerry Mueller he talked about two of these, as examples.

On a visit to a Montreal high school he met two Grade 11 students who wanted to be admitted to Mechanical Engineering, but whose Mathematics background was hopelessly weak because of the way the Quebec post-secondary system was structured at the time. Going on to the next stage in the Quebec educational system, a Collège d'enseignement général et professionnel (CEGEP), would not remedy this. Bodnar suggested they enroll in two UWaterloo correspondence courses in mathematics for the Summer, and guaranteed them admission if they met a high standard. They were admitted, and in time graduated with honours.

A second instance was a 30 year-old man who had only finished Ontario Grade 10, but wanted to study Mechanical Engineering. Bodnar set him an extensive program of correspondence courses with a guarantee of admission if the person met a defined standard. He did, and eventually graduated from UWaterloo with a good academic record.

Few other engineering schools of that time, and even fewer now, would be ready to be this accommodating.

Return

An Expensive Free Computer

Ted Rhodes and Gerry Sullivan visited London, England, with the goal to secure a gift of hardware and software from IBM for the Department of Chemical Engineering. After two days of negotiation that ended with a $2 million donation, the Waterloo contingent offered to take the IBM executives out to lunch.

When asked where they would like to be entertained, the IBM people suggested the top floor restaurant at the nearby Kensington Palace Hotel. Arriving there, host Rhodes sat at the head of the table, read the menu, and gasped at the prices. “Oh my goodness!” he thought. (Possibly he thought something less printable.)

The group of eight people set about ordering the most lavish lunch that he had ever seen, complemented by elegant table settings and a violin serenade. Rhodes worried throughout that his credit card might not handle the bill. Even with the 1980s prices that seem so affordable now, the bill reached $1,300.

When he later scolded Gerry for ordering so much food and wine, Rhodes learned that only he knew the prices – the menus that the servers handed to the other guests lacked all mention of prices.

Back in Waterloo, having submitted the expense claim to the University, Ted was called by the President to account for this extravagance. Fortunately, President Doug Wright, formerly Dean of Engineering, chose to see the comical side of how the London IBM crowd had led them on. Rhodes kept his job.

Return

Ted Rhodes Answers the Siren Call of Industry (Not for Long)

In the fall of 1986, Ted Rhodes announced at a departmental meeting that he would resign to pursue a new industrial role with Polysar Ltd., formerly known as Polymer Corp. and before that as the Government-owned Canada Development Corporation. Instead, the department graciously voted to grant him a three-year leave of absence. Rhodes was humbled and thankful for the generosity granted him by his colleagues.

Three years later, after the takeover of Polysar by NOVA Corporation of Alberta, Rhodes returned to academia as Dean of Engineering at the University of Calgary. Later, he became President of the Technical University of Nova Scotia, which merged into Dalhousie University in 1997, where he concluded his academic career as Vice President.

Rhodes retired on Vancouver Island, where he pursues his hobbies – music and singing, acting as president of the local symphony society, golfing, and gardening.

Return

Cheaters Do Not Prosper

In the late 1970s and early 1980s, when cheating during exams became in vogue, faculty members developed their own strategies to fight back.

Tom Fahidy created two exams: A and B. Without mentioning his strategy, he distributed the exams across the rows in an A B A B pattern. With Fahidy in charge, ten or twelve graduate student invigilators paced the room watching the students closely.

The silence was deafening, you could hear a fly having a heart attack. The exam ended and students handed their papers to Fahidy and left. One of them flashed a brilliant smile and said, “Sir, there are two versions of this exam, aren’t there?”

Other strategies were developed. Jeno Scherer, who was an amateur puzzle developer had a mid-term with four versions, developed such that it was possible to discover who had copied from whom. A substantial number of students were publicly identified and warned about cheating and expulsion if caught again, and given failing grades on the examination. On a subsequent mid-term, one examination was printed onto 4 different coloured papers, with the expected effect that no one dared to cheat.

Return

Another Experiment in Education—Self-Paced Learning

Fads regularly sweep into Canada from the United States. They flourish on our soil for a while before, eventually, being adopted or fading away. This pattern happens in fashion, to be sure, and, oddly enough, in engineering education as well.

Student learning, also known as self-paced learning, was one of those fads. Promoted in one or perhaps two departments of the Faculty of Engineering, it quickly became a Faculty undertaking and generated a Faculty project with several workshops on how it could be used at Waterloo.

Several chemical engineering faculty members, including Pete Silveston, attended those workshops. Pete volunteered to use self-paced learning in his 4A kinetics and reactor design course and diligently prepared a set of notes, exercises, and self-graded quizzes as modules for student use. In the spirit of self-paced learning, a student would submit his or her quiz result and collect the next module in the series. The regularly scheduled class time was to be used for student questions about their textbook reading and the distributed notes and exercises. There were to be no conventional lectures on course material.

For the first week of the course, the classes were well attended and Pete answered and elaborated on several questions from the students. By the second week, most of the students submitted their self-graded quizzes and picked up the second module. However, the number of students submitting quizzes and moving to the next modules dropped significantly in the third and fourth week. Attendance at classes was way down and, because only one or two questions were asked, the classes ended well before the end of the hour.

As mid-term exams approached, just a handful of students from a class of forty were moving through the course modules. Just before these exams, the students panicked and a delegation went to the Associate Chairman. The self-paced experiment wasn't working.

Pete agreed to abandon the self-paced learning strategy and return to conventional teaching for the second half of the term. Class performance in the usually popular kinetics and reactor design course was poor and Pete Silveston's mean teaching rating on that course was dismal.

In hindsight, the self-paced learning experiment was a mistake. Throughout their past schooling, including university, students responded to pressure. With limited leisure, their work is forced onto courses that make clear demands. In such circumstances, a single self-paced learning course may wrongly be perceived by the inexperienced as a cinch. Self-paced learning, apparently, can only be successful when the entire teaching system adopts such an approach.

Return

O'Driscoll Works "with" Xerox

In the fall of 1979, Ken O'Driscoll received an unusual invitation to become a manager at the Xerox Research Centre (XRC) in Mississauga. The position was offered by an old friend, Bob Marchessault, who was then VP and director of the research on materials in Xerox. The XRC lab lacked a focus on polymers, so he asked O'Driscoll to organize a group that would research this important substance on a part time basis.

The department chair, Ted Rhodes, liked the idea. So did the University of Waterloo, with its strong roots in co-op education. The University reduced O'Driscoll's work (and pay) by 25 percent, while XRC regarded him as a half-time employee.

O'Driscoll was busy, but nicely paid for the three years he worked with Xerox. He usually spent two days a week at the XRC, sometimes three. Initially, he focused his efforts on recruiting young polymer chemists and choosing research paths that made sense within the Xerox business area.

Given the enormous importance of toners in xerography and the fact that toners are mostly polymers, he created a specialized group that developed novel ways of making particulates out of polymers. Today, that type of research would be considered part of the glamorous nanotechnology specialization.

His polymer research group included some recruits from inside and outside the Xerox research lab, as well as some Waterloo co-op students that he had convinced XRC to hire. O'Driscoll was particularly interested in having his former PhD student Hadi Mahabadi bring his expertise to the team.

At the time, Mahabadi was in Iran, his home country, working as a professor and chair at the University of Tehran. Mahabadi was unhappy living in the turmoil that had developed in his country after the Islamist Iranian Revolution that overthrew the Shah. Then, in late 1979, a group of Iranian students attacked the US Embassy in Tehran and held captive 52 American diplomats and citizens. In the midst of this uncertainty, Mahabadi accepted the XRC job.

XRC mailed him a formal job offer with instructions to present it at the Canadian embassy in Tehran to get the visa necessary to work in Canada. Mahabadi did so, but the embassy representatives required that he leave his documents, including his passport, for processing.

A day or two later, the Canadian Embassy in Tehran closed suddenly after revealing that it had been hiding six American diplomats who had evaded capture during the attack on the US Embassy.

Because of this difficulty, Mahabadi's passport and visa application passed slowly though the process; his visa was eventually made available via the Demark Embassy after almost a year. When he got it, Mahabadi had to leave his home and job surreptitiously, after sending his wife and child to "vacation" with a sister in Italy.

Mahabadi made his way to Canada with great difficulty. But he came, did a great job, and ultimately became the VP in charge of the lab. After his retirement, he was invested into the Order of Canada, which is one of our country's highest civilian honours.

O'Driscoll's work with the Xerox lab ended as planned in 1982, after three successful years. The Waterloo-Xerox relationship continues to this day, with many Waterloo undergrads benefitting from unique and informative co-op positions at the company.

Return

Peter Douglas Returns "Home"

Every several years a group of remarkably talented students finishes the ChE program. In 1974, Peter Douglas, was a member of such a group (the others being Gerry Sullivan and John Chatzis). He stayed on in the Department to take MASC and PhD degrees under the tutelage of Francis Dullien and Don Spink. Indeed, he worked on the scrubber later commercialized by the Turbotak organization.


Peter Douglas (~1990)

After finishing his degrees, Pete joined the ChE department at Queen's University for the years 1981-1986, before returning UWaterloo. His administrative talents soon took him to an Associate Chair position and later to a faculty post as an Associate Dean.

His interest in foreign students brought him to Thailand, where he established links to their leading universities. Those links initiated a stream of talented graduate students for chemical engineering.

His work with foreign universities and his administrative skill made him the obvious choice to lead the Waterloo expansion into the Gulf Oil States in the first decade of the current century.

Return

Chemical Engineering Artists

There was a fateful Faculty members' New Year's Eve (year unknown) party at the Faculty Club. A few drinks had been imbibed and all was getting merry, to say the least. Rhodes was enjoying dancing with Mrs. Ethel Fahidy when a proposition was made. As a New Year's resolution, "I wager that I can outlast you in singing lessons" was a challenge put forth in merriment! The loser was to deliver either a set of opera vinyl records (Ted to Ethel) or a bottle of Scotch (Ethel to Ted).

Ted forgot all about the challenge until a few days into the following year when Ethel marched into his office and announced she had arranged auditions with a certain young singing teacher by the name of Lynda Neufeld (recent graduate of Waterloo Lutheran University) and that if they passed that audition, they would be signed up for lessons.

Obviously both passed the first test (Lynda needed the money) and their artistic second careers began. Who outlasted the other remains still to be determined, but Rhodes has sung his way from coast to coast in Canada and has just sung the Bach Christmas Oratorio (Christmas 2013) with the Victoria Symphony Orchestra. His wife still claims he makes his hobbies into work. The prizes have never been claimed by either party of the original wager.

Of course this raises the interesting fact that many of our great chemical engineering faculty members are also great artists, artisans, and connoisseurs. Bob Hudgins is a magical piano player. He and Ted Rhodes did small recitals together. Carl Gall was a professional actor who appeared in plays at Stratford and directed both plays and operas. What Park Reilly didn't know about opera isn't worth knowing. (A few more: Alan Turner was a brilliant model railway builder; Jim Ford was an important soccer coach etc.)

Bob Hudgins

Carl Gall (1984)

Return

The Rempel Years

The Burgess Shale

Once posted on the door of the retirees' room:

Welcome to the Best of the Burgess Shale*

Beneath a slump of papers and old notes
Are buried relics of our recent past —
Chem engineers sans lab'ratory coats
Perusing jokes and theses first and last.

Within these lush accretions you will find
Soft-bodied vertebrates of ageless mien,
A spot where ancient faculty unwind
Once they have left the hyperactive scene.

The fauna layered here are near unique.
This quarry offers its own evidence —
The fossil record's naked, so to speak.
So come on in, enjoy the ambience!

Don't let the lack of oxygen offend —
Anoxic air preserves us without end.

* The Burgess Shale Formation is a Canadian fossil field noted for its unique species. Credit to the Departmental Poet Laureate, Bob Hudgins!

Return

A Traveller's Life

A researcher's life includes many opportunities for travel.

While many chemical engineering faculty members could vie for the title of "Most Travelled" over the years, Pete Silveston owned that title while employed at UWaterloo. In 1965, after four consecutive terms on campus, he went to the University of California, Davis, for eight months. Then, after only four terms on campus, he left for another eight months in the US.

Soon afterwards, the University dropped the plan that allowed faculty to take off a double term. Nonetheless, Silveston vanished from campus every term he wasn't teaching – and often even during the roughly three weeks between the end of one term and the start of the next. All these departures and arrivals were noticed by his departmental colleagues. Indeed, Gerry Mueller, another department wag, dubbed Silveston as "Waterloo's only visiting professor with tenure."

Silveston's satirical title was possible because of Bob Hudgins' willing participation. He managed their co-supervised research effort while Silveston was absent. Of course, this arrangement worked both ways. Hudgins also took leave for stimulating sabbaticals in Canada, Europe, and New Zealand. Thanks to the year-round teaching needed for co-op, both Silveston and Hudgins shuffled their teaching terms to have two successive terms off campus.

Bob Hudgins penned the following bit of doggerel in recognition of his colleague's proclivity for travel. Since it was written stenos, typists, draftsmen, and dictation machines have all become extinct and fax machines almost so.

Silveston's Leaving Town

The fax machine is humming
As his typist adds a noun,
The draftsmen's brows are fevered 'cause
Silveston's leaving town.

His desk is soon chaotic
And his plants are turning brown.
His limo driver idles ere
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No dean would turn him down.
Whenever there's a conference
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Now the corridor's deserted
While cassettes recite his sound:
It's The Voice of the Departed.
Silveston's now left town!

L'envoi
Enjoying perfect silence,
You're in your dressing gown.
Uh-oh, the phone — it's cheerful Pete:
My slides! Quick! Mail them down!"

Yes, the Editors know this is the 2nd appearance of this, but It's worth repeating!

Return

If the facts are against you, baffle them with science!

According to Tom Fahidy, many moons ago Kun Soo Chang was charged by police in Guelph with dangerous driving. He was exiting a clover leaf to enter a main artery and the cop thought that he did not leave enough room for a car coming up behind him.

Kun Soo went to court equipped with portable chart-board and coloured markers, set it up in front of the magistrate, then drew several pictures, wrote on the chart a couple of differential equations and proceeded to show that given the "geography" of the area (he had apparently gone back to the scene with a measuring tape prior to the court case), his speed and the most likely speed of the other driver, it was physically/mathematically impossible that he would cause any danger to that driver. Properly stunned, the magistrate stared at him, shook his head and announced that, although he did not understand a word of what Kun Soo was saying, he was nevertheless impressed with the presentation, so he would impose neither a fine nor demerit points. Just the same, Kun Soo was to pay court costs.

Face was saved!

Return

Cheating prior to the smartphone

In the late 1970s or early 1980s, when cheating during exams became fashionable to some, faculty members developed their own strategies to fight back.

Tom Fahidy created two exams: A and B. Without mentioning his strategy, he distributed the exams across the rows in an A B A B pattern. With Fahidy in charge, ten or twelve graduate student invigilators paced the room watching the students closely.

In Tom's playful telling, "The silence was deafening. You could hear a fly having a heart attack." The exam ended and students handed their papers to Fahidy and left. One of them flashed a brilliant smile and said, "Sir, there are two versions of this exam, aren't there?"

By the nineties, mid-term exams were often held in close quarters, since exams and lectures were starting to compete for the use of lecture rooms. Bob Hudgins was sure that the cheek-by-jowl proximity of some first-year students was an inducement for some "cloning" of answers.

In a defensive move, he prepared two exams that differed only in their numerical values and handed them out according to a checkerboard seating pattern that was carefully noted. During the marking, several students were found to obtain a few right answers to the wrong exam paper. Confronted, they admitted guilt.

The associate dean of undergraduate studies invited them to a little chat during which he allowed them and their answer-donors to continue in the course with an academic penalty and warned them of the dire professional consequences that could result from any further offence. Apparently, the warning was heeded.

Gerry Mueller adds that there were other strategies. He notes that Jeno Scharer, who was a bit of a puzzle fan, once devised an exam with four versions and a strategy to reveal the cheaters and their abettors. Then another time, he handed out the same exam printed on four differently coloured papers.

June Lowe (1984)

June Lowe, who taught the first-year design lab, used to set a mid-term take-home, with strict instructions against copying from or consulting others. She too made it easy to identify who had copied and from whom. The guilty were then sufficiently threatened with expulsion if they ever did it again. Then these facts were carefully" leaked" to the entire class, so that most got the message that we were not fooling around with academic infractions.

These faculty members who taught before smartphones became universal must wonder how examinations of students in parallel can be organized, apart from individual oral exams, an impossibility for large classes.

Return

Tragedy fueled by Alcohol

Not all anecdotes are lighthearted. The following is truly tragic. You may not wish to read any further.

On New Year's Eve 1992, one of our married third-year ChE students consumed nearly a litre of champagne and half a bottle of scotch at his apartment. Shortly after midnight, he left the married students' complex intending to play computer games in one of the engineering buildings. When his userid would not allow him on a computer, he became furious and left the building.

David Zaharchuk (1982)

He proceeded to Engineering 1, which he entered by smashing the glass of an exterior door leading to the second floor. There, he kicked in the door of the Reaction Engineering Laboratory and found an oversized wrench used to attach gas cylinders. Still enraged, he shattered several pieces of research equipment with it and left the lab.

From the second-floor hallway, the highly agitated student moved to the first floor of the laboratory wing smashing things as he went. There, graduate student David Zaharchuk, until that moment alone in the building, was editing his overdue PhD thesis, expecting to submit on January 2. Responding to a disturbance in the hallway, David left his office where he surprised and was slain by the crazed student wielding the wrench.

The killer, having placated his fury, made his way back to his apartment. A day or two later, he left for his work term assignment in Alberta. After a month, he returned to Ontario and turned himself in. In the meantime, police were baffled, since there had been no witnesses. Later in the year the student pleaded guilty to manslaughter and received a 10-year prison sentence.

A memorial bursary was created in David's memory.

Return

Plagiarism Detection Before Internet Searches

As a PhD comprehensive exam committee member in the mid-eighties, Professor Tom Fahidy was wading through a poorly written proposal when he suddenly read a paragraph of impeccable style and excellent scientific material, but without any reference(s).

His suspicion finally settled on a widely known article published by an equally widely known researcher in the field. Suspicion was confirmed upon a brief visit to the library.

When questioned why he lifted the offending paragraph verbatim, the candidate blithely stated that it had been so well written by its author that he himself could not have done a better job

Return

The Chatzis Years

A Long-term Tragedy from the Solution of the Alcool Problem

From the beginning, the department has been supported by chemical engineering technicians who operated our machine shop and analytical labs and prepared our teaching laboratories. Everyone was surprised when one of them suddenly lost his sight over a weekend.

The cause was attributed to his close and long-term work with the departmental still, which was used to teach students about unit operations, transport phenomena and separation processes.

It contained ethyl alcohol that was denatured with methyl alcohol, a known poison, a substitution for the original ethanol-water made for both pedagogic and legal reasons. Even a small amount of methyl alcohol can cause toxicity and death, preceded by other symptoms including vomiting, abdominal pain and decreased vision, among others. Apparently, there was enough methanol vapour in the air near the still to have destroyed all but some peripheral portion of the technician's eyesight.

Return

A Canoe Trip from Hell

Pete Silveston and Bob Hudgins took their research students on occasional canoe trips on local rivers. Pete, an avid paddler, promoted the canoe trips among foreign academics as "an introduction to Canadian culture."

Bob Hudgins (rear) leading Team-building Trip

In the early 1990s, when Pete hosted a team of Japanese visitors, he invited them and three of his Canadian students on a canoe outing that would take a summer afternoon on a river west of London, likely along the meandering Thames River. Cars had to be stationed at the planned terminus.

The canoe trip got underway after a major delay. It began at 2 pm instead of the planned 11 am. The first couple of hours were pleasant paddling, and the group stopped for a snack along the shore. Then, soon after re-launching, the canoes began scraping rocks in the shallow riverbed.

Though it would have been smart to abort the trip then and there, Pete was guiding the trip without a map. In addition, there was no road beside the river bank to act as a good spot to haul out.

After another hour, Pete and the Canuck students reluctantly climbed overboard to slog through the shallows to maneuver the canoes past rocks that were becoming less visible as the sun set. Progress was painful, slow, and wet. The air temperature dropped and a mist descended on the river.

No one had a flashlight. Any moonlight was obscured by the mist. Exhausted, the party finally reached the take-out point shortly before midnight. Everyone in the company helped drag the canoes up a steep bank and to the waiting cars. Ending the journey offered little relief to a sense of disappointment.

An hour or so later, the group arrived at the guests' hotel. As they shook hands, the Japanese visitors murmured "… a very interesting excursion … thank you very much."

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A plug for modified lecturing

Having read about and listened to professors and lecturers who had modified the lecture method, Bob Hudgins decided in mid-career to do a similar thing. So, in subjects that required quantitative problem solving, he used a lecture format to work through one or two typical problems in the first half of the class. Following that, he would assign a related problem or two to be done to complete the class.

Although the approach was greeted with some bewilderment when first started, students seemed to become well-adapted within a short time. This method offered some formal guidance at the beginning of each lecture, followed by a chance to apply the methods shown. It then gave him a chance to talk with a number of them about problems they might be having with concepts or solution techniques. Also, they could work individually or in small groups as they preferred. Incentive to complete the problems was a single point for a correct result as part of a term mark that was diluted to a few percentage points of the overall grade for the course.

The course's teaching assistant joined the walk-about feature of the final half of the class. It was more than a pleasant escape into informality. More importantly**, it required the participants to formulate questions of their own, to spot where their own thinking might be deficient, and learn from it.** Not all students were fans, but many seemed pleased to be able to learn in a consultative style of problem solving. The hope was that this method might also prepare them for their professional activity as graduate engineers.

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