# Chemical Engineering at West Virginia University: A Living History

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**Table of Contents**

Tumultuous Start for Engineering (1867 - 1921) ........ 1

The Hodge Era (1921 - 1938) ........ 4

The Koehler Era (1938 - 1958) ........ 8

The Simons Era (1958 - 1970) ........ 30

The Wen Era (1970 - 1981) ........ 35

The Henry Era (1981-1988) ........ 64

The Cilento Era (1988 - 1999) ........ 86

The Dadyburjor Era (1999 - 2009) ........ 93

The Gupta Era (2009 - Present) ........ 109

# Tumultuous Start for Engineering (1867 - 1921)

When WVU started in 1867, the student/faculty ratio was 1:1 with six students and six professors. Tuition was $8 per semester; room and board was $3.50 per week. The new University took over the building that housed the Woodburn Academy for Women, but wouldn't let women enroll. The Civil War had ended just two years before and sentiment ran high: Northern sympathizers at WVU wanted to admit women; Southerners did not.

Twenty years later, WVU offered engineering courses, but these were part of military studies. Then in 1887 civil and mining engineering began as one program. What is now the vibrantly successful Benjamin M. Statler College of Engineering and Mineral Resources was up and running.

By 1889 enrollment was so low that the administration admitted women. Engineers and the sciences demurred, wanting none of that nonsense.

"This is an outrage. Women in engineering? Never!" fulminated William Aldrich, who taught mechanical and civil engineering. "It is a man's field . . . it requires intellectual perception, a keen mind, quick wit, and an able body. There never have been; there never will be."

Time and fate proved Aldrich wrong. There are now many women studying chemical engineering (ChemE) at WVU, and several are on the faculty.

Two years later, engineering added a civil engineering department, and trouble started again. Although 30 years had passed since the Civil War, partisan tensions vibrated in a faculty still divided between Yankees and Confederates. Aldrich, a Yankee, re-organized mechanical and civil engineering. Colonel Jackson, a relative of Stonewall Jackson, had southern inclinations, and a deep interest in civil and mining engineering. Aldrich wondered, should there be a new school for mechanical engineers? Jackson demurred. They argued also about engineering education in general. After three years of infighting, Jackson left WVU. The Yankees had won again.

The next chair of civil and mining engineering had equally bad fortune; Henry Davenport quarreled with the administration and lasted just two years. Turmoil was endemic in these early years, and in 1893 the Board of Regents had had enough. A faculty committee ran the University for the next two years until another president came aboard.

In 1895 the College of Engineering offered mechanical arts classes, stressing hands-on shop courses like welding.

In these early years, each student had to attend daily chapel where Holy Scripture and prayers were mandatory. Students attended church on the Sabbath; in fact, the University president himself taught the Christian religion to the engineering students.

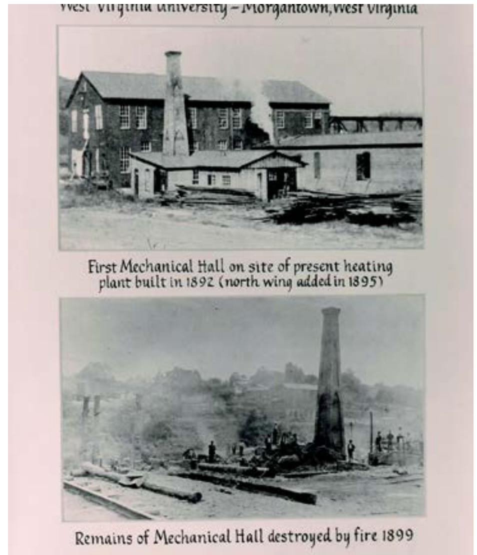
Many students resisted, as did Aldrich. He explained, “The requirement of daily convocation for the youth in attendance here is ludicrous . . . my students are not desirous of the pursuits of immortality.”

Though Aldrich stuck up for his students, irritations continued for engineers on campus. In 1897 WVU President Jerome Raymond told the engineering faculty they must do maintenance work around the campus, building benches and chairs. They felt degraded.

Though the faculty felt free to smoke, Raymond proscribed tobacco use on the University grounds. In 1899 the Mechanic Arts building (also called Machinery Hall), located on Beechurst Avenue, burned down seven years after having been built. Though the cause of the fire was unknown, some thought since the engineering faculty included smokers, they could be the culprits.

Whatever the spark, all the engineering library books and records went ablaze. The engineering faculty had spent personal funds to give the library the best, most current engineering books and magazines. Engineering students then went to Fife Cottage and Science Hall for classwork. In 1902, a new Mechanical Hall, located on North High Street, replaced the burned one.

By 1908 students still had to attend chapel, and neither students nor faculty could use tobacco on campus. However, during the University's early years, West Virginia students enjoyed free tuition; others paid $30 a semester. Room and board, laundry, and books only ran about $168 a semester.



Before and after the fire of Mechanical Hall

By 1916 the Draft Law affected students; those who signed up did not have to take final exams. Students unaffected by the Draft Law were furious; unfortunately some engineering students who refused to take exams never got their degrees.

In 1917-18, chemical engineering classes got a toehold at WVU, and seven students signed up. The curriculum would teach young men to design, build, and manage manufacturing plants. The engineering college now offered four years of chemical engineering classes. Beginning students had to know German to matriculate.

The first class included Charlie Carden from Weston; John Gregg from Morgantown; Fred Houston from Elm Grove; Paul Nifflen from Elkins; Benjamin Preiser from Moundsville; Newell Stewart from Sistersville; and Ernest Thompson from Toms River, New Jersey.

Chemical engineering students took two years of military science courses, given for six summer weeks, for two years. For the first two years, there were no chemical engineering professors. The courses' instructors came from other disciplines.

The advent of chemical engineering heralded a sea change in engineering education. At the end of the day, students went home with less grease on their clothes and fewer grimy fingernails. Higher math classes became more important, as did basic research.

# The Hodge Era (1921 - 1938)

Willard Hodge was the first chemical engineering professor at WVU; he joined the faculty in 1921. He had a master's degree, and taught a combined course in chemical and metallurgical engineering. In 1921, he became the first chairman of the department of chemical engineering when it split from mechanical engineering. The first chemical engineering program had started at MIT in 1920, one year earlier. Also in 1921, West Virginia began licensing professional engineers (P.E.), who would need to show their competence, experience, and pass a written test on theory and practice. Twenty-three years later Hodge would become WVU's engineering dean.


*In the Metallurgy Laboratory, Mineral Industries Building*
*Left to Right: W.W. Hodge, J.R. Macdonald and Jane Zinn, Secretary*

Engineering continued to grow at WVU. Hugh Jones and Aubrey Ford became student assistants. The students attended classes in the basement of Mechanical Hall. The new chemical engineering department enjoyed fast growth due to advances in chemical technology. In 1922, the department had two graduates.

The WVU Engineering Experiment Station started in 1922. There were many extension classes, and ceramics played a large part. Chemical engineering had a research fellowship in both coal and ceramics.

In 1922, Tau Beta Pi, the engineering honorary, became a part of campus life, and by 1929, the College of Engineering was thriving, with 50 faculty members and 371 students. As decades passed, engineering students continued to have fewer shop courses and more math.

## Engineering and Science Honor Societies at the University:

| | | |
|---|---|---|
| Tau Beta Pi (1885) | Engineering | Alpha Chapter 1922 |
| Phi Lambda Upsilon (1899) | Chemistry | Tau Chapter 1924 |
| Omega Chi Epsilon (1931) | ChE | Theta Chapter 1958 |
| Sigma Gamma Epsilon (1915) | Earth Science | Upsilon Chapter |
| Sigma Xi (1886) | Research Scientists | Inactive |
| American Institute of Chemical Engineers (1908) (AIChE) | | |

Chemical engineering professor Walter Koehler joined the WVU faculty in 1923. He had his M.S. degree, and began a pottery at Jackson's Mill 4-H camp and also worked with the state's water purification conferences.

Joseph Berkenstein and Frank Burdette served as student assistants in that year. By the following year, Koehler finished his doctorate, and George Stein became a student assistant. In 1925, John Osmond became a student assistant.

In 1926-27, the department started awarding the M.S. degree. Students had to finish 32 credit hours of coursework, eight of which would be for their thesis, and had to spend a year on campus.

In this year Harold Harkins and Frederick Villers became student assistants. In 1928, Villers continued, and William McElroy worked as a student assistant.

Clyde Jenni joined the faculty as an instructor in 1928. Homer Haskins and Richard Newton became research fellows. William Schambra became a student assistant.

In 1929-30, the director of the Engineering Experiment Station was Clement Ross Jones, and Professor Hodge was assistant director. Its purpose since 1921, said the Board of Education, was to do research and conduct experiments.

In the 1930s, students could select from chemical, metallurgical, and ceramic engineering within the department. In 1931-32, Professors Parry, Cather, and Irons joined the faculty.

By 1932, religion had a less dominant place at WVU. Each Wednesday at 10 a.m., there was a convocation to sing, pray, and hear announcements; attendance was voluntary. One presumes classwork regularly interfered with attendance by hardworking engineering students.

Courses in pipe fitting, machine work, foundry, and blow pipes were still part of the curriculum. Professor Brown came aboard in the late 1930s.

Between 1921 and 1943 there were 89 graduates in chemical engineering. Fourteen people earned master's degrees in the department. In 1932 Charles Potter of Greenfield, Missouri, earned the first WVU Ph.D. in chemical engineering, eight years after the first chemical engineering Ph.D program started at MIT.

By 1931, three women had earned engineering degrees at WVU. One was Emma Myers, a chemical engineer who earned her master's degree two years later.

Since the early days, snarled traffic has been infamous on the WVU campus. In 1930, the administration wanted either a tunnel or a high bridge from Oglebay Hall over to Sunnyside. The engineers resisted such ideas as impractical. Another disagreement began when engineering dean Clement Ross Jones did not want to start a graduate school. He also did not want the School of Mines to leave engineering.

Jones, however, would be hard for the administration to fire. Under his direction, engineering had grown considerably and earned high regard. He cared for his students; during these early days of the Great Depression, Jones got jobs for his students and even loaned money to some.

WVU President Turner looked for a subterfuge to rid himself of his balky engineering dean. Here's how he did it: Turner told Jones to recommend R.P. Davis as assistant dean, who would then act as dean when Jones was away from campus. The embattled engineering dean, though wary, consented, clearing the way for Turner's power play in 1931.

Two days later, Jones left Morgantown for a conference in Montreal. Davis moved. Engineering and Mines quickly became different colleges. While Jones was away, Turner had also changed the budget, the requisitions, and the appointments.

Jones understandably stated that this assistant dean thing was not working well. Turner, however, had won, and Jones' rank became emeritus. The fallen dean took a salary cut.

The new dean, R.P. Davis, decided all freshman engineering students would have the same curriculum. They would need more mathematics but fewer courses, making the degree a bit less expensive.

Chemical engineering was the first department at WVU to offer the Ph.D. Dean Arents used that success in the 1970s to leverage a college-wide doctoral program that included all engineering departments.

In 1936 the WVU College of Engineering, continuing to advance nationally, was among the first schools accredited by the Engineers' Council for Professional Development.

In 1937-38, Professors Barrett and Cantelo joined the faculty. Professor Hodge left the faculty, returning for the 1940-41 term. Professor Skeeters joined the faculty in this year, and in the following year, H.P. Simons came aboard.

# The Koehler Era (1938 - 1958)


*Electroplating Section, Mineral Industries Building, — 1942*
*Left to Right: W.A. Koehler and A.F. Galli*

In 1938 W.A. Koehler became the chemical engineering department's acting chair. By the late 1930s, shop courses became even more outmoded and scientific lab courses started to take ascendancy in engineering departments.

Between 1935 and 1945, WVU had 228 chemical engineers graduate, and 24 earn their M.S. degrees. In 1940, there were 31 graduates in chemical engineering at WVU, and eight students earned their M.S. degrees.

In 1942, the chemical engineering department moved from Mechanical Hall, where they had 7,000 square feet, to the first floor of Mineral Industries, where faculty and students had more laboratories and 15,000 square feet. This first-floor complex, built partially below ground level, soon filled its new space.

World War II initially took a toll on WVU's engineering enrollment when 50 percent of its students left for the armed services. Military enrollment, however, kept numbers high.

In 1944, West Virginia Governor Matthew Neely fired the entire WVU Board of Governors, replacing them with people willing to fire WVU President Lawall and Engineering Dean Davis. The charge? "They were not handling the University's affairs properly," a rather vague insult.

Davis had been working on national and international bridges at the time, so he may have become distracted. Moreover, his faculty believed Davis was too much of a penny-pincher. Davis stepped down to become professor of structural engineering, and Willard Hodge took over as dean.

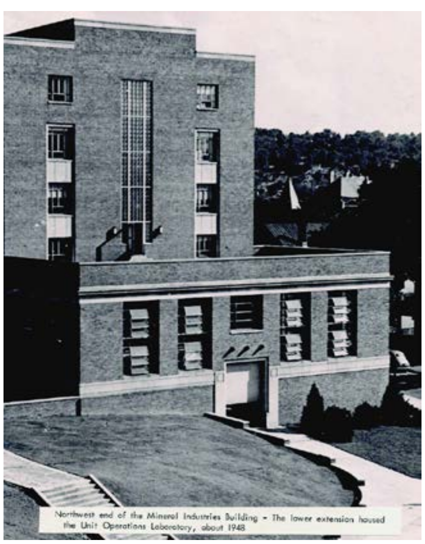
These changes at WVU caused a major eruption. The state Senate took over, naming new Board of Governor members to preclude such chaos from happening again. A new Board of Governors reappointed Davis as engineering dean and he served from 1945 until he retired in 1956.

The G.I. Bill allowed returning vets to attend the University. Technical skills learned in World War II helped develop an interest in engineering, so the College's population rose when these veterans finished military duty.

Teaching support came from engineers in nearby industries, with able help from the engineering faculty who mentored them with their own teaching expertise. The engineering student population continued to rise, so the faculty started night classes. These extra classes also obliterated lunchtime. Adding to the already heavy student load, more humanities classes entered the engineering curriculum.

In 1946, Walter A. Koehler took over the Engineering Experiment Station. Koehler got the position because, at that time, chemical engineering was the only department doing much engineering research.

Koehler ran the chemical engineering department from 1945 until 1961. His doctoral students cared deeply about him, and they would meet for reunions at the Hotel Morgan. Also in 1946, Harold Fairbanks joined the faculty.




*Northwest end of Mineral Industries Building – The lower extension housed the Operations Laboratory — 1948*

Three years later, Alfred Galli joined the faculty. He taught students for 40 years.

From 1947 until 1958, the popular Irvin Stewart presided over WVU, which then had about 15,000 students. Stewart could not have known all his students by name, but if they passed him in some faraway airport, they would get a quick smile of recognition.

The chemical engineering department became nationally accredited in 1948. More money came to the department, as accreditation spoke of high-quality education, and graduates found becoming a P.E. easier. Again there were course changes, and again they involved more mathematics and advanced engineering.

In 1948, WVU bought land that eventually became the Evansdale Campus. The Dille and Krepps farms became the site for the engineering buildings. Student fees helped retire the bonds that paid for the campus. This was a new and successful concept in our country, and soon other universities used student funds this way.

In 1954, Chin Yung Wen joined the faculty. Koehler had a habit of renaming foreign students who had names sounding strange to western ears, renaming Wen "Jimmy." L.T. Fan became "Clancy." Narayan Haribhau Harkare became "Harry."

*Staff of the Chemical Engineering Department — September 1954*

In 1955, Chester Arents became engineering dean. One year later, a fire destroyed Mechanical Hall, which had oiled, wooden floors. The infamous "Tin Can" took over. This time, no one blamed engineers who smoked.

Nuclear engineering, under the direction of James Kent, became a part of chemical engineering, but was a broadly based program that admitted graduate students with other engineering degrees.

Chemical engineering professor Alfred Galli worked at the national level to create the P.E. test given by the National Council of Engineering Examiners (NCEE). Galli was active for many decades in this work. Dean Arents, also interested in the P.E. exam, served as president of NCEE.

In 1957, chemical engineering awarded three Ph.D. degrees, a quarter of all doctorates given at WVU at that commencement. One doctorate went to Chin Yung Wen, whose life work brightened the department until his untimely death in 1982.


*Department of Chemical Engineering Staff — 1959*
*Left to Right: C.Y. Wen, R. Barnard, R. Seeger, A.F. Galli, P.R. Jones, C.E. Walls, J.A Kent, W.E. Crockett, H.V. Fairbanks, Mary Ann Bartuch, H.P. Simons, Joan Morony and W.A. Koehler*

On January 31, 1958, under Koehler's chairmanship, the state legislature, with Senate Bill 79, established the Kanawha Valley Graduate Center (KVGC) of Science and Engineering. The Graduate Center, at the request of Kanawha Valley companies Union Carbide, DuPont, FMC, and Monsanto, began offering master's degrees in chemical engineering, mechanical engineering, and chemistry. The tuition was $150 per course, with the four companies making up any budget deficits. The companies also refunded most of their employees' tuition.

During the first semester of operation, there were 82 course registrations, 64 of them from Union Carbide. James K. Stewart of WVU became the first director, but the faculty were mostly from Union Carbide, including R.R. Ashley, a WVU graduate; Edgar Lavergne; and Charles H. Gilmour. During these early years, Gabe Harris, another Union Carbide employee, chaired the student organization.

Richard Barnard, a WVU Ph.D. graduate, was named to lead the engineering offerings of the Graduate Center with offices in the Heck's warehouse in Nitro, West Virginia.

In 1967, with KVGC's success in serving industrial employees with the possibility of earning a master's by taking late afternoon and evening classes, other employers wanted programs to serve their employees. Thus, business and education classes became a part of the Graduate Center.

Finally, in 1972, probably due to heavy lobbying by Charleston-area industries who were footing more and more of its costs, the legislature passed HB 618, which converted the Graduate Center under WVU to a free-standing, state-supported institution. The faculty members, by their choice, also were no longer WVU employees.

The new institution, after several different name changes, still exists. Unfortunately, the industrial climate slowly changed when Dow Chemical bought Union Carbide and started to move most of its chemical engineering employees to Michigan. This led to the steady decline in chemical engineering enrollment and the elimination of the chemical engineering master's program at KVGC.

West Virginia University's department of chemical engineering has always been more than science, teaching, and research. During the years in Morgantown, we became family to each other. Down through the many decades since, old ties still bind us together.

## Recollections

*Dr. Walter Koehler, Dean of the Graduate School and his wife — October 1, 1976*

What follows are personal memoirs from this era from people connected to the West Virginia University department of chemical engineering. These stories depict students' lives during their Morgantown years and their careers after they left the University. If our past is prologue, we can continue to expect greatness. With fondness and admiration, we remember those who have passed away. Students, colleagues, and spouses have written of these people.

This first memory of college days and a stellar chemical engineering career comes from Wisconsin, and was written by Lenore McComas Coberly, a professional writer and Cam's wife:

*"1942 - I had never been to Morgantown, nor had I ever met an engineer when I embarked from Hamlin, Lincoln County, for my first year at West Virginia University, in 1942. To get there, my cousin, Lena Jo Hauldren, and I were taken to Huntington to catch the midnight train to Parkersburg. The train carried milk and stopped often.*

*"In Parkersburg we walked from the C&O station to the B&O to catch the 2:30 a.m. train to Grafton, where we caught the 8 a.m. bus to Morgantown. We were to take this journey many times, alternating with riding the bus from Charleston, sitting in the aisle on our suitcases – assuming we could get a ride between Hamlin and Charleston.*

*"We had high-heeled pumps, which we had never had before, and on the first Sunday in Morgantown we walked down the brick street to the First Baptist Church on High Street. Since we lived in*

*Terrace Hall, those pumps grew dusty from not being worn. However, that first Sunday was the day I met my first engineer. Camden Coberly was the president of the Baptist Student Fellowship and he greeted new students at the door of the church. He was a sophomore in chemical engineering, but it was church that brought us together.*

*"My mother was killed in an auto accident the next spring and the whole Baptist student group met my bus when I came back to finish my freshman year. I would be spending increasing time with engineers.*

*"My first real date with Cam was for dinner at Walter Baker's apartment across the river from campus. We walked, of course, as everyone did. When we got to the middle of the bridge, Cam stopped and dropped something into the river. There was a shocking explosion. Walter, watching from his window, knew it was time to put the rolls in the oven. So I not only learned about sodium that evening but I was introduced to engineering humor and to the future best man at our wedding.*

*"Both Walter and Cam were in the Naval Reserve and knew they would be leaving for wartime duty. Walter served on a battleship in the Pacific, and Cam, after radar training at Princeton and MIT, served on a radar equipped destroyer in the North Atlantic. He was ready to sail on a Texas radar picket ship into the Pacific when the atomic bomb was dropped. I knew from his letters that the strawberry feeds and adventures disposing of Prof. Hodge's explosives in Morgantown seemed very far away but were important to remember.*

*"1946 - I had started graduate work at Pitt when the war ended. Cam enrolled in what was then Carnegie Institute of Technology. When we were married at my aunt's home in Huntington, with Walter as best man, both men were still in uniform.*

*"While Cam and I were living in Pittsburgh we went down to Morgantown on the bus for a weekend. Cam went to see his professor, W.A. Koehler, who had gotten his doctorate from Wisconsin. He advised Cam to go to Madison and study with Olaf Hougen.*

*"At the same time, I was talking with my professor in business, O.A. Roberts, and he told me I would be able to get a teaching job at Wisconsin where GI students were returning in unprecedented numbers. Dr. Roberts also came from Madison. Cam and I were to learn that Wisconsin had always produced more doctoral graduates than the state could use and a surprising number went to West Virginia.*

*"So we went to Wisconsin, lived in GI barracks, and got to know the remarkable Olaf Hougen. When Cam was deciding where he would work, he went to visit several companies in Delaware, Ohio, New York, Virginia, and Missouri. Engineer-like, he made a chart of job offers by salary, location, opportunity to advance, interesting work, etc. Then he weighted each factor. Mallinckrodt of St. Louis was last on the list, but he said, "That is where I want to go." Whoever suggested that engineers aren't intuitive? One of our children was born in Madison, three more were born in St. Louis—all in five years. We were busy.*

*"Cam always said he was going to teach, but he thought engineering professors should have work experience. In five years, he was chief engineer at Mallinckrodt and Mr. Mallinckrodt was asking his advice about the ancient plumbing in his St. Louis home. After our younger son, Robert, became a student at Central Institute for the Deaf and Aphasic (Washington University), it was clear that we would stay longer in St. Louis.*

*"Cam returned to the University of Wisconsin-Madison as a tenured professor in 1964. He soon became chairman of the highest-ranking chemical engineering department in the United States. He moved then to the Engineering Experiment Station and later to associate dean with responsibilities for research, foreign programs, and other activities of the College of Engineering. He also spent an extended time on Bascom Hill, advising Chancellor Irving Shain, who told me Cam was his most trusted advisor.*

*"Under Cam's leadership an engineering college was built, staffed, and funded by the World Bank, in Surabaya, Indonesia. He also advised programs in many countries, including Colombia, Egypt, Liberia, Pakistan, India, and the Philippines. His unusual ability to speak clearly and briefly served him well in this work.*

*"1979 - In February, right after the fall of the Gang of Four in China, Cam and I went with a university delegation, led by Chancellor Shain, to the People's Republic of China. This amazing experience resulted in many students and faculty coming from China to Madison. One especially memorable time was when the president of Hunan University and 10 of his faculty came to our house for Thanksgiving dinner. I roasted a 30-pound turkey and stuffed it with rice and Cam carved it at the table (extended with card tables) to the delight of our guests. As we finished a very leisurely meal I asked the university president, who was very old and spoke no English, to tell us about the Long March, in which I knew he had taken part. With tears streaming down his face he recounted that experience and a younger translator, who had learned English from missionaries, struggled to keep up. The next day Cam introduced them to Frisbees and they took 20 back to China.*

*"Cam returned twice more to China, once with Chancellor Shain and once for AIChE. We continued to have Chinese students and visitors as guests in our home. Indonesian faculty, students, and visitors also often were our guests. The wife of one professor who stayed in our home asked me to show her medical facilities since she was a public health nurse. She placed orders for two Red Cross emergency vehicles to use as clinics in Java. Perhaps I had learned something about engineering problem solving!*

*"After Cam retired he returned to the department and taught part time. His experience in the field helped him come up with interesting problems. He was first an engineer but also a teacher, as his father before him had been.*

*"I think there was nothing that delighted him more than going to the Academy of Chemical Engineering meetings at Morgantown. When Joe Henry invited him to his first Academy meeting he asked me to come as well, and Cam and I had a delightful weekend. West Virginians understand hospitality! This annual event strengthened old ties and created new ones among chemical engineers. Betty Miller and I were sorority sisters as undergraduates before she actually got into engineering.*

*"Cam often spoke with gratitude for his training at West Virginia University that made him an engineer. Through my long life among engineers from all over the world, I have asked them why they became engineers and the answer is surprisingly uniform—they like to solve problems. For that I am thankful.*

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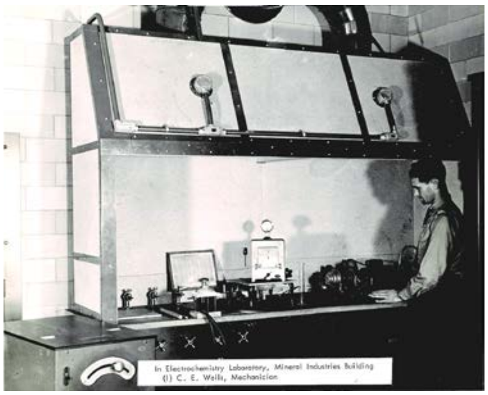
What follows is **J. Reginald "Reg" Dietz's** recollection of **Charles Ernest Walls**, laboratory assistant and mechanician:

*"Ernie Walls was the 'go to' person in the chemical engineering department when I was a student there in the late 1940s and early 1950s. If you needed something repaired, Ernie was your man. If you needed some things from the storeroom, Ernie had the key. If you needed a box made or a repair made to a unit in the pilot plant area of the building, Ernie could do the job. He didn't have any high-sounding degrees; he just knew how to get the job done.*




*C. E. Walls in the Electrochemistry Lab, Mineral Industries Building*

*"Ernie had a shop on the ground floor of the Mineral Industries Building for woodwork and some metalwork. He had cabinets in the shop, which had fine tools stored in them, and they had strong locks on the cabinet doors. Like most craftsmen, Ernie protected the use of his tools of the trade very carefully. These were the days when the ChemE department was located in the Mineral Industries Building (White Hall today).*

*"Senior design was an important ChemE class back in the 1950s, and Dr. H.P. Simons was the professor in charge. The class required ChemE seniors to select a chemical to produce, and then the class had to design a chemical plant that would start with the raw materials and produce this chemical. In my senior class, we chose to produce high-purity phenol from the raw materials of benzene and salt brine.*

*"We called our company the No Khrudde Phenol Corporation. After the design of the plant was completed, we had to build a scale model of the plant and lay it out on a 4' x 8' piece of plywood. Wow! This is where Ernie came in. Oh, Ernie didn't build the scale model of the plant. We students had to do that. But we called on Ernie to show us how to make wooden and metal parts that looked like the real thing only on a much smaller scale, and we did much of this work in his shop.*

*"Ernie cringed when a new class of ChemE students came to his shop to use his equipment to make their scale model of a chemical plant. Many of these students had little or no experience using power tools and hand saws, etc., and so they didn't know how to take care of the tools. Ernie would just shake his head sometimes, but he always tried to help the students with their tasks, and he gave them safety instructions on the use of the tools in the shop. I should add that there were some tool cabinets that Ernie never unlocked when the student engineers were in the shop. Usually, when the scale model of the pilot plant was completed, the senior design class was completed, and graduation was just days away. That was a relief for the students and a relief for Ernie.*

*"Ernie joined the ChemE Dept. in 1938, and I seem to recall that he retired sometime in the 1970s. He and his wife, Mary, lived on a farm on the outskirts of Morgantown. A few years after retirement Ernie and Mary were invited to attend a ChemE Academy dinner at the Erickson Alumni Center. They accepted the invitation, and Ernie proved to be the star of the evening. All of Ernie's long-ago students flocked to see him and chat with him when he appeared at the dinner. When the picture was taken of the Academy group, everyone insisted that Ernie be seated in the center of the group. When the dinner was over, Mary and Ernie went home, and Ernie still had that shy smile, for which he was well known, on his face. No tools damaged, no tools lost! A good evening.*

*"Mary and Ernie are gone now. Mary Walls passed away before Ernie died, and Ernie was lost without Mary. I don't remember the dates of their passing, but I attended Mary's wake and then a few years later, Ernie's funeral."*

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**Further recollections by Reg Dietz:**

*Walter A. Koehler, chair: A person of the highest integrity, he could always find a small job for a student who needed to earn some money to help pay his college bills. I worked in the store room cleaning and dusting the various cans and jars of chemicals. John Doss worked in the darkroom doing picture developing work for Koehler. Cam Coberly long credited Koehler with finding jobs for him when he was going to college. Cam said that without that help, he could not have attended and graduated from the WVU ChemE Dept.*

*One Sunday afternoon, Dr. Koehler decided to do some woodwork in Ernie's shop. Wow! He violated all the safety rules Ernie had taught him. First, one was not to work alone in the shop. Second, one was not to use power tools with which he was not familiar. But, Dr. Koehler was using the power table saw when his hand slipped, and he cut off the end of his finger. The pain was great, but the embarrassment was even greater. Needless to say, when Dr. Koehler showed up at his office the following Monday, his hand was bandaged, and he had a lot of explaining to do to his many friends and students.*

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**Alumni recollections of Fred Galli:**

The class of '56 had its first real encounter with Fred Galli in the unit operations problems course, an all-afternoon affair. What follows are some recollections of students who took that class, or other memories of Fred.


*Students in the Unit Operations Room, Mineral Industries Building*

**Mike Dean** remembers when he came to WVU from WV Tech at the start of his junior year, how shocked he was after Freddie's first test…he had received a 70 percent,… until he found that was the best grade on the test. Freddie's tests were classics—always open book. Fred allowed the students to use books, notes and homework.

**John McGee**, who was a year ahead of Mike, says that Fred always walked into class without notes and gave the best lectures at WVU.

**Jerry Worstell** remembers that Fred was a very good teacher, but more important, he was a good man, the best teacher that Jerry ever had.

**John Dietz**, a classmate of Jerry's, remembers two things that stand out in his recollections of Fred, both relating to the Unit Ops lab:

*"First, the lab really forced on me the difficulty of collecting reliable, meaningful data. Fred never tried to make data-collection too easy. In fact, I think he structured the experiments in a way that fully displayed the vagaries of data collection. The real world is full of error sources that are not even hinted at in textbooks. This realization served me well in my professional career. I soon developed the philosophy that data that is too perfect is surely too good to be true.*

*"The second recollection was that data is useless until it is organized and presented in a format that is understandable (and useful) to the target audience. Fred insisted on such an organization of the reports. He recognized that decision-makers seldom have the time to plow through the actual data. It is the responsibility of the engineer to organize and analyze the data and present conclusions that honestly portray the results."*

**Richard Barnard** tells the Freddie story about the young engineer at Ashland starting up a new heat exchanger installation and, instead of just slowly cracking open the steam valve, he just opened it completely. The heat exchanger went flying out of the building.

**Bill Crockett** remembers the story differently. The young engineer was starting up a newly installed steam plant in a brand new brick building, and turned the steam on full blast. The expansion joint straightened out and pushed the lovely new building into the river.

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Richard Barnard and Bill Crockett were never able to get Fred to divulge the name of the young engineer, or even if his initials were FG!

Fred's life was an inspiration to everyone. He loved his wife, Bea, his chemical engineer son, his students, his ChemE department, and his Bureau of Mines. The sudden death of his son was a terrible blow to everyone.

Students have always enjoyed coming back to the ChemE to see the Gallis; Fred and Bea were wonderful people. At the annual Academy meetings in the spring, members particularly looked forward to seeing Fred and Bea with their beautiful, welcoming smiles. They will always miss Freddie, but know that he is up there now welcoming newcomers with his warmth and friendship.

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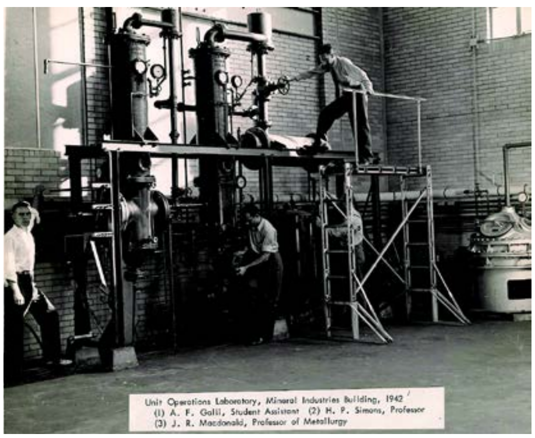
**A Tribute to Professor Fred Galli. Chemical Engineering Banquet, April 28, 2000 – by Reg Dietz**

*"Mr. Toastmaster, Professor Galli and wife, Bea; members of the Academy; students; faculty members; friends; and guests: I'm pleased to be invited to say a few words tonight about our honored guest, Professor Fred Galli. I first met Prof. Galli about 50 years ago when I was a chemical engineering student at West Virginia University. In those days tuition for one semester at WVU was $42, and a ticket to a good movie was 50 cents.*

*"At that time Professor Galli taught the Unit Operations Laboratory in chemical engineering. As I recall, these classes were listed as ChemE 211 in one semester and ChemE 212 in the next semester. My memory is a little fuzzy, but I think that these classes were taught one day a week, and each class lasted all day or most of the day.*

*"Unit Operations Laboratory - The purpose of the Unit Operations Laboratory class was for Professor Galli to train students how to conduct large-scale experimental tests, then collect and analyze the data, develop the results, and draw the conclusions from these tests.*

*"A 10-15 page report presented the results of the tests. Since these were large experiments, teams of three or four students worked together to conduct the tests and report results. I was a member of the Doss, Dietz, and Verikios team. For short, we were known as the DDV team.*




*A.F. Galli, H.P. Simons and J.R. Macdonald inside the Unit Operations Laboratory of the Mineral Industries Building, 1942.*

*"This all-day laboratory met in the high bay area at the west end of Mineral Industries. Since campus parking was a problem in those days, as it is today, department chairman Dr. Walter A. Koehler's Studebaker sedan was usually parked outside on the driveway leading to the Unit Operations Laboratory. The Laboratory had dryers, distillation columns, evaporators, fluid bed units, etc. So, once a week the chemical engineering students rolled up their sleeves and conducted day-long unit operations experiments.*

*"As important as these laboratory experiments were, there was something even more essential. That was the written report containing the results of these experiments. Professor Galli put great emphasis on the report. He had a format that had to be followed, including a title page, a summary of the report, and its details. The details section included an introduction, objective of tests, experimental setup, data collected, data analysis, results, and conclusions. The student teams prepared the reports correctly, or they did them over again. Such was student life 50 years ago.*

*"One of Professor Galli's greatest contributions was his ability to teach students how to write technical or engineering reports. In later life I had the opportunity to read many such reports, and I soon discovered that many engineering graduates did not have the training and could not properly prepare these reports. Professor Galli's students were not among those who hadn't mastered this task. And so Professor Galli's contributions to his students' future professional careers were enormous. Let me say thanks once again to Professor Galli.*

*"One Special Unit Operations Report - Let me recall for you one special Unit Operations report written by the DDV team and submitted to Professor Galli almost 50 years ago. We ran the pilot plant experiment, collected the data, and analyzed the results of the tests. Now the DDV team had only to write the report and submit it by May 1st.*

*"Fifty years ago the Communists in various parts of the world celebrated May Day on May 1st. These celebrations always had red flags, red signs, and red decorations. Although we were not Communists or Communist sympathizers, the DDV team decided to add a little spice to our May 1st report by writing it all in red. Big mistake! We forgot that Professor Galli used a big red pencil to correct and grade all these reports. Professor Galli had a field day. He went over this report with a fine tooth comb. He found every split infinitive, every dangling participle, and every misspelled word. Technical errors were noted with big X marks. When Prof. Galli returned this report, it looked like a red coloring book. Even the coloring book of his young son, Allen, had less red in it than this report."*

*"Another big mistake! On the title page we had addressed the report to Comrade Galli and had signed the report Comrades Doss, Dietz, and Verikios. Big mistake! Professor Galli corrected this by stating that in the new order teachers would be called commissars, not comrades. Commissars, of course, had a much higher rank than the comrade peasants. Ha! And so it was. The DDV team never again submitted a report to Prof. Galli written in red. We had learned our lesson.*

*"Let me conclude with a poem that seems to fit Professor Galli and this occasion. The late great sports writer, Grantland Rice, wrote this poem in the 1940s or 50s. It goes something like this:*

*For when the One Great Scorer comes*
*To mark against your name,*
*He writes not that you won or lost,*
*But how you played the game.*

*"Professor Galli played the game of life as it should be played: with honesty, integrity, and humility. For that his family, his friends and his many students will forever be grateful.*

*"Professor Galli, or rather, Commissar Galli, God bless!"*

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**Bea Galli** (widow of Fred Galli) shares a somewhat different side of her husband.

*"He was into everything. He was crazy about cooking, which he would do with his students. He had lots of cookbooks, and really liked the two that our granddaughters, Christina and Jennifer, brought him from Italy. He liked to make Italian spaghetti and a ring roll with nuts and raisins. He could make that, but his Mom didn't know how."*

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This next recollection is part of a letter that **James "Jim" Kent** sent to Joseph D. **"Joe" Henry Jr.**, recalling the years he was a student and later a faculty member at WVU, and the accomplishments of his later career:

*"I did my master's thesis under Walter (Koehler) and my dissertation under Howard Simons. My thesis was "Effects of Cerium Oxide on the Spectral Transmission of some Experimental Glasses," which involved preparation of small batches of various glass compositions using cerium oxide as a fining agent. The production vessel was a small platinum crucible and the heat source a Bunsen burner. I had occasion to melt or fuse more than one such vessel, and I recall the look of dismay when I reported the first casualty. But Walter produced a replacement and work went on. This happened at least twice and I am sure did not help the ChemE budget.*

*"Walter had me prepare a paper on the work to submit to an upcoming technical meeting (it was American Ceramic Society or a related organization). The paper was accepted and Anita and I were off to Chicago for the meeting where I presented it. Afterward, someone in the audience mentioned that the cerium oxide content of the experimental glasses far exceeded the level of fining agent typically used. Walter came to the rescue, pointing out that these were experimental glasses and not related to industry practice. That was quite an experience, and had something to do with helping to define my future career, and especially my relationships with students and later with faculty for whom I was responsible.*

*"Some years later, when I was recruited to the ChemE faculty, Walter, Howard Simon, and others, including Dean Chester Arents, were very supportive when I sort of kicked over the traces to start the masters' degree program in nuclear engineering. This involved teaching load relief; budget help; a bit of travel; and I think a few dollars to cover my fees in Ann Arbor, where I spent a summer learning nuclear science and technology, including radiation facilities and related subjects.*

*"This kind of support, rare in more traditional organizations, demonstrated to me the value of giving motivated and adventuresome individuals their heads, and helping them run the race. There is much more to be learned in any setting, even more staid academic ones, than science and technology. I have always been proud of the records and accomplishments of the students who worked with me in the nuclear engineering effort, and while it has faded from the scene at WVU (for West Virginia had a real live nuclear reactor in its borders and a powerful cobalt 60 radiation source), a new star has been born in bioengineering activity. This one will last and will dominate the future.*

*"This may be a good place to mention Howard Simon. That gentleman was a gifted, knowledgeable individual, and in my view was never sufficiently appreciated. But the same can be said of many people. He was very bright, well read, gentlemanly, astute, always helpful, and pleasant to be with. He helped me do a paper on my doctoral dissertation, 'Continuous Esterification in a Packed Column.' The paper was not accepted, and Howard was upset because a reviewer got it all wrong. But that's life.*

*"There were several others in the department both while I was an undergrad, in grad school after I returned home from WWII, and later, when I left industry to spend 13 years on the faculty as professor, and later associate dean for graduate studies and director of the Engineering Experiment Station. Those 13 years were the most fun-filled I have ever experienced.*

*"I don't know where all of this came from, but the fact that I just celebrated my 90th birthday likely led to more introspection than usually characterizes my thoughts. Someday I may look for an opportunity to talk about Dean Chester A. Arents, who ran the ship during most of those 13 years and had much to do with empowering the fun to which I referred earlier. It is not too generally recognized, but Chet plucked the College from the jaws of obscurity and a measure of national irrelevance, and*

*dragged it into a new era. I was fortunate indeed to have been there at the time and to have been invited to work as his associate dean for several years.*

*"There are many who played more important roles in the ChemE department before, during, and after the years I was there. They are the ones who, over time, imbued the department with the heart and soul it possesses yet today, and which I trust will continue for a long time to come. In addition to Walter Koehler and Howard Simons, Fred Galli (the one and only), Ernie Walls (everyone's helper and friend), Paul Jones (ceramics), Harold Fairbanks (metallurgy), Jimmy Wen (left us much too early), and several others who stopped by only long enough to be part of the passing scene—a year or three—but managed to leave something of themselves when they departed.*

*"I hope these brief remarks will shed some additional light, badly distorted of course by the recollections of one individual who was much too preoccupied to notice and appreciate everything of importance that was going on around him. I work too much with blinders on."*

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## Memories of 10 Wonderful Years with WVU Chemical Engineering: 1952 — 1962

***By William E. "Bill" Crockett***

*"I grew up in a small coal-mining town in western Pennsylvania, 15 miles from WVU. It was football country; many of the WVU football players grew up in my area. Since I was neither big nor muscular, I spent time reading and studying; it impressed my parents but not local young ladies. But it did land an appointment to West Point for the year following my high school graduation. In the meantime, my grandfather paid my way to WVU (God forbid I should loaf). I plunked down my $45 out-of-state tuition and college life began.*

*"In those days, all WVU engineers had to take such useful courses as welding, machine shop, surveying, and ROTC. Since I wanted to be a civil engineer, that was fine. I enjoyed surveying around campus, especially with the transit aimed at Women's Hall. But then came the snow and it wasn't as much fun. Luckily, compulsory ROTC cured me of a desire for a free West Point education.*

*"In those days, all engineers took the same courses: inorganic chemistry, English, trig, mechanical drawing, surveying, and physical education—19 credit hours. And that was just the first semester. The second semester, we took the same courses with analytic geometry and descriptive geometry replacing trig; another 19 credit hours. Then in the following summer, we had welding, machine shop, and speech. We were not sissies in those days. The English classes were a blessing; there actually were real live girls.*

*"The first time I went home after enrolling, I was loafing at the service station with some of the older town folk. One old guy asked what I was studying at "that there" college in Morgantown. I told him I wanted to be an engineer. His response, 'That's wonderful, I always wanted to learn how to drive one of them there trains.'*

*"Later that semester, I wanted a ride home with a friend who was majoring in ChemE. I met him at the end of the MI building in the unit ops lab, which Fred Galli taught. From that moment on, I was hooked on chemical engineering, no more traipsing around in the snow.*

*"I began my sophomore year as a real ChemE student by meeting my advisor, Paul Jones. It's funny how little things stick with you over the years; Jones wore tinted glasses, the first that I had ever seen.*

*"My real ChemE courses included, in the first semester, ChemE operations, quantitative chemistry, economics, calculus, PE, physics, and that dreaded compulsory ROTC, followed by, in the spring semester, ChemE calculations, statics, calculus, physics, and ROTC. This year we started to get instructors who were ChemEs: Koehler, Simons, Fairbanks, Jones, Crewe, Galli, and Harvey.*

*"After a summer of working on rural Pennsylvania roads running a jackhammer (it paid an extra 10 cents an hour), I was thrilled to get to my junior year. If you ever want to get your kid to go to college, get him a job working on the road.*

*"By our junior year we realized that we were really in a chemical engineering program. Each semester we took 19 credit hours that included principles of ChemE, organic chemistry, physical chemistry, and economics. In addition to these, the fall semester included differential equations; the spring had mechanics of materials. The faculty now also included Asst. Prof. Kent, and instructor Wen, along with lecturer Sebastian.*

*"To help pay my college expenses, Koehler and the department hired me to help out around the MI building, working with Ernie, cleaning the stockroom, anything that needed done that didn't require a lot of thought. Sometimes when I think about my WVU days, I get teary; this was, and is, a class place.*

*"After spending the summer working at Mobil (then Socony Mobil) in Paulsboro, N.J., I started my senior year. The fall semester had the ChemE lab, chemical technology, thermo, design, electrical fundamentals, and two electives. The final senior semester had the ChemE lab, thermo, design, but also an electrochemical course, a physics of materials course, and another two electives. This curriculum was topped off with an inspection trip visiting chemical companies.*

*"This was very exciting for those of us who thought our college careers were over. The department was swarming with chemical and petroleum company recruiters, begging us to join them. But then Doc Simons asked if I'd like to stay around to work on a M.S. Of course that's what I always wanted to do, but lack of funds was a tremendous drawback. Doc said that Carbide had a scholarship that I could apply for. I did, got it, and started my graduate career.*

*"My four years as an undergrad were great; my graduate years were fantastic. I shared an office in the MI building with Jimmy Wen and his orchids. We both got along fine with the orchids. Jimmy taught me to say "wo ai ni," Chinese for I love you. It came in handy when I started to date my future wife.*

*"My research advisor was Doc Simons, who loved to go to the doughnut shop across the street from MI. I suspect what Doc preferred was getting out of the office. He would round up willing faculty and his grad students and we'd head over. Now this drove Koehler, the ChemE chairman, up the wall; he thought everyone should work 100 percent of the time. He claimed that drinking coffee should not take a half hour.*

*"One day, he invited all of us to accompany him across the street for coffee. His coffee came, steaming black. He picked it up, downed it without removing the cup from his mouth, stood up, steam emanating from his ears, and left the shop. He never again said a word about our coffee breaks. Of*

*course, Freddie Galli was never part of the coffee klatch; he spent his free time at the Bureau of Mines…work, work, always working.*

*"Koehler loved his Studebaker (after he retired, he drove a motorcycle) and Fred loved his Cadillac. Fred always drove a new one. We assumed that he could afford it because he always worked at the Bureau of Mines whenever he wanted. In fact, he was a big deal there—they thought that he was a genius, or at least a minor god. So did we. We appreciated a real live working engineer teaching us. However, I bet that Caddy caused consternation in the other engineering departments.*

*"Richard Barnard's research advisor was Prof. Harold Fairbanks, who had a sabbatical in China for a year. Richard, his wife, and their children were invited to move into Fairbanks' house while they were away. Not all ChemE departments were like this one.*

*"Ernie Walls, the department assistant who could do any job well, always helped the graduate students set up their experimental equipment. He and his wife, Mary, were a much admired part of the department.*

*"Bunny and I were married in 1957; unfortunately, my Carbide scholarship was only $150 a month. Like some other WVU chemical engineering students, I was fortunate to get a part-time job at the Bureau of Mines. But summers were still lean. Luckily, our little grocery store in Sunnyside carried us during the summer. I still marvel at the generosity of the Morgantown locals.*

*"Later, Doctor Koehler offered me an instructorship to teach in the program while working on my research for a Ph.D. And you wonder why I always have considered my life to be charmed?*

*"I taught ChE 140, Chemical Engineering Calculations, and a chemical technology course describing various industrial processes for producing chemicals. The 140 course was tough to teach; it was the first ChemE course and we got some interesting students…and parents.*

*"One semester I had both Fred Wyant and Bruce Bosley in the course and these football stars definitely did not have their minds on chemical engineering. Another time, I had a student who told me that every once in a while he would have an epileptic spell, but I was not to worry. He had a buddy that would take care of him and I should just remain calm and continue lecturing. You try it. He did and I did, unsuccessfully.*

*"Being a new, young instructor, I was sensitive to how good a job I was doing. In one class, a student fell asleep, loudly. I continued my exciting lecture as I slowly walked to the metal wastebasket near the door. I kicked it across the room. The fellow never fell asleep again.*

*"Yes, teaching was fun, but it really was hard work. I had fathers call me and plead with me for their sons. One student's mother called me and made nasty comments about my mother. Sadly, not everyone could catch on to stoichiometry or material and energy balances.*

*"Marriage while both are in college can be interesting. A miscarriage during finals week of her junior year was not Bunny's favorite memory, nor mine. One of our good memories was having a lovely little girl during Bunny's senior year. Since we handled this well, Bunny figured that since we would be at WVU for a while, she should enroll for the M.A. in English.*

*"I was still taking classes and doing research. I had my equipment set up in an MI lab, hooked up with electric wires all over the place. I quickly learned a valuable lesson while lying on my back five feet from the equipment; be very careful when working around electric lines—they bite. Eventually, I completed all my experimental work, developed my equations and conclusions, and started to relax a little.*

*"About this time, John Mahoney, a Ph.D. from Lehigh, came to teach. He was from Staten Island, N.Y.; Bunny was raised across the bay in Brooklyn. We became good friends. His only vice, although an inexpensive one, was beer. He would spend his evenings driving up to Point Marion, Pa., where they had real beer. He hung out in one of their bars with the locals, and discussed the world. Bunny and I, being parents, could not often join him.*

*"About this time, the administration built an engineering tower on the Evansdale campus. Everyone packed up belongings, marking boxes with new office numbers, and took off for the weekend. I made a cardinal mistake; in one box, I packed all my experimental data; calculations; and copies of my finished, but not defended, dissertation. When Monday arrived, I walked into my lovely new office on the fourth floor of the engineering building, ready to unpack. 'OMG, it's all here except my research box.' With the help of friends, I looked everywhere. Not a smell. Finally, Barnard and I, thinking that the garbage men picked it up by mistake, went to the garbage dump.*

*"At that time, Morgantown was extending the airport runway by dumping garbage at the end of the runway. It was a massive, smelly dump; a very, very good friend like Dick Barnard helped me look. To no avail!*

*"I had a decision to make, stay and redo my research or find a job without the Ph.D. Bunny was willing, so we stayed. The research went much easier this time; I now knew what I was doing. In a year's time, I had finished. To this day, I still feel that it was worth it.*

*"We have always enjoyed coming back to the ChemE department…wonderful people, wonderful memories. But we don't enjoy gazing at the runway extension."*

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## Memories of Morgantown

***By Maureen Fitzpatrick "Bunny" Crockett (wife of Bill Crocket)***

*"John McGee, a chemical engineering graduate student, who later ran the chemical engineering department at Tennessee Tech University and set up a Tech scholarship in chemical engineering, was a friend of Bill Crockett, another grad student in the program. John's fiancée, Sylvia Means, was my roommate. Soon Bill and I were dating.*

*"When I visited Bill's office in the gloomy Mineral Industries building, I met his office mate, Chin Yung (Jimmy) Wen, from Taiwan. The sink area in their office held Jimmy's well-loved orchid, which lay on a board with exposed roots, no soil. Every day, Jimmy gently poured water over these roots.*

*"Bill was working on his master's degree; Jimmy was finishing up his doctorate. A month later I left for the University of Arizona, but Bill followed me at spring semester's end. We married and were*

*soon back in Morgantown. Jimmy gave us a sculpture of a ship, carved from water buffalo horn. It still has pride of place in our dining room after 55 years.*

*"Many of the chemical engineering grad students were married, and some had children. We all studied very hard during the week, but threw parties on the weekend. We lived, however, well under the poverty line, with food money sometimes running out before the month did. There were poverty banquets with variations on a theme of pasta and ground beef.*

*"I remember we had a wild, late night bash at our apartment, with the last friend leaving about 2 a.m. We were sleeping in on Sunday morning when our downstairs doorbell rang. It was Dr. Koehler and his wife, arriving for a surprise visit. He wore a three-piece brown suit and she was properly dressed with fox furs around her neck. I kicked empty beer cans under the sagging couch while Bill went downstairs to let them in. They were sweet to pay us a visit, but it taught us never to visit friends unannounced.*

*"For entertainment, we looked for free fun, like hiking at Coopers Rock and ice skating at Cheat Lake. Or kite flying...I remember the open fields at the Evansdale campus, before the engineering tower went up. Bill would lie on his back, holding a 3,000-foot kite string aloft, while I spooned strawberry shortcake into his mouth. Those halcyon March afternoons stopped when the new campus sprang up.*

*"Two years later when our Peg arrived, Bill and I took turns babysitting so both of us could get to classes. Life was full. We also had our beloved cat, Leprosy, all of us in a four-room slum apartment on Grant Avenue in Sunnyside. Fully furnished in wrecked furniture, our home cost us $45 a month.*

*"When the engineering tower was ready for students and faculty, Jimmy Wen took Bill and me up on the high roof of the new building, where we could survey miles in all directions, down to the river and across to the medical center. Great spot to fly a kite.*

*"But then came a very hard, unforgettable time for Bill. Our friends had graduated and gone, and we were almost ready to go also. I had finished my M.A. in English. Bill just had to defend his Ph.D. dissertation and we were off to a new life.*

*"In the chemical engineering department's move from Mineral Industries to the fourth floor of the new engineering tower on the Evansdale campus, everything got there except the box holding Bill's two dissertation copies and all his research. We were devastated.*

*"Richard was done with his Ph.D. He and Emma Jean and their children left Morgantown for a new job. Bill and I discussed what to do. Should he leave Morgantown with a master's degree, or start all over again?*

*"He started from scratch, and kept teaching as an instructor. He worked part time at the Bureau of Mines. He also suffered intense migraine headaches during that difficult year. The only friend we had was a new chemical engineering faculty hire, Dr. John Mahoney, who came in from Lehigh.*

*"John was frugal, never needing much money. With no family to lure him home at a decent hour, John worked day and night at his office. Months on end, he let his checks from WVU pile up on his desk. Finally, the WVU treasurer pleaded with John to cash the checks, as he was fouling up the University's financial system.*

*"John and Bill became fast friends, with their love of learning a mighty glue holding them together. They would ask their chairman if they could teach a certain new subject in the fall. Getting approval, they would spend the summer learning the topic and then team teaching it.*

*"At the same time, Bill did his research all over again. He defended his dissertation, and we were finally off to New York, my old home, where Bill had a research position in petrochemicals with Texaco. All I knew about the company was that their gasoline was purple.*

*"Bill soon came back to both West Virginia and college teaching. Our ties to WVU have never frayed."*

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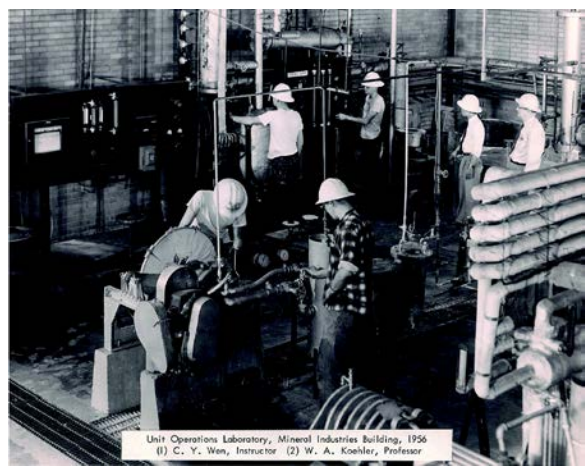
**By E. Ronald "Ron" McHenry, BS 1956**

*"It has been almost 60 years since I made my initial journey to Morgantown. After this many years, I am not sure that I had a favorite professor. I remember H.P. Simons discussing odd consulting experiences at a brewery and re-crystallizing salt. He was my advisor.*

*"I enjoyed electrochemistry as taught by Dr. W.A. Koehler. He was co-author of the textbook that we used. As a result of his class, I remember placing a light bulb in a large salt solution tank and lighting it for a Mother's Day weekend demonstration. In fact, it was described in the school newspaper. In my career with Union Carbide I was able to relate and benefit from my knowledge of electrochemistry.*

*"I really enjoyed the unit operations lab with Professor A.F. Galli and Dr. C.Y. Wen. I was surprised that a picture taken of Dr. Wen, Ernie Andraski, and I, was used for many years in a publication used by the department.*




*Unit Operations Lab, Mineral Industries Building – 1956*
*Pictured: C.Y. Wen, W.A. Koehler with Students*

*"What I learned in the distillation area helped me in many projects with both Union Carbide and Koppers. And I remember a research director conning me into distilling a bad batch of homemade wine in an attempt to salvage it.*

*"I remember helping Eddie Becker, a starting player on the University basketball team, keep up with his lessons in a math course. And I saw three or four dorm residents type notices that excited other residents to participate in a panty raid at Women's Hall. As I recall, the instigators watched from a safe distance as the raid occurred. Later in life I heard a former Kent State student tell how a few people had fun as they created the incident that resulted in several deaths in a clash with some untrained National Guard soldiers. This later incident reminded me how a few people and a typewriter initiated the WVU panty raid. Thankfully, it did not result in any tragedy.*

*"I wanted to return to the University for graduate work or to enter law school, but I was caught keeping the draft board away, and enlisted in a reserve unit. As a result, I served six months of active duty. I then married a young lady from Clarksburg and in early 1960 Union Carbide transferred me to a*

*special U.S. Air Force contract. I relocated from West Virginia to western Ohio and then to south-central Tennessee. We were close enough to the construction of the Saturn rockets for the moon launches, so that every test firing was like an earthquake.*

*"I learned how to make raw materials for carbon and graphite structures. We developed fibers and substrates for coatings used as nose cones, nozzles, and leading edges. It was a challenge to match thermal expansion and conductivity graphite to unique coatings for reentry from space vehicles. We were exposed to space travel technology from Cal Tech. We had the only true continuous pilot delayed coking unit ever built. It was located parallel to a commercial unit in a large oil refinery.*

*"I learned how to distill many different hydrocarbon feeds to make binders for carbon forms. During those four years I had the opportunity to learn enough about making commercial and specialty carbon to support me for the remainder of my professional career. It was a graduate school in carbon production.*

*"The challenge became how to use that knowledge. Recently, I was deposed for two days in a class lawsuit and realized that my experience from raw material production through carbon and graphite processing and application gave me a unique position in present-day business.*

*"I transferred to the Union Carbide Parma Technical Center in the Cleveland area and cycled through research, development, and production. I developed new materials, and managed technology and production. I contributed to high performance carbon and graphite fiber development with scientists Len Singer and Irv Lewis. In fact, the three of us had key patents in this area. The resulting high tensile strength, low weight graphite fibers have been frequently used in the space shuttle and most of the modern military and commercial airplanes.*

*"I became senior manager of worldwide raw materials and traveled extensively, and then I retired from Union Carbide in 1988 and began a consulting business. However, in 1989 I joined Koppers Industries as director of technology and worldwide research for the next 10 years. I continued to travel a lot, meeting with various divisions, customers, and suppliers. I was also involved in acquisitions and long range planning. In 1999, I retired from Koppers and returned to worldwide consulting.*

*"At Koppers, I worked extensively with the regional academic world. In particular, I frequently met with staff from Penn State, WVU, Southern Illinois, and Carnegie Mellon. At WVU, I worked with Drs. Gene Cilento, Carl Irwin, John Zondlo, Al Stiller, and Peter Stanberry in the carbon technology area. I joined this team in meetings with federal, state, industrial, and other academic officials. We met with congressional, and departments of Energy and Interior staffs in Washington and other locations. I was a member of the Industrial Visiting Committee at WVU and also was honored with election to the Academy of Chemical Engineers.*

*"During my career I have found that a day of work does not have an established time; i.e., it can be eight to 24 hours or more. I believe that honesty; courtesy; ethical standards; and hard, dedicated work must always be foremost. I have been fortunate to have worked with some great teachers and team players during my life. It is humbling to receive a call from former colleagues that say a former competitor recently inquired about me and relayed that he always appreciated my honest business standards. In industry many inventions do not have patents because they could easily be copied or would disclose too much about a product or process. Also the patent process has been long and complicated; I hope that new revisions to the U.S. Patent Process will allow more good ideas to be patented."*

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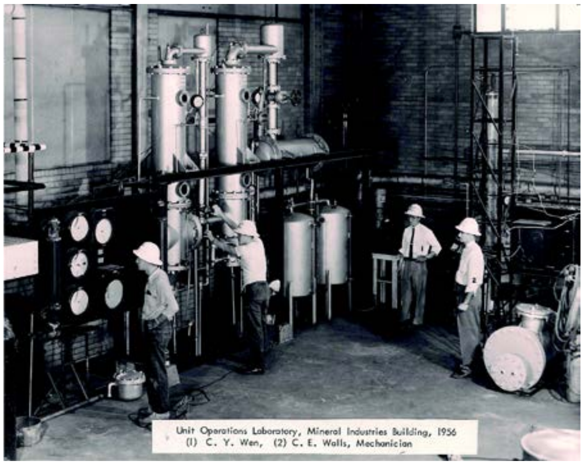


*C.Y. Wen and C.E. Walls inside of the Unit Operations Laboratory, Mineral Industries Building, 1956*

In the 1950s a great and long-lasting influence on our chemical engineering department came from abroad. When **Chin Yung Wen**, known affectionately in our department as Jimmy, left his Taiwan home for Morgantown, another era began for chemical engineering at WVU. Below is a loving account of his life and career by his daughter, Emily Wen. We who admired and cherished him almost never got the chance to make his acquaintance because of war. During World War Two, Japan seized Taiwan.

### Emily Wen remembers hearing this family story, and writes:

*"Taiwanese men had to join the Japanese army. My father had apparently been so mistreated by the Japanese soldiers during camp that he volunteered to go on a suicide mission called kaiten, similar to kamikaze airplane attacks. Kaiten were torpedoes modified to fit one man inside who had some ability to steer towards its target after being launched from a submarine. Luckily my father fell ill with dysentery (he claims that it was caused by eating green bananas) and was hospitalized until the end of the war.*

*"To say that my father's career was a big part of his life is an understatement. He was either at work at the office or working on proposals at home. Even so, my father always made it home at a decent hour for the family dinner–it helped that my mother has always been an excellent cook! He also drove home every afternoon to lunch with my mother and to have a quick power nap. He didn't talk much about his work, but it was always on his mind. My mom recalls that even during his hospitalization and last month of life, he continued to work and managed to complete one last paper that was later successfully awarded.*

*"He also drew my siblings and me into his work by drafting us to edit his proposals. We quickly learned how to spell and use the vocabulary words of his topics: coal liquefaction, gasification, fluidized beds. There seemed to be an endless stream of proposals for us to edit, all with these few words repeated over and over. I wondered how the proposals were any different from one another.*

*"My father left his native country, Taiwan, to come to the United States for higher education; he also desired to leave a country experiencing post-WWII political upheaval. He eventually followed the path of an acquaintance who had a scholarship to study in the United States.*

*"He had little knowledge of American geography. Los Angeles and Morgantown were no different in his mind, so he told himself he would go to the first university that accepted his application for graduate school. This happened to be WVU.*

*"My father often retold his 1951 journey to America, arriving in Morgantown only after a month-long rocky boat ride across the Pacific and then a train ride from Los Angeles, only to find that Morgantown wasn't on his map. Yet he was warmly greeted by a group of students and university staff upon arrival.*

*"According to my father, he was the first Taiwanese student at WVU. He spoke a lot about how people from WVU helped him learn English and advised him about life in America. One such person was Betty Boyd, the dean of students, with whom we socialized through my childhood years. The stories of those early years were often retold with much teasing and affection between the two; it was clear that despite his cultural isolation, he was part of a community at the university."*

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***By L.T. Fan, a colleague of Jimmy Wen's and longtime chair of the chemical engineering department at Kansas State University:***

*"My Ph.D. tenure at WVU was between 1954 and 1957. My advisor was the late Professor Fairbanks. After my degree, I continued to work part time at the Bureau of Mines and did collaborative research with C.Y. Wen.*

*"Koehler was likely the first ChE faculty member to write a widely used text book, Principles and Applications of Electrochemistry, Creighton, H. Jermaine and Koehler, W. A. about 1935."*

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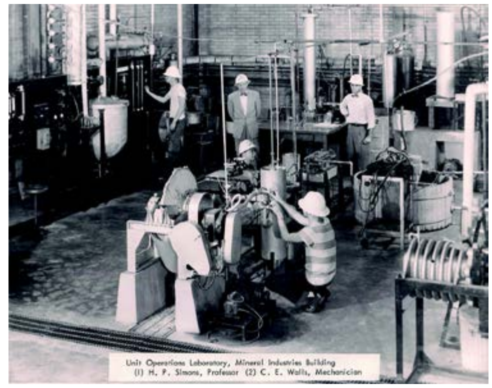
# The Simons Era (1958 - 1970)

In 1958, Howard P. Simons began an 11-year stint as chemical engineering chairman. Simons ran a faculty committee studying whether faculty should do outside consulting work. The group decided outside consulting would broaden a faculty member's education, making him a more valuable and effective teacher. Simons' committee added that, unfortunately, engineering faculty salaries were below industry salaries, and the faculty had a long work day.




*H.P. Simons and C.E. Walls with students in the Unit Operations Laboratory, Mineral Industries Building*

Construction workers broke ground for the new engineering buildings at Evansdale; they were finally done in June 1961. Forty years of overcrowding were over. Engineering had 11 stories above ground, three below. Chemical engineering has been on the fourth floor ever since.

Morgantown built Monongahela Boulevard at this time, connecting Evansdale to the downtown campus.

Richard Bailie joined the faculty in 1965.

In the early 1960s when the Russians sent up Sputnik, more money became available for engineering education. Chemical engineering dropped the ceramics program. Standards went up, and courses became harder. Enrollment temporarily declined. Deja vu all over again.

Also in the sixties, Simons started the senior block: 10 credits of the senior year subsumed in comprehensive design course work. On faculty now were also Richard Bailie and Lansing Blackshaw. Additional professors teaching then were William Boyle, Harold Fairbanks, Alfred Galli, Dean Harper, Paul Jones, Walter Koehler, and Chin Yung Wen. Duane Nichols joined them in 1968 and Alfred Pappano a year later.

John Sears became a faculty member in 1969. In 1982 he became department chairman at Montana State University.

### The Nuclear Engineering Program

In the 1960s, James Kent started the nuclear engineering (NE) graduate program, offering the M.S.N.E. degree. At the time Kent was leading a sponsored research project to develop wood plastic composite materials using ionizing gamma radiation. During this period the department operated a Cobalt-60 gamma irradiation facility; an experimental AGN-211 100 watt nuclear reactor (probably the only nuclear reactor that will ever exist in W.Va.); and a Van de Graaf accelerator/neutron generator, purchased with Atomic Energy Commission grant funds. Several students in the nuclear program also continued to earn their Ph.D. in the nuclear engineering field under the auspices of the ChemE department.

The NE program always was challenged to enroll a critical mass of graduate students, due to increasing competition from major universities that had full-fledged nuclear engineering departments, and the fact that West Virginia was so dominantly a coal state. The program ended in 1973, and the AGnN-211P reactor decommissioned in 1978, with the fuel elements being transferred to Kansas State University.

## Recollections

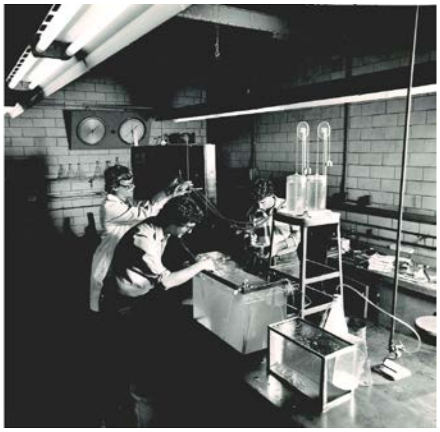
***By John Mahoney, assistant professor of chemical engineering, 1960-1964***

*"Starting in the fall of 1955, I was a graduate student in chemical engineering at Lehigh University. In January 1960, I entered the Army for six months of training. Upon leaving the Army in July 1960 I returned to Lehigh to complete my dissertation.*

*"Earlier I had applied to several universities seeking a teaching position. To my surprise I received a job offer from H.P. Simons at WVU. He had never met me and would not pay my way to Morgantown for an interview. I decided to go at my expense. I flew from Allentown to Pittsburgh, where I spent the night. I intended to get the morning flight into Morgantown, but missed the plane. Simons was waiting for me at the Morgantown airport; bad first impression.*

*"I took a bus to Morgantown and arrived about noon. I located Simons and tried to ask penetrating questions, such as, 'how many new graduate students will there be in the fall?' He showed*

*me a stack of applications and said, 'if half of these come it will be quite a bunch.' Very few came. I accepted the job offer.*



*Students in the Operations Lab*

*"I returned to Morgantown in September 1960 and took an apartment close to campus; I did not have an automobile. My initial teaching duties involved graduate mass transfer, undergraduate thermodynamics, and some duty in the unit operations lab. WVU was different from Lehigh.*

*"Chemical engineering was blessed with PhDs. There was Simons (true love was organic chemistry), Kent (nuclear), Wen (a giant in my opinion), and possibly Koehler (did not teach). Other professors were Jones (ceramics), Fairbanks (materials), and Galli (unit operations). Crockett and Boyle were instructors. The departmental maintenance man was Walls. He always wore a suit and tie to work so that it was an imposition to ask him to do welding or machining.*

*For my first year, chemical engineering classes were in the Mineral Industries Building. In 1961 we moved to the Tower. In the Tower, chemical engineering was on the fourth floor, while my office was on the fifth.*

*"I did not agree with the Simons management style. I had written a paper based on my dissertation, and needed to have it typed. Simons said that it was not in the departmental secretary's job description to type my paper. It was typed at Lehigh and published in the AICHE Journal.*

*"Simons announced at a departmental faculty meeting that our students no longer had to take the physical chemistry lab. He insisted that they still had to take the organic chemistry lab. His reasoning: the smells are different.*

*"My teaching duties now consisted of the undergraduate stoichiometry course, unit ops lab, graduate thermo, and graduate transport phenomena.*

*"After four years of $200 a year raises and no hint of promotion I left WVU for the University of Florida in 1964. In about 1969, I switched to the Department of Industrial and Systems Engineering. I retired in 1996 and now I am professor emeritus. My chemical engineering education served me very well in my adopted department."*

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***By James Kent (further recollections):***

*"I well recall Howard Simons, one of the brightest people I ever knew, from my undergraduate days and later experience in grad school, after I had done my bit with the combat engineers in the ETO from 1944 to 1947, and Walter Koehler (Electrochemistry, by Crichton and Koehler), a hardworking, smart perfectionist. Both were major influences.*

*"I have a very different perspective of the department for the period 1954 to 1967 during which I was with the ChemE faculty and working with Chet Arents in the Dean's Office and Engineering*

*Experiment Station. During the early days of that period, Chet set about totally changing the College by introducing the idea of research as an important faculty activity. Prior to his arrival, there was no research, and very little publishing. Early on, he solicited four research contracts (with investigators undesignated and objectives only roughly defined).*

*"This was the beginning of sponsored research in the College, and the time when the modern history of the College, and incidentally, chemical engineering, really began. ChemE had been a leader in scholarly activity and continued at an accelerated pace. One need only review issues of the American Society for Engineering Education (ASEE) annual reports beginning in 1947 to see the exponential growth of research, which had for a long time been taken for granted.*

*"My work with Chet equipped me for my assignment as dean of engineering at Michigan Technological University, with one of the biggest undergraduate enrollments in the U.S., and to build a large and successful research program, with concomitant growth in funding, in the graduate programs.*

*"For the past year and a half I have been preparing a manuscript for the 12th edition of my Handbook of Industrial Chemistry and Biotechnology (Springer). It runs over 1,700 pages in two volumes, 36 chapters, and includes contributions of more than 60 of the brightest, most generous people with whom I have ever associated. My publisher expects my end of the task to be completed by July 1, 2012, a reachable goal. I am eager to complete the job so I can wake in the morning with some priority on my plate other than coping with incomplete manuscripts, missing copyright permissions, tardy manuscripts, etc. I said they are bright and generous. I did not say they are perfect."*

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***By Frank Wheeler:***

*"My path to and from WVU has been a bit circuitous and the education's value surprising in retrospect, but I thought I would pass it on for what it might be worth.*

*"In late August of 1958, Mom and Dad took me to a small private college in Ohio and dropped me off with a hug, a kiss, and a suitcase containing my wardrobe. I had a sport coat; several shirts; maybe two sweaters; a couple of cotton slacks; one pair of cords; plus some underwear and socks, maybe a week's supply. With only a winter coat slung over my shoulder, a little bag of school supplies, and my suitcase, moving in was simple. Not so for my roommate whose parents took hours to help him unpack his stereo, clothes, and God knows what else. Although I did stay in school, I never felt a part of that college.*

*"The summer after my freshman year, I worked at a YMCA summer camp in upstate New York. As the summer drew to a close, the thoughts of returning to school turned my stomach upside down. Dad had a temporary assignment in New York City that month and Mom had joined him there. They came to get me at camp and as we drove home I said I was not going back to school. They took that in stride, but as we approached Morgantown, one of them suggested, 'Maybe you would like to go to school here.' I said, 'No way can I get in; school must start soon.'*

*"But we stopped anyway, stumbled into the admissions office and met the director, Joe Gluck, as he was going into his office. He stopped and inquired if he could help. I, rather embarrassingly, told him the situation and that I might better fit into a state school. Joe listened thoughtfully, asked a couple of general questions then quizzed me about my grades. I told him the truth and he said, 'OK, son, get me*

*your transcripts and if what you say is true, I will accept you. See you next week.' As we got up to leave, he shouted, 'Hey, what do you want me to put down as a major?' I said, 'I liked chemistry, how about that?' Dad interjected, 'If you major in chemistry, you will need a Ph.D. to do much. How about studying chemical engineering?' I said, 'OK.' And so my undergraduate major was set.*

*"Over time I developed good study discipline, engaged with campus life, made friends, and amassed a creditable resume, finishing at or near the top of my chemical engineering class. Clearly my decision to study chemical engineering was not well thought out at all but rather just a spur of the moment choice. In fact, I never practiced that profession and the world is a safer place because I did not. But I do not regret the choice at all. It was great boot camp for life as it:*

- *Demanded hard work and encouraged a strong work ethic.*
- *Required a disciplined approach to study and effective organizational skills.*
- *Developed the ability to see how multi-disciplinary pieces fit together in carefully sequenced steps respecting critical paths. This required an accurate understanding of the ultimate objective and how to isolate and assemble complex, interrelated building blocks.*
- *Demonstrated the value of well-thought-through experimentation to find the optimum route to an identified goal and comfort with the inevitable failures, refinements, and reevaluations. Knowing when to hold 'em and when to fold 'em.*
- *Acquired comfort in unknown, unfamiliar situations that could be dealt with by analysis, experimentation, and optimization.*
- *Taught that details are important.*
- *Engendered confidence and a certain external credibility. At the time, except perhaps for nuclear physics, chemical engineering was generally recognized as the most difficult course of undergraduate study. Potential employers and graduate school admissions officers recognized that successful completion required diligence and some significant level of intelligence. That opened some doors.*

*"Indeed the education served me well, in a varied and pleasantly successful career that has provided resources for a full family life, active retirement, and abundance to be shared with others, including scholarship recipients at WVU. So, this might not be the conventional story you are seeking, but it is mine, and hopefully helpful."*

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# The Wen Era (1970 - 1981)

***By Joseph D. Henry***

Beginning when **C.Y. "Jimmy" Wen** became department chair in 1970, a period of exceptional innovation and productivity occurred in both the undergraduate and graduate research programs. There was a tradition of excellence established much earlier, especially under the leadership of W.A. Koehler and H.P. Simons. The department had benefited from having the first Ph.D. program in the College and one of the first doctoral programs at WVU.

*C.Y. "Jimmy" Wen*

The surge in quality and innovation that occurred during Wen's time as department chair can be traced to his leadership effectiveness and the example he provided with the excellence of his own research. He both encouraged innovation in the undergraduate design-based curriculum (later called the PRIDE Program) and inspired growth in research programs focused on nationally relevant projects. Their excellence was increasingly recognized nationally and internationally. Some of Wen's successes resulted from:

- The ability to successfully recruit many faculty members who received their doctoral education from leading programs. (See the following table). Capacity to motivate and enable faculty.
- Leveraging his own well-established national and growing international research reputation to open doors for faculty, who collaborated with him and those faculty who were not directly involved in spin-offs from his research program.
- Now for a truly unique aspect of his leadership genius: University faculty in general and chemical engineering faculty in particular can be demanding and self absorbed. In the 10 years I worked for Wen I never heard any faculty member complain once on any matter related to his leadership. Few chairs anywhere accomplish this.
- Finally, Wen worked harder than any of us. His quiet example motivated all of us. During the time we were privileged to work with him there was an inspiring culture of hard work and excellence among the faculty, so he never had to directly make requests or demands.

The discussion of specific department achievements and faculty that follows will bring the period of innovation and quality improvements to life and illustrate many aspects of Wen's leadership.

The broad impact of his research with his graduate students is discussed by L.S. Fan in a later subsection.

**Wen Research Impact - WVU Chemical Engineering Faculty 1972 to 1981**

| **Faculty** | **Research** | **Teaching** |
|---|---|---|
| Richard Bailie, Ph.D., Iowa State University | Fluid Bed Pyrolysis, Solid Waste Disposal | Design, Reaction Engineering, PRIDE Program |
| William R. Boyle, Ph.D., WVU | Associate Dean for Research | Mentoring of Young Faculty: Attracting Research Funding |
| Duane Nichols, Ph.D. University of Delaware; B.S., WVU | Coal Based Energy and Chemical Complexes, Process Simulation | PRIDE Program, Unit Operations |
| William Boyle, Ph.D., WVU, B.S., Newark College of Engineering | Associate Dean for Research, Energy Research Policy | Unit Operations, Material & Energy Balances, Nuclear Engineering, Process Design |
| Robert Hamilton, Ph.D., Cornell University | Mass Transfer | Mass Transfer, Unit Operations |

| **Faculty** | **Research** | **Teaching** |
|---|---|---|
| C.Y. Wen, Ph.D., WVU,Department Chair | Fluidization, Reaction Engineering, Coal Gasification and Liquefaction | Reaction Engineering, Unit Operations Lab |
| Fred Galli, M.S., B.S., WVU | Coal Processing, Gasification, Liquefaction | Design, Unit Operations, Process Control, PRIDE Program |
| Paul Jones, M.S., Ohio State University | Ceramic and Glass Processing | Thermodynamics, Reaction Engineering |
| John Sears, Ph.D. Princeton University | Coal Conversion | PRIDE Program, Design |

| **Faculty** | **Research** | **Teaching** |
|---|---|---|
| Al Pappano, Ph.D., WVU | Nuclear Engineering, Separation Process, Reverse Osmosis, Acid Mine Drainage Treatment | Fluid Dynamics, Heat Transfer, Material and Energy Balances |
| Lance Blackshaw, Ph.D., North Carolina State University | Associate Dean for Academic Affairs, Reactor Physics, Neutron Activation Analysis, Separation Processes, Reverse Osmosis, Acid Mine Drainage Treatment | Reactor Physics, Intro to Nuclear Engineering, Applied Mathematics for Engineers, Material and Energy Balances, Calculus Courses for the Math Department |
| Harold Fairbanks, M.S., Michigan State University | Materials Science, Corrosion, Ultrasonic Assisted Processing | Materials Science |

| **Faculty** | **Research** | **Teaching** |
|---|---|---|
| Joseph Henry, Ph.D., University of Michigan | Separation Processes, Colloid Science, Particle Removal from Coal Liquids, Biochemical Separations, Energy Research Policy | Separation Processes, Mass Transfer, Fluid and Heat Transfer, Unit Operations Lab, Mathematical Modeling |
| Eugene Cilento, Ph.D., University of Cincinnati | Biomedical Engineering, Blood Flow, Microcirculation | Transport Phenomena, Thermodynamics, Biomedical Engineering |
| Christopher Ludlow, Ph.D., University of Virginia | Computer Aided Experiments, Process Control | Unit Operations Lab, Transport Phenomena, Process Control |
| Frank Verhoff, Ph.D., University of Michigan | Mathematical Modeling, Mass Transfer, Particle Removal from Coal Liquids | Process Control, Thermodynamics, Transport Phenomena |

| **Faculty** | **Research** | **Teaching** |
|---|---|---|
| James Riggs, Ph.D., University of California, Berkeley | Electrochemical Engineering, Process Control | Process Control, Transport Phenomena, Reaction Engineering |
| Desmond King, Ph.D., University Cambridge, UK | Fluidization and Particle Science | Fluid and Heat Transfer, Reaction Engineering |

## Development of the PRIDE Program (1970 – 1982)

***By John Sears***

The heart of chemical engineering was teaching undergraduates, most of whom would be on an industrial job site after graduation, the procedures for systematic problem solving, rational reasoning, and analysis of engineering problems in numerical (quantitative) terms as far as process performance and costs are involved. So, teaching design in the chemical engineering undergraduate program at WVU has long been a priority. It was a focus of the senior program devised under Howard Simon as chairman, developed throughout the curriculum by the PRIDE Program in the years 1970-1982, and continued to the writing of the present best-selling textbook, *Analysis, Synthesis and Design in Chemical Processes*, by Turton, Whiting, Bailie, and Shaeiwitz. This section of WVU chemical engineering's history will discuss the PRIDE Program, which stood for Professional Reasoning Integrated with Design Education. Certain elements of this study course have continued.

### Previous Structure Supporting PRIDE Program Development

**Senior Course:** The WVU department of chemical engineering historically emphasized practical situations in its programs. A unique aspect was the establishment of the senior course sequence during Dr. Simon's tenure as chair, in which the setting was made to simulate a professional engineer's practical day-to-day experience. This sequence was a 10-credit course each semester to incorporate the senior chemical engineering subject matter and the pursuit of a senior design project. So reactor design, process control, design processes, and engineering economics were subjects of instruction. Thus a senior design room was provided in which each senior had an assigned desk.

The senior project was chosen to engage the entire class, so it could be a more comprehensive problem. A senior design chief engineer was chosen from the junior class applicants, along with the selection of appropriate group leaders. The chief engineer was to coordinate the project and establish time lines, etc., but the groups were to perform the actual detailed calculations, design, and capital investment estimates. But this procedure would leave some overall design outlooks unavailable to every student; such an experience was provided by the introduction of the design exams. These were individual design projects to be undertaken by each student, who did the calculations, wrote up the design, and gave an individual oral presentation of results to a two-person faculty panel.

There were four exams during the senior year; the last exam often was the AIChE design competition problem for that year or from a previous year so it could be a 50-plus hour experience. These exams were accomplished in a several-day to two-week time period. The 10-credit course could accommodate this intense effort by ceasing instruction in subject matter and senior design project work. It was an intense effort by students and faculty, as a reasonable effort at determining a good solution needed to be developed by the faculty before the assignment of the exam. Fred Galli provided most of this effort on the design component in the senior year.

**Freshman Guided Design Course:** The College of Engineering had hired Charles Wales and Bob Stager in a bold move to start student engagement in open-ended problems and design thinking by developing an introductory course in engineering for all students. The course introduced students to introductory concepts in measurements, material balances, forces, and electric currents and then stepped them through strategies in using these concepts in solving problems.

These stepped problems were integrated with teaching concepts by asking students questions and providing answers in Q & A text format called guided design, an innovation that was a leading engineering educational concept. The course used faculty from all departments in the College to emphasize that engineering was a broad discipline. Professors Wales and Stager led workshops on this approach nationwide at individual colleges and at national meetings, such as the annual American Society for Engineering Education. WVU was a recognized innovator in design education through the discussions led by Wales and Stager. This course used both new faculty and established leaders, including John Sears and Richard Bailie.

*C.Y. Wen making a point.*

### Program Start

**Integration:** Faculty love to talk, and discussion in this innovative environment led to wild ideas. Bailie knew Wales from the time they were both at Wayne State University and was enthusiastic about the new freshman program. In these discussions, Wales and Bailie, and then Sears, felt that design should be presented in all four years of an engineering curriculum—a direction Wales had been presenting previously. Why not make WVU an example of this idea? Bailie, as a faculty leader, and Sears, as an enthusiastic young faculty member hired in 1969, approached Prof. C.Y. Wen to make the chemical engineering department the innovative example.

Wen knew everybody had to buy into the proposal. New faculty, such as Pappano, Nichols, and Sears, hired to spark the department, and older faculty such as Galli, Blackshaw, Fairbanks, and Jones would need to work together. The idea was presented to the faculty and discussion was heated, as one could imagine. Design projects would need to be developed in all the years, in order to make it a transition to increasingly more complex projects, and it was felt that written materials to accompany some of the course work would be needed.

Wales made a case that now was the time to strike, as he could approach the Exxon Education Foundation to underwrite such an intense effort as a natural sequel to their support of his freshman course. The leadership of Wen in promoting teaching/education while being the acknowledged leading researcher carried the day. The faculty as a group agreed to try this approach. In order to provide appropriate protocol, Wen was slated as the principal investigator in the proposal to the foundation. Sears coordinated the writing of the proposal to Exxon.

**The program had four basic objectives:** 1) to present a coordinated, professional ChemE curriculum oriented toward the education of practicing engineers; 2) to involve the student every year in a team-oriented effort to design and solving engineering problems; 3) to take advantage of faculty specialties in each area by the use of team-teaching; and 4) to use innovative education techniques to achieve efficiency in teaching subject matter.

Progressively more complex design problems would be presented through each of the four years. Instructional materials to aid the program were to be written as needed, using the then-innovative technique of guided design. The proposal was funded and the work began in 1972.

## PRIDE Program Development and Implementation

The proposal was funded for a three-year period, and Sears coordinated its development. An immediate task was to create a flow sheet of design and integrated content. This changed throughout the project.

Marian Jones, a communication specialist, provided expertise in helping students develop communication skills. WVU was one of the first schools to establish such a tutor approach to communications, first in chemical engineering, and later in the College. This was a success; recruiters loved the skills and presentation ability of our students. The students were experienced in thinking on their feet and writing effective reports.

Regular meetings of the faculty for coordination and to air differences were the norm. It was not a smooth road, and the guidance of Wen was critical to the success and maintenance of the program through this period. Faculty members had funds to develop materials and design problems. Guided design texts for the sophomore material and energy balances were written by Pappano, Bailie, Wales, and Sears, while vapor-liquid textual material was written by Sears and Wales.

This was a big task, so standard texts were used for most of the coursework. Faculty in each of the three upper years wrote design problems. It was found to be an arduous task; faculty teaching those years coordinated each of these years. Pappano directed the sophomore segment. Nichols and Bailie supervised the junior block, while Galli and Sears directed the senior block. While lectures and problem solving as homework were continued to some degree at the junior level, awareness that systematic problem solving was at hand continued throughout the courses. Out-of-town plant visits continued, in many cases at locations chosen to complement the course material and/or the design projects. For example, students made a site visit to the Dominion-Hope wet natural gas cryogenic separation plant at Hastings, West Virginia, as part of the study of vapor-liquid equilibrium and separation processes.

Galli primarily led the senior exams, but Sears also gave problems to the students. The major exams required considerable effort to provide guidance to faculty members who interviewed and questioned the students, as they were recruited to help on this load for logistic purposes. The final presentation of the senior project was a formal presentation to all of the faculty members, including the chairman, who listened to the individual student presentations as a pair of faculty members to help ensure the fairness of the process. This was a great student development tool.

**Results**

The resulting program was established after three years, and continued for many years. While lectures and problem solving as homework continued to some degree at the junior level, systematic problem solving also carried throughout the courses. There were out-of-town plant visits, in many cases at locations chosen to complement the course material and/or the design projects.

The senior block was later broken into individual courses for more fairness in grading, but the practice of stopping course work for the majors was continued, although the number of exams was reduced. Operating the program still required coordination, and this we accomplished by regular meetings and an undergraduate coordinator. Feedback coming from the students who had completed the PRIDE Program and taken jobs in industry indicated that these students had a confidence on the job about their ability to take on new problems and projects, to be able to choose the resources needed, and to proceed in a rational and systematic manner.

Further, those students that went on to graduate school generally indicated their ability to compete and to succeed at that level in competition with graduate students from other schools and programs. Recruiters of our undergraduates often commented that the communications capability and maturity of our undergraduates were among the best they encountered anywhere. Success of the program was fueled by the integration of the design through four years, coupled with the use of design majors in the senior year.

Students and the program were evaluated after it was in full swing. The most important evaluation was by a blue-ribbon committee led by Lee Harrisberger, an icon of engineering education, and education experts in innovation and evaluation, as part of a study of six programs on engineering practice, because of the increasing emphasis in this arena starting then across the nation. The study results were published in the monograph: Experiential Learning in Engineering Education, ASEE, 1976.

The PRIDE Program at WVU had only been in full swing for one year at that time, while other programs had been in existence for up to 75 years. WVU faculty and students were found to be aware that considerable extra effort was required to make the program go. Benefits included the effort in communication and self-confidence and thinking on one’s feet. Students found their problem-solving skills, creative expression, and interpersonal skills accelerated, but were concerned about technical aspects. This continued throughout the program, as found in a long-term study discussed in the AIChE Symposium Series, 228 (1983), Problem Solving.

The PRIDE Program was the subject of at least 10 articles in Chemical Engineering Education and other journals in the engineering education community, including an article featuring the department in the summer of 1975, and a presentation at the 1977 ChE Summer School. All in all, WVU was noticed as a leader in engineering education, and this program was part of the process step to the present nationwide emphasis on design in all four years.

The program morphed into the present standard for design incorporation, but left a legacy of design emphasis that helped lead to the best-selling text (and editions) on process design by Bailie, Shaeiwitz, Turton, and Whiting. The design majors drifted away with the departure of Sears and the retirement of Galli. But the strength of the undergraduate curriculum was set and continues today.

## Independent Evidence of Research Productivity

Richard Griskey published a ranking of the effectiveness of chemical engineering graduate programs in the summer 1976 issue of Chemical Engineering Education. WVU's chemical engineering graduate programs ranked 13th nationally. A quantitative ranking illustrated on the next page is much different than the traditional opinion-based American Council of Education (ACE) rankings. The quantitative rankings were controversial especially with departments that did not rank as well as they did in the ACE rankings. There are many merits to the ACE peer opinion-based survey.

The primary point I wish to make here as that the productivity of WVU ChemE graduate program ranked well when based on a weighted average of the number of master's and doctorates, thousands of dollars of external funding, and number of refereed publications, all expressed per faculty member per year.

Griskey's ranking criteria follows:

1. Master's degrees awarded/faculty member/year,
2. Doctoral degrees awarded/faculty member/year,
3. Extramural research funding/faculty/year, and
4. Refereed publications/faculty member/year.

The rankings of the top departments follow:

**TABLE III**
**Institution by Ranking of Graduate and Research Program Effectiveness***

| | | | |
|---|---|---|---|
| 1. | Stanford | 12. | Notre Dame |
| 2. | Rice | 13. | Carnegie-Mellon |
| 3. | M. I. T. | 13. | West Virginia |
| 4. | Illinois | 15. | Minnesota |
| 5. | Oklahoma | 16. | PINY |
| 6. | Pennsylvania | 16. | Stevens Institute |
| 7. | Illinois Institute of Technology | 16. | SUNY (Buffalo) |
| | | 19. | UCLA |
| 8. | Columbia | 20. | Purdue |
| 9. | University of Southern California | 21. | Texas (Austin) |
| | | 22. | Clarkson |
| 10. | Lehigh | 23. | Iowa State |
| 11. | Northwestern | 23. | Ohio State |

SUMMER 1976

## Research and Graduate Programs

There were several major research programs under way during the 1972 to 1981 period that attracted excellent graduate students, major federal and other research funding, and produced research results that were widely published and well recognized. Most of the research was funded by the National Science Foundation (NSF); the Department of Energy (DOE) and its predecessor agencies, Office of Coal Research and Energy Research and Development Administration (ERDA); the Environmental Protection Agency (EPA); and the Electric Power Research Institute through their funding of coal conversion research.

## Impact of Jimmy Wen's Research

***By L. S. Fan, Distinguished University Professor, Ohio State University***

*"Jimmy Wen's research on fluidization, reaction engineering, and applications to coal conversion technology have had a lasting impact on the on the practice of chemical engineering internationally. The outstanding accomplishments of his doctoral students are a wonderful testimony to his mentoring skills and the high expectations he had for all who work with him. He insisted that his students' research have a practical and often experimental grounding. He required his foreign students and post docs to converse*

*and write in English. Many years later his students cite these expectations as contributing to their career success.*

*"The four years I spent at WVU were among the most important of my life, particularly because of my association with Professor Jimmy Wen. I knew Jimmy long before I came to the U.S. because he was a close friend of L.T. Fan, my cousin. Jimmy and L.T. were very well known in the Taiwanese chemical engineering community, and I had harbored the hope that my future career would be just like theirs. I first met Jimmy in Taipei in 1970 when, on an invitation from National Taiwan University, he came to lecture on flow models for chemical reactors (the very subject he later published a book on with L.T.).*

*C.Y. Wen*

*"I still remember vividly my private conversation with Jimmy at the Angel Hotel in Taipei where he showed me his lecture notes and explained to me mathematical modeling and the physical significance of those models used to describe fluidized beds. I found him to be friendly, humorous, relaxed, and fun to talk to, which was counter to the intense and tough reputation that preceded him. Several months later, I received an admission and scholarship offer from the chemical engineering department of WVU. I was thrilled at the opportunity of pursuing graduate research with Jimmy as my advisor. At that time, U.S. scholarships were rare, and this scholarship made my study abroad possible.*

*"When I arrived in Morgantown from Taiwan, I first met Jimmy in his office at 2 a.m. Jimmy was busy working and appeared exhausted. I saw a pile of paper on his table. He talked to me of the high expectations he had for me and hoped I would do well. I promised that I would do my best. My four-year study at WVU was filled with good memories of learning, productive research, and fun. Jimmy was strict but considerate as an advisor. I learned many research ideas and techniques from him, but even more importantly, I developed an ethos of professionalism from Jimmy's example.*

*"I also benefited considerably from the courses I completed on three subjects: chemical reaction engineering (Professor Wen), separation processes (Professor Henry), and process design (professors Galli, Sears, and Bailie). These were the signature courses of WVU chemical engineering at the time. I have kept the class notes for these courses for all these years and have reviewed them often in my own teaching at Ohio State University.*

*"Jimmy's program attracted many excellent students from abroad and the best post-doctoral associates around the world. It was an added advantage to work in Jimmy's group, as the intellectual level of discussion was very high, particularly when post-doctoral associates were involved. I was very pleased to have in-depth discussion on the topic of fluidization with Dr. S. Mori, Jimmy's amazing post-doctoral associate. This association developed into a lifelong friendship. Also, many world class scholars, such as Professor Daizo Kunii of Tokyo University, came through Jimmy's lab, giving his students an opportunity to interact with the brightest minds. The experience I garnered from such opportunities was most valuable as a student, and the impact from this interaction has proven to be lasting throughout my career."*

*******

Wen was an incredibly devoted scholar and teacher and dedicated 30 of his most productive years to his profession. He was a world-class researcher and an internationally recognized leader in the areas of coal conversion technology, fluidization, solid-gas reactions, and modeling of chemical reactors. His lasting contributions are prodigious. However, perhaps his most widely recognized work is the Wen-Yu equation (1966) to calculate the minimum fluidization velocity for a range of particle types and sizes based on experimental data in the fluidized bed. This work ranks 44th in the 100 most cited articles in AIChE Journal History and may well be one of three most cited articles in the history of fluidization literature.

Briefly, the Wen and Yu equation is valid for particles over a wide range of sizes covering the Reynolds number from 0.01 to 1000. For gas fluidization, the equation is most suitable for particles larger than 100 micron. Wen also pointed out that although the equation was developed for room temperature operation, it was found to be valid also for high temperature operation. The advantages of the Wen and Yu equation over other correlation equations include simplicity, accuracy, and universal applications for academic and industrial systems.

The Wen and Yu equation also contributes to continued interest in the fluid-particle drag force formulation for computation in a profound way. Drag force has been recognized as the single most important computational parameter governing the accuracy of the simulation results. The Wen-Yu drag model is being used today to benchmark the current analysis of the interphase drag coefficients in predicting fluidized bed behavior in relation to other drag models. For densely distributed solid particles, the Wen-Yu drag model is valid for solid phase volume fractions at least up to 0.2, and probably higher. Currently, the computational fluid dynamics approach, based on a two-fluid model, is widely used to understand the complex hydrodynamic interactions of the fluidized-bed reactors. The Wen-Yu equation, together with the well-known Ergun (1952) equations, are now classical duals on drag laws in interpreting the interphase drag force.

Wen's other important contribution to chemical reaction engineering is the Wen-Ishida work on non-catalytic solid-gas reactions occurring at high temperatures (1968-1971). In their study of a reaction in a particle, Wen and Ishida noted the reaction may occur along a diffuse front rather than along a sharp interface between ash and fresh solid as assumed in the original shrinking core model. They also treated the effect of temperature gradients caused by heat release for fast reaction and the situation by which a solid is converted by the action of heat without needing contact with gas. Wen and Ishida also compared the original and modified shrinking core model with other models for gas-solid reactions in their paper, Comparison of Kinetic and Diffusional Models for Solid-Gas Reactions, which was ranked 53rd in the 100 most cited papers in AIChE Journal history.

Their conclusion, based on the studies of numerous systems, in which the shrinking core model is the best simple representation for the majority of reacting gas-solid systems, has served as a general guideline for model selection in describing the complex heterogeneous solid-gas reaction systems. Wen's phenomenological approach in the analysis of rate-controlling steps was useful not only for solid-fluid reacting systems but also for other systems such as drying of porous particles, leaching of ores, melting and freezing, crystallization, and ion exchanging.

Wen published a well-circulated book, "*Models for Flow Systems and Chemical Reactors"* in 1975 with L.T. Fan. The dispersion models given in chapter five, which were the highlight of this book, was a Wen contribution. The dispersion model has been one of the most widely used flow models for multiphase reactors. The model contains empirical parameters that closely approximate the actual behavior. Wen pointed out that when the flow behavior deviates considerably from plug-flow, the dispersion model cannot always represent the flow behavior, but can still be used in each phase when two phases are involved. The widespread continued reference to the work in this chapter indicates the considerable value of this book.

Wen also made groundbreaking and lasting contributions in the field of coal gasification and combustion. Wen was recognized as the “King of Coal” by many in the 1970s because of the depth and breadth of his research in a variety of coal conversion processes and pollution control methods evolved from coal use. He was also funded extensively by federal agencies for coal research. Some important activities of his coal research can be illustrated below. Wen, together with Dutta and Belt, presented results of C-$CO_2$ kinetic studies for a variety of coal chars between 1975 and 1977.

They studied the reactivity of a few coal and char samples produced in some pilot plant experiments conducted under different gasification schemes. They investigated the relationship between the reactivity and the physical characteristics of the coal and char samples. They also compared the relative reactivity of coals and chars observed in a $CO_2$ atmosphere with those in an atmosphere of oxygen and nitrogen. They examined the effects of the gaseous environment and the reaction mechanism involved on the relative reactivity.

Pore surface areas of the chars were found to vary during reaction in a $CO_2$ atmosphere. They also pointed out that the degree and nature of pore surface area variation depend on the char sample and affect the rate of conversion. Wen and Chuang also developed a mathematical model to simulate the Texaco down flow entrainment pilot plant gasifier using coal liquefaction residues and coal-water slurries as feedstocks. The entrainment gasifier was conceptually divided into three zones: the pyrolysis and volatile combustion zone, the gasification and combustion zone, and the gasification zone. In each zone, different controlling mechanisms are considered, so that the model can better depict the real gasification process.

Wen and Chuang discussed the characteristics of different regions in the entrained flow coal gasifier. Temperature and concentration profiles along the reactor were obtained by solving the material and energy balances and taking into consideration the gasification kinetics, the transport rates, and the hydrodynamics of the gasifier. They used the numerical model to optimize the operating conditions to provide a better understanding of performance under various operating conditions.

Wen also discussed optimization of coal gasification systematically in his publication (1972 and 1973) that described pretreatment of coal, gasification, shift conversion, and purification, and shed light on the wide application of coal gasification processes in chemical industries. Much of today's coal research continues the path that Wen laid out many years ago. He is an undisputable pioneer of this field.

Wen also worked on flue gas desulfurization in 1976, using a wet limestone scrubbing technique in the turbulent contact absorber (TCA). They analyzed the data from both small and large scale turbulent contacting absorbers and spray columns used in wet scrubbing of sulfur dioxide from flue gases, and obtained gas film mass transfer coefficients and the overall coefficients in the liquid film, which includes chemical reactions.

They developed correlations for the gas film mass transfer coefficient and the ratio of mass transfer resistances that could predict sulfur dioxide removal efficiencies for widely differing size TCA and spray column scrubbers. His work was used for design of commercial wet scrubbers for flue gas desulfurization being operated in the boiler industry.

The designation of the NSF Fluidization Center in 1984 at West Virginia University was a tribute to Wen's reputation and achievements. It was the first of its kind in the U.S. in this field and one of the earliest NSF centers dedicated to a specialized field. With this award, Wen set a high standard for an NSF center. It was most unfortunate that he did not live to advance the cause of this center. See the detailed discussion of the efforts to assure the designation of the NSF University/Industry Fluidization Center in the 1981 to 1988 section of the history.

Wen presented numerous seminars at universities, delivered invited lectures at workshops and symposia throughout the U.S., and he was often invited to deliver plenary or keynote lectures at conferences held in England, Germany, China, Australia, and Japan. WVU named him a Claude Worthington Benedum Professor. The C.Y. Wen Memorial Library and Laboratory in the Fluidization Center commemorates his many achievements as an outstanding educator, researcher, and administrator.

When Wen was terminally ill in 1982, my wife and I visited him at the WVU Hospital. He was calm, smiling, and did not show any sign of fear of the disease as he talked with us. He had apparently just finished reviewing papers from his office, and his hospital room was organized like his office. He sensed that we were more worried about his condition than he was. At this time, Wen invited me to come to WVU and take over his lab. This was an incredibly emotional moment for me, particularly when he reminded me that this would be the last time he would invite me to join the WVU faculty.

My personal experience with Wen at the end of his life has offered me a potent example of the ability to display grace, calm, and bravery at the most difficult time in one's life. Wen's life, career, and achievements made all of those who were associated with WVU proud and he will always be remembered with fondness and affection.

## Jimmy Wen's Relationship with Research Students and Post Docs

***By Emily Wen (Jimmy's daughter)***

*"This WVU community of faculty and students was a vibrant part of our lives throughout the years. Faculty and students often gathered on holidays or for summer picnics. When more graduate students and post-doctoral fellows started arriving from other countries, they often came to our home to socialize since their families were so far away.*

*"I remember the many meatballs that we had to fry for these parties since it was always on the menu and had originally been created by my father in his bachelor days. I also remember learning how to play poker by watching the students who played into the wee hours of the night. Ping pong was another favorite game at our parties.*

*"It was a rich experience for us children to have so many international gatherings at our house. The students/fellows were from India, Japan, or Taiwan. There were also visiting professors from Russia, Korea, Romania, and Australia.*

*"The international people we got to know deeply respected my father, yet they also seemed very comfortable with him in an informal way. A few of his students even babysat us while he was a single*

*divorcee. Having spent afternoons hanging out at his office until he was done working, I remember seeing how stern he was as a teacher, as he was as a father, yet he joked frequently with his students and colleagues.*

*"It has always amazed me how long the ties have lasted between our family and some of the international fellows, long past my father's passing. Many have traveled from Japan and paid visits to my mother several times over these last 30 years to pay their respect and appreciation, yet they had worked with my father for only a few years."*

*"One such individual was Dr. Kunio Kato, who came to Morgantown from Japan in 1967 as a post-doctoral student and stayed a year and a half. In this short period, he and my father proposed a new model for coal gasification using a fluidized bed catalytic reactor. They published the frequently cited paper, 'Bubble assemblage model for the fluidized bed catalytic reactor.' Through the years since my father's passing, Dr. Kato has made the long trek from Japan to Morgantown numerous times, with the most recent trip just a few years ago to see my mother and the chemical engineering department.*

*"He has expressed his immense gratitude to my mother for having the chance to work with my father, an experience that had a significant impact on his career. Dr. Kato felt that the research experience he gained in Morgantown helped him to publish 'more than 150 academic papers.' Additionally, he told my mother that his academic experience with my father helped him in his own mentoring of Chinese scholars who later returned to China to become professors, associate professors, and even a president of a company.*

*"Another post-doctoral student from Japan, Dr. Shigekatsu Mori, also expressed to my mother that '[my] days with Professor C.Y. Wen were most important and fullest academic experience in my life.' Their work on estimating the bubble diameter of fluidized beds culminated in the Mori and Wen's Equation, which is also still widely used today. Dr. Mori felt that another paper published in 1977 by Wen, Mori, Gray, and Yavorsky 'was probably the first paper in the world, which analyzed reaction performance of fluidized bed coal conversion processes by these bubbling-bed models.'*

*"Like Dr. Kato, Dr. Mori felt that the year and a half he spent working with my father helped his career tremendously after returning to Japan. 'I organized a new coal research group in Society of Engineers Japan. . . . This group was the first chemical engineers' group for the modern coal conversion process in Japan and greatly contributed to drive major Japanese national projects on the development of coal-utilization processes.'*

*"Another family friend was Marian Jones, who taught technical writing at the department. She was also the wife of Dr. Paul Jones, also a professor of chemical engineering at WVU. Both my father and Mrs. Jones had big personalities and shared much humor in their relationship.*

*"One year, Mrs. Jones asked some students to draw a caricature of my father, crowning him as 'King Coal' for his life's dedication to the study of coal as a clean energy source. This large drawing still hangs on our basement wall.*

*"The year 2011 marked 60 years since my father arrived in Morgantown. He has two granddaughters who don't know him at all, so we took them on a field trip to the department. Thanks to the historians there, the girls, ages 6 and 7, were surprised and amazed to learn so much about their grandfather's accomplishments on the walls of the fourth floor of the engineering building. Large pictures of distinguished alumni hang there, including my father, who are charter members of the WVU*

*Academy of Chemical Engineering. There is also a special plaque with a carving of my father's face. My mom recalls how contributions to the WVU Foundation in honor of my father at his passing supported the creation of the plaque.*

*"The Foundation also supported efforts she and Professor L.S. Fan, a former doctoral student at WVU, made to compile and publish my dad's most quoted research papers. They collected 42—14 on fluidization, 16 on solid gas reactions, and 12 on coal conversion technologies. These reprints became gifts to some of his colleagues with the intention of encouraging future research and continuation of his unfinished work.*

*Wen as King Coal*

*"My father marveled many times at how long he had stayed in Morgantown ... 30 years for him, and our mother is still quite rooted there. A few times he mentioned moving out, but it never seemed serious. I think he stayed so long because West Virginia was really the place to be to research coal. He also appreciated the ability to be innovative and creative about his research ideas at the department. Where else could he be 'King Coal?'"*

In separate communications about their work with Wen, Kato, Mori, and Uchida noted that he insisted they always communicate in English in all their interactions with him. He also emphasized the importance of both theoretical and experimental elements in their research.

### Long Chen, a student of Dr. Wen, writes:

*"I was Dr. Wen's Ph.D. student from 1977-1981. During that time, there were quite a few graduate students from Taiwan. We often carried on conversations in Mandarin among ourselves, even in the hallways and/or classrooms. Dr. Wen reminded us to speak English all the time. I remember one time we saw him leave the office via elevator and we started talking in Mandarin loudly in the hallway. Suddenly, Dr. Wen came out of nowhere smiling and telling us, 'Speak English! Speak English!' Since then, we seldom spoke Mandarin with each other in the Department.*

*"Later on in my career, I finally understood Dr. Wen's valuable advice when I was a manager, and started practicing the same with my Chinese colleagues. I still benefit from his earlier advice today.*

*"When I graduate in 1981, I bought my first Honda with a standard shift. Dr. Wen was so excited when he first saw my car. He even drove it around the parking lot in front of the engineering building and showed me a few tips on using the shift. I had the sense that he was happy with my choice of the car. I shared his excitement greatly.*

*"There was a period of time that I traveled back and forth between Washington, D.C., and Morgantown. Dr. Wen always cautioned me to drive safely, especially during the snow seasons. He shared with me the terrible accident he had with Dr. Fan on Route 40 so many years back. Although we no longer have to travel through Route 40, I always remember his warning to drive safely in the snow.*

### Duane Nichols

Duane Nichols' research focus was process, systems analysis and design, and environmental assessment of coal conversion processes. His multiyear NSF grant with Wen on coal-based energy complexes directed at national needs was related to diversifying the supply of gaseous and liquid fossil fuels.

### John Sears

John Sears' diverse research was related to coal conversion, secondary recovery of oil, fluidization, desulfurization, and economic analysis. Sears' curriculum-related research was published widely. His educational innovations were recognized by his receiving the ASEE Westinghouse Award. After 13 years on the faculty, Sears was appointed department chair at Montana State University, where he was a major collaborator and organizer of an NSF Engineering Research Center.

### William Boyle and Joseph Henry: Energy R&D Policy Research

William Boyle and I had a grant in 1973-74 from the NSF Office of Energy Research and Development Policy to propose and evaluate ways to interest increased numbers of faculty to pursue coal conversion and related research. This study was part of a broader NSF initiative providing advisory services to Dixie Lee Ray, then a member of the Atomic Energy Commission. She was charged by the President's Office of Science and Technology Policy to develop a proposal to Congress to establish the Energy Research and Development Administration.

Boyle and I spent a summer traveling to most of the federal labs even tangentially involved in coal resource use and held workshops at several professional society meetings, including AIChE, American Chemical Society (ACS), and one of the Gordon Conferences on coal-related research. A year or so later I met with Dixie Lee Ray and spent a day with her and others helping with a concept draft of the coal research section of research priorities for the new cabinet-level Department of Energy.

This was heady stuff for a green assistant professor who was on the make to get a broad energy related separations research program funded. It worked! I have always thought that Wen had an invisible hand in my getting this opportunity at such an early stage in my career. When I asked him, he would never admit it.

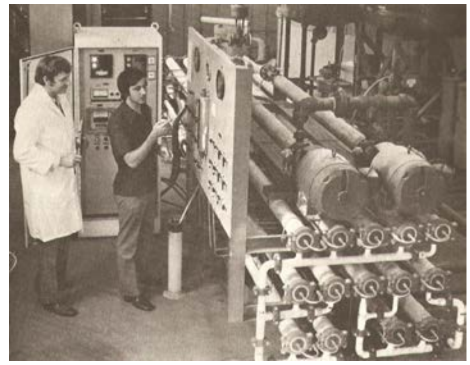
More broadly, Boyle was a superb mentor of young faculty who were seeking their first federal research grants. He would challenge faculty to develop a variety of research prospectuses, then travel with us individually to federal agencies and arrange for us to make presentations to key program officers. In the spring of 1974, five or six young engineering faculty were awarded NSF Research Initiation Grants. Only one other college of engineering in the U.S. received that many faculty research initiation grants that year.

Other chemical engineering faculty members were very generous to new faculty members. Wen played a major role in creating this with lots of support from Boyle and other departmental faculty. Lance Blackshaw, e.g., approached me the summer after my first year and offered to support me for two months from the overhead on his EPA project. I asked Blackshaw what my responsibilities would be. He said, “Do your research well.” I will never forget his generosity and interest in my success.

### Richard Bailie

The EPA extensively funded Richard Bailie’s research on fluidization, reaction engineering, pyrolysis, and incineration of solid wastes. His research resulted in a broadly patented process for solid waste disposal and energy recovery. He left the faculty for several years to found and lead a company focused on commercializing this technology. He returned to the faculty just after Wen’s death to help lead the successful effort to have the NSF establish the NSF University/Industry Fluidization Center.

## Lance Blackshaw and Al Pappano



*Blackshaw and Pappano working on reverse osmosis for acid mine drainage treatment*

Lance Blackshaw and Al Pappano, who had physics and nuclear engineering backgrounds, had a major, multiyear EPA-funded project on the application of reverse osmosis (RO) to acid mine drainage treatment. This culminated in an RO pilot plant constructed near Rivesville, West Virginia. Working in tandem with EPA personnel, the goal was to develop design parameters for an RO system that would remove noxious substances from raw mine drainage to produce an effluent (of possibly potable quality) that could be safely discharged into natural waterways. The process proved to be costly and getting potable quality a challenge.

Blackshaw also conducted research in a variety of nuclear engineering-oriented research projects in neutron scattering, reactor criticality, and neutron activation analysis, receiving support from the NSF Research Initiation Grant program and the West Virginia Department of Highways. In addition, he served as project director for the College’s NSF-funded undergraduate research participation program for three years, and was a co-investigator with Jim Dowdy, a mathematics faculty member, on development of an undergraduate applied calculus program for second-year calculus students sponsored by NSF.

Al Pappano collaborated with Charlie Wales and Tom Long to co-author a guided design style manual on material and energy balances that for many years was the foundational text for sophomore year students in ChemE.

## Harold Fairbanks

Harold Fairbanks’ research involved diverse material science related problems, including corrosion and powder metallurgy. He was most noted for his study of the interaction of ultrasonic radiation with materials and other chemical processes.

Fairbanks was a scholar and enjoyed being in his lab working with students. His office was next to mine when I joined the faculty. We usually met up at lunch in his office and discussed diverse research problems. He retired to Mesa, Arizona. The first week after I started my new responsibilities as chair of the department of chemical, bio, and materials engineering at Arizona State, Fairbanks appeared at my office and said we should meet every week or so to discuss research. He continued to do research until the time of his death. Again, what a scholar he was.

**Fred Galli**

Fred Galli was an incredibly effective teacher. Galli's teaching gave his students a comparative advantage related to other engineers we worked with all our professional lives. It is not generally recognized that he had a major impact on departmental research programs.

Now for a personal story: I was working on the application of particle transport in three phase systems (particle, liquid, liquid). All the applications I was considering involved biochemicals or bacterial cells. I always talked with Galli when I was considering new research projects. One day, Galli said in his soft spoken manner, "Joe, you could use a process like that to remove mineral particulates from coal liquids." That one comment led to a 12-year research program funded by NSF, ERDA, DOE, and EPRI. Years later I told Jimmy Wen about Galli's insight. Wen smiled and said, "Fred has done the same for me many times."

**Joseph Henry**

My research focused on separation processes. Virtually all my research projects were interdisciplinary (ChemE, biochemistry, and surface and colloid chemistry). My first doctoral student, Alan Lui, and I developed a framework, multiple functional separation process, which used multiple transport process and/or separation bases to systematize the process of inventing new separation methods. Early related work included cross flow filtration, cross flow electro-filtration, and a dual functional filter that combined filtration and settling. The work on particle transport in systems with two liquid phases led to new processes for removing mineral matter from coal liquids and petroleum, and highly selective protein separations. Research programs were funded by NSF, ERDA, DOE, and EPRI. Several industrial sponsors including Union Carbide, Gulf Research, National Steel, Merck, and Union Pacific provided additional funding.

A new method of indirectly observing the sedimentation of particles (by x-ray photography) in high temperature sub and super critical oil phases was developed with EPRI sponsorship. This project involved collaboration with Frank Verhoff.

Our separation processes research group's research was recognized by Henry's election to chair the Gordon Conference on Separations in 1981, editorial board of AIChE Journal, editor of Separation and Purification Methods, and the editorial board of Separation Science and Technology. He was three times invited to write and edit the section on novel separations in Perry's Chemical Engineer's Handbook. In 1979-1980, the NSF and their Australian equivalent jointly funded his research on surface and colloid chemistry with colleagues at the Universities of Melbourne, the Australian National University, and the University of Sydney.

*Mike Prudich investigates the removal of ash particles from liquefied coal by partitioning the particles into a water phase.*

**Mike Prudich**, one of Henry's doctoral students and later a professor and chair of chemical engineering at Ohio University, writes about the graduate student environment and culture in the department and his impressions of Henry's research group:

*"I remember my time as a graduate student in the Department of Chemical Engineering at West Virginia University with much fondness. In general and with all seriousness, it was a time of discovery and comradery for me in a community of scholars.*

*"The departmental graduate student body made up a majority of that community. There was a large degree of communication, both technical and social, among the chemical engineering graduate students. This communication was facilitated by the fact that many of us—regardless of research group—were housed together in a graduate student bull pen located in a corner room on the chemical engineering floor of the Engineering Sciences Building. We each had an individual desk to use as a work*

*space and a storage locker for books and such. Most of us treated graduate school as a job in that we regularly showed up for work early in the morning and stayed on duty until that day's work was done.*

*"Since we were bull penned together we could share thoughts and views on our various research problems which, surprising to us, were often similar even though we might be working with different faculty members (Henry, Wen, Verhoff, etc.). The bull pen room was also a launch point for socializing where we could plan common grad student dinners at each other's places, pickup basketball games in the parking lot outside the Coliseum, rock climbing and rappelling, and other less-than-academic activities.*

*"Faculty members were often participants in these activities. I remember well that my own research group (actually Joe Henry's research group) would often meet on Wednesday afternoons at the Little Village in Star City for 'hydraulic seminars.' In addition to the research group, friends and families were also welcome. I remember storing my infant daughter, Julie, in her baby carrier under the table where we sat so that she could sleep while we talked and played pinball and pool.*

*"In the scholars' part of the equation, we were also a community if community is defined as interaction with others. All members of our research group were willing to discuss and help with problems, mathematical, theoretical, or mechanical, whenever they were encountered. Since we were not all working on similar projects, this allowed us to broaden our perspectives by learning about—through applied problem solving—other research areas. I learned about anti-solvent settling, the use of x-rays for imaging, cross-flow filtration, electro-filtration, and electro-osmosis, and many other areas in addition to my own research area of surface-based separations through these student-to-student interactions.*

*"I also learned through frequent and direct interactions with my advisor, Joe Henry. I really benefitted from these interactions in that Joe would question, and cause us to question, what we were doing, our assumptions, and sometimes why we thought that we should be in graduate school (that last, at least, is said with at least a little tongue-in-cheek). I have later come to learn that such intimate student-advisor interactions are rare, but I have really valued what I gained from them throughout my career."*

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**Frank Verhoff**

Frank Verhoff's research involved water and air purification, biological and biochemical modeling, and nutrient cycling. He was co-investigator on a multiple-year EPRI grant with me (Joe Henry). A new method was developed to indirectly observe particulate settling in sub and supercritical oil phases. Verhoff was a highly sought consultant to several companies in the pharmaceutical and food industries.

## Eugene Cilento

Eugene Cilento had a joint appointment in the department of anatomy. His research involved biomedical engineering and microcirculation. His research was funded by the National Institutes of Health.

## James Riggs

James Riggs' research included projects in process control, simulation, and electrochemical processes. Later in his career he moved to Texas Tech, where he wrote a widely accepted textbook on process control.

## Desmond King

Desmond King joined the faculty in 1979. His research area was fluidization. King is presently president of Chevron Technology Ventures. In May 2010, he was appointed the 69th president of the Institution of Chemical Engineers, which is the global professional organization of chemical engineers.

## Further Perspective on Jimmy Wen's Leadership

Finally, to bring the discussion of the Wen era to an end, Frank Saus, who was Wen's administrative assistant during most of his years as department chairperson, reveals Wen's leadership style from his unique perspective:

*"Dr. Wen hired me as his administrative assistant, allowing him to re-engage in research. My job was essentially to take on the burden of the department's administrative busy work, and to assist his post-docs and graduate students.*

*"As everyone knows, Dr. Wen was internationally famous for his work in fluidization, which at that time was in use in commercial applications—more so in foreign countries than in the U.S. No less, each year the department received many applications from foreign nationals wanting to enter the Ch. E. programs as graduate students or post-doctoral fellows and to have Dr. Wen be their research advisor.*

*"This created a problem at times for the department would only accept new students for whom there was one year of guaranteed research funding—generally faculty research grants that includes graduate student support. Therefore, new students had to choose a faculty member to direct their research based on available funded positions. However, it is safe to state that Dr. Wen had the majority of research funding and as a result a large number of foreign nationals were under his direction.*

*"I recall that the department was undergoing several significant changes. Several faculty had departed; state funds limited the College for new faculty positions as well as operating expenses; the PRIDE Program was coming to a close; research funds were hard to obtain; and the Department was searching for its future direction, both academic and research.*

*"Dr. Wen's research program had a structure similar to that practiced in eastern schools. A research professor is at the top of a pyramid. There may be one or two persons immediately beneath the professor. The structure then tumbles down to post-doctoral persons who each head a major research area and who supervise four to six graduate students. The post-doc provided day-to-day supervision for the graduate students as well as maintaining a research program at a higher level.*

*"When I came on board, I relieved Dr. Wen of much time and responsibility by performing departmental administrative functions and helping his post-doctoral people prepare proposals. This allowed him to concentrate on the department's educational aspects and his research. During the time I worked for Dr. Wen, the department had no problem placing B.S. students due to the department's educational component, the still-operating PRIDE Program. In addition, many private firms looked to the department for top notch researchers from the M.S. ranks.*

*"To complete aspects of the research program, Dr. Wen had many grants from the Department of Energy. At that time, there was a research umbrella between WVU and DOE. So many research projects, ideal for M.S. candidates, were of the nature 'I wonder what if' questions raised by DOE staffers. Dr. Wen held weekly meetings with his post-docs and biweekly with students to discuss research and academic progress. Students were repeatedly reminded by Dr. Wen that success was in dedication, performance, and achievements; he was not tolerant of slackers. Students were to maintain high marks in their classes as well as keeping progress in completing their degree. I believe this was a direct result of Dr. Wen's own personal journey.*

*"Dr. Wen was very mindful of his staff and faculty. When he traveled abroad he would bring back small gifts for the staff. We had the first Pentel 5 mm lead mechanical pens in the U.S. prior to Pentel introducing them a year or so later. Likewise, I received a palm-sized solar powered calculator upon his return from a Taiwan trip.*

*"He was also concerned about his faculty. As with the students, he expected them to be accomplished in teaching the basics of ChemE and in performing research. This was especially evident in his interest in the senior design projects and how well faculty guided the students to be imaginative and productive. The department had one of the first Apple computers in the College, although we had to settle on IBM or IBM clones due to the large documents and data number crunching handled at the time.*

*"One example I recall most notably about Dr. Wen and his faculty relationships was one of the first tasks I had to perform when I joined the department. A faculty member had recently passed away. Dr. Wen was asked to present a small narrative at the funeral. He asked my assistance in creating the presentation. He found it very difficult putting his feelings to pen and paper. When we had finished and he returned back to Morgantown after the funeral, I realized that I had been given a glimpse into a more complicated individual.*

*"One concern he had was for the safety of his students. I asked a National Institute for Occupational Safety and Health individual involved with industrial safety if we could get a few speakers to present seminars on such topics. Energy was becoming big business, plus material handling and chemical tracking was important to the EPA in the industrial arenas. This series of seminars resulted in the department chemical and equipment store rooms in the highbay area needed to be cleaned out.*

*"I remember clearly Professor Galli claiming that a bottle of unidentified chemicals in an unlabeled bottle was the same one used when he was a student in Professor Fairbank's classes. Although there existed an industrial hygene program in athletics and industrial engineering, none addressed the chemical reactions which faculty and students were addressing in their research. The final outcome of this initial activity was the safety program, which later adopted faculty and graduate students writing a chemical hygiene plan outlining their research and addressing the use of chemicals and possible dangerous procedures.*

*"Fluidization was reaching industrial applicability in the view of the DOE. So funding for research was only into unique methods or combustion applications. A number of industries were using fluidization for drying materials, applying coating to pharmaceuticals, and even on-site material combustion. The drive for the fluidization center (FC) was greatly dependent on industrial sponsorship. It was difficult to generate funding on the financial scale being proposed, i.e., having a full working 1 MW unit in the revamped agricultural engineering wing. The program started and the unit dedicated in a very nice program. However, the road was uphill and Dr. Wen's health was not the best then to pursue this activity with the vigor required.*

*"Although industry was unwilling to provide the large financial commitments for the FC, they were eager to have consulting done. The benefit was that the department received contributions to the (WVU) Foundation account, which could be used for all types of programs or activities. Dr. Wen used this money to provide faculty travel to help faculty stay current with their peers and to purchase research and educational equipment. I recall that when he passed away and I left the department, the fund in the Foundation account was over $100,000. This was all due to industrial partners. Wen had me research past fund contributors, alumni, etc. We contacted them through letters and phone calls. All this allowed the department to benefit from such sources. Faculty also got the overhead funding generated by their research grants rather than placing it all into department activities.*

*"Dr. Wen's office was on the corner of the engineering tower, which had a coal-fired combustion unit attached to the building. He would comment that when they were disposing of the ash, the building would shake and flakes of material would drop from the ceiling. He reported this and no action was taken. He asked if there was a way to test the ceiling material, since some ceilings appeared to be texturally different than others. This was eventually done and my report was passed on to the dean's office. The final outcome was that the entire engineering building was overhauled and all asbestos material removed.*

*"Finally, I will end on a note that involves me to some extent. Many years ago, DOE wished to establish a number of National Centers of Excellence. Dr. Wen turned me loose on this request for proposal and we created a proposal to establish a center at WVU dealing with energy. The proposal was named Center for Energy Studies and Research (CESAR). DOE decided to eliminate the program. Dr. Wen, armed with the proposal that addressed everything from coal, oil shale, gas, and water, went and spoke to a number of state legislators. After much persuasion, the state gave funds to WVU to establish energy research and faculty. A direct off-shoot of this, in conjunction with some federal funds to deal with small*

*communities, was the Energy and Water Research Center. Funding availability for both programs was difficult and ultimately they became one program, joined under the directorship of Dr. Richard Bajura and the National Research Center for Coal and Energy (NRCCE). I was primary author of the CESAR proposal, establishment of energy funding, and the design and construction of the NRCCE."*

# The Henry Era (1981-1988)

***By Joseph D. Henry***

A lot of changes occurred in the department during the 1981 to 1988 period. Some of the factors that underpinned the changes were:

1. Several faculty members left the department in the early 1980s to pursue other interests. John Sears became department chair at Montana State University, Desmond King joined Chevron Research, Jim Riggs accepted a faculty position at Texas Tech and returned to his beloved Texas, and Frank Verhoff left to pursue consulting opportunities full time and ultimately had key R&D positions at several firms. In addition, Lance Blackshaw was appointed associate dean for academic affairs and Al Papanno joined Jet Propulsion Laboratory.

2. Jimmy Wen was making great progress with the NSF University/Industry Fluidization Center planning grant at the time of his untimely death.

3. Nine faculty members were recruited between 1981 and 1988. I was appointed department chair in 1981.

## Lessons Learned from Wen's Period as Department Chair

1. The pursuit of innovation in both undergraduate and graduate programs enhanced the excellence and external recognition of the department.

2. The well-established ties with industry and the outstanding successes of our graduates in industry practice enabled many opportunities. Industrially relevant research does not compromise academic excellence.

3. Innovative research and focus involving cross-disciplinary in addition to more traditional research on mature technologies added to the national and growing international recognition of the department. This was entirely the focus of my research during the 1972 to 1988 period.

The 1980s was a period of major changes in academic chemical engineering research. Several National Academy of Engineering and National Research Council reports established major opportunities for chemical engineering faculty and their graduate students to be involved in cross-disciplinary research. Opportunities included biochemical; biomedical engineering; materials science, especially electronic and biomaterials; advanced ceramics; surface science; and others.

The College of Engineering had a new dean, Curt Tompkins, who encouraged substantive planning and identification of areas to enhance excellence. This coupled with the events described above, including changes occurring in federal research agencies, created a productive environment for the faculty and me to respond to the many planning exercises. Several early goals came out of this:

1. Hire faculty with expertise in reaction engineering, catalysis, computer aided design, fluidization, and innovative chemistry. This was eventually expanded to biochemical separations and others.

2. Diversify faculty research capabilities beyond coal conversion related research while assuring excellence in that and related areas.

3. Continue the design emphasis in the undergraduate program.

4. Improve relations with both alumni and industry to enable fund raising opportunities.

5. Review and refine graduate degree requirements to enable more emphasis on the doctoral program and the direct pursuit of the Ph.D. without a master's degree on the way.

## Early Experiences as Department Chair

### Teaching Moment and Walter Koehler's Thumb

The day after I was appointed department chairperson, Ernie Walls, our beloved retired shop manager and technician, appeared in my faculty office. He had a jar of formaldehyde with Walter Koehler's thumb in it. Koehler had managed to cut his thumb off in the shop while working alone on a Saturday. Before seeking medical assistance, Koehler had the presence to preserve his thumb as a teaching tool to get future generations of students to pay attention to safety. After losing more blood than he should have, Koehler went to the hospital. The following Monday, he was waiting in Walls' office and said, "Keep my thumb in your desk and use it to persuade both students and faculty to follow safety rules." All this occurred before my time as undergraduate in the department (1960-64).

Koehler was an outstanding researcher and expert on the process aspects of electrochemistry. He was a very effective chair and associate dean for research. Much of the research focus and excellence in the can be traced to his accomplishments and values.

Back to Walls in my office. He said, “Joe, do you recall when you were beginning your undergraduate research project your senior year and wanted to use the shop, that I showed you Walter’s thumb and told you never to work in the shop alone.” He went further. He told me that safety was important to every aspect of chemical engineering practice and wanted to know what I planned to do to improve safety in the department. During his career, Walls was held in as high esteem as any faculty member. Years after his death I never discussed him with Fred Galli that we both did not have tears in our eyes.

One of my first acts as department chair was to appoint Chris Ludlow to lead the safety committee and prepare a safety manual. I talked with Galli and asked him bring up the topic of process safety with the undergraduate curriculum committee. As always, Galli was several steps ahead of me. The integrated design-based curriculum and design major exams provided many opportunities to bring process safety to life for our students. A few years later when we in the early design phase for the new research building, we worked with the architects to cluster research labs around graduate student offices, with expansive glass windows looking into the labs, to assure that no student was working in isolation or alone. I credit Koehler and Ernie’s diligence for preparing us to do this.

## Role of the External Visiting Committee

Jimmy Wen had a departmental visiting committee. Dick Bannister was its chairman. After consulting with Wen and Bannister, I decide to expand the committee. One of my first acts after my appointment was to convince George Keller, a separation processes expert at the Union Carbide Technical Center, to join the committee and to eventually become its chairman. It was an easy sell because Keller already had high regard for the department. He was a VPI undergraduate and Penn State doctoral alum who had strong loyalty to West Virginia. Keller serves both on the department and College visiting committees to this day.

Other members we added were Camden Coberly, associate dean for research and former chairman of chemical engineering at University of Wisconsin at Madison; Gene Whitmer, PPG; Jack Fitzgerald, Exxon; Alan Singleton of Gulf Research; and others.

The committee was very effective. Many of the members developed close relationships with departmental faculty. The committee acted in an advisory role on virtually all aspects of the department's efforts to enhance its programs. This included helping identify promising faculty candidates, advice on modification of the graduate program requirements, and the occasional review of faculty research programs with the goal of bringing external perspectives that might be helpful to faculty. Committee members also met privately with students and advised us on what we were doing well and where they saw opportunities for improvement.

The department also had close ties with industrial researchers who were not on the visiting committee. **Jean Cropley**'s summary of his involvement and collaboration is an example of this:

*"My first involvement with the WVU Department of Chemical Engineering was probably in the late 1970s, in the form of some consultation and some seminars on real-world chemical reaction engineering, which I presented. I functioned as an internal consultant in this field at Union Carbide, and was active in the knife-and-fork lecture circuit at a number of universities, including WVU, Washington University in St. Louis, the University of Akron, and Oregon State University.*

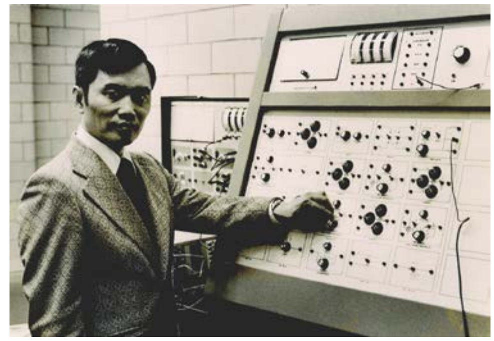
*"My relationship with WVU naturally evolved into participation as a member of a number of graduate student committees, and I came to know several members of the chemical engineering faculty rather well. This relationship naturally led to my participation with the WVU Fluidization Research Center in the mid-1980s.*

*"Union Carbide subsequently participated with the WVU Department of Chemical Engineering in several joint projects that involved the utilization of synthesis gas in the synthesis of fuel alcohols. Laboratory research was carried out both at Union Carbide and at WVU, and the project time-scale problem discussed above was largely avoided because Union Carbide and WVU could pursue conceptual engineering simultaneously at an overall pace that was more compatible to corporate interests.*

*"There were several people at Union Carbide who were involved in these projects, notably Duane Dombek, Don Best, and, of course, me. All of us were members of the Union Carbide Research and Development Department. Professors Dick Turton and Nigel Clark were among those who were involved at WVU.*

*"After I retired at the end of 1993, I continued to be active for several more years at WVU as a member of its graduate committees, as an honoree in the Union Carbide/WVU Distinguished Seminar Series, and as an honorary member of the WVU Chemical Engineering Academy."*

### Untimely Death of Dr. C.Y. Wen



*C.Y. Wen Illustrates a control problem*

Jimmy Wen was in the prime of his career, making great progress, and was well on his way to getting the NSF University/Industry Fluidization Center established. Suddenly in early 1982, he was gravely ill. I will never forget when I got a call to visit him in the hospital. To set the stage, Wen and L.T. Fan competed both during their grad school days and later during their faculty careers regarding the quality of their research programs and numbers of publications. When I walked into Wen's room, his first words were: "Joe, I am here dying of cancer and L.T is still at Kansas State publishing papers at an ever-increasing rate." Wen then began to talk with me regarding how I could help with a smooth transition for his 30 or so graduate students and post docs. He also said he knew it would make my job more difficult as new chairman. It was clear that Wen was as worried about the welfare of the departmental faculty and students as he was himself. Wen, Amy, and I talked for about an hour.

*Amy and Jimmy Wen*

Within a month or so Wen was gone. I got a call from Frank Saus, who was his administrative assistant, early on a Saturday morning; he told me that Wen had died. I asked him to contact all of the students working in Wen's research group and to arrange a meeting so I could talk with them later that day. In about half an hour, Saus called back and said every student he called already knew and indicated that he and I would meet with students in a couple of hours.

As I drove to the University, my mind raced to think of ways and approaches to assure that the maximum number of students would be able to complete their dissertations. It would also be important to meet the obligations to Wen's research sponsors.

When Saus and I entered the classroom, many of the students had concern about their own professional futures registered on their faces. After I expressed empathy that we had all lost a mentor and friend, I told them that the department would do everything possible to assure their educational progress. I explained that Saus and I would be calling NSF, DOE, EPA, and other agencies to talk with all of Wen's project officers. We planned to ask them to continue the funding until we could present the plan to continue to make progress on his research grants and contracts.

Wen was much more than a master's or doctoral advisor to his students. He was their friend. He looked out for their welfare and nurtured them to rapidly integrate into American society. In many ways he viewed his graduate students as family. As each student talked with me after the meeting, this became very clear. It was like each student was placing their educational dreams and welfare in my hands. This experience will always be with me. Prior to Wen's death, I had no problems sleeping in on weekend mornings. After that, I have never slept later than 6 a.m. to this day! I had lost a beloved colleague, a good friend, and the welfare of his graduate students was at risk.

Saus and I were not the only ones working that weekend on assuring the continuation of Wen's research program and generating ideas that would help his students. Early on the following Monday, John Sears and Dick Bailie were waiting for me in my office with the beginnings of plan to keep the projects going at least until the students finished their degrees. Bailie indicated he wanted to work with me to continue with the effort to establish the Fluidization Center.

When Saus and I called each research agency, every one of the project officers gave us the flexibility to proceed to finish research problems the students were working on. In only two of the cases did students who had barely begun their research and graduate studies transfer to other universities.

Bailie, Sears, L.S. Fan at Ohio State, Jean Cropley at Union Carbide, and other industrial researchers who had collaborated with Wen helped mentor the graduate students.

## The Two-Year Process to Establish the Fluidization Center

Dick Baillie was a very productive researcher and excellent teacher when he resigned to put all his efforts in his company that was a spin-off of his fluidization research and a multiple-year EPA research program on incineration of solid wastes. His company demonstrated this on a commercial scale as well as variety of other novel fluid bed processes such as production of activated carbon. Baillie expressed an interest in rejoining the faculty to contribute to the establishment of the fluidization center and to mentor young faculty yet to be recruited to eventually teach the capstone design course.

The chemical engineering faculty unanimously agreed to offer Baillie a faculty position. We also decided to solicit L.S. Fan, one of Wen's former doctoral students who was then a young faculty member at Ohio State, to advise us. A brief summary of the key elements of the plan that evolved follows:

1. Convince Dean Curt Tompkins and Gordon Gee, the new president of WVU, that we had a realistic opportunity to create the first NSF-funded center at WVU. This was important because NSF would expect the University to allocate resources to the center. Both Tompkins and Gee quickly agreed.

2. With the University's commitment, I talked with the Marshall Lih, the director of the NSF University/Industrial Centers program to continue the planning grant for the Center. Lih had been the long-term section leader of all programs at NSF that funded chemical engineering faculty research. He was an old friend of Wen's and my best friend in the federal research agencies. He expressed a strong desire to continue the planning grant. He asked to participate in our next planning grant meeting with potential industrial members once we had recruited a director.

3. Begin a national search to hire a senior faculty member with broad fluidization expertise who could eventually become the center director. Bailie had already stated he had no interest in becoming the director of the center. He wanted to assure its formation and be involved in center research programs. He still wanted to be involved in some of the day-to-day management of his company along with David Doner, one of his former Ph.D. students and a partner based in Pittsburgh.

4. Begin immediately to communicate with industrial fluidization and reaction engineering experts who might convince their companies to become initial industrial members of the center. Bailie and I spent lots of time responding to advice from Jean Cropley, who was Union Carbide's contact regarding Wen's planning grant.

5. Begin communications with faculty in other departments who would be interested in participating in center programs.

6. Develop a conceptual design for large circulating fluidized bed facility that would be the centerpiece of the center's unique capabilities. This was Wen's original vision and Bailie was ideally suited to take on this responsibility.

7. Get a commitment of new space to house the center's laboratories. When we asked Gee, he quickly agreed to allocate a major portion of the agricultural engineering building to the center and committed funds for the building renovation to accommodate the laboratories. The space at that time was assigned to the College of Agriculture.

All of the above activities were underway while a national search for a faculty member with sufficient stature and fluidization expertise who could lead the center research programs if NSF ultimately designated the center as a grant recipient.

The search for a faculty member to lead the research programs of the fluidization center culminated in our hiring Hisashi Kono in 1983. One aspect of the hiring process illustrates Gee's genius in attracting funding for the center. He knew then-Governor Jay Rockefeller spoke fluent Japanese and was very proud of his efforts to attract Japanese business to West Virginia. Gee wanted Rockefeller to close the deal in recruiting Kono. Once we knew Kono would accept an offer if made, Gee scheduled a meeting with the governor. Kono, Gee, Curt Tompkins, and I met with Gov. Rockefeller at the capitol.

Once the introductions were made, the governor began to talk with Kono in Japanese. After a few minutes, the governor smiled, looked at the rest of us, and announced that Kono had accepted his offer. Gee congratulated the governor on hiring Kono and briefed him on the funding we eventually would need to pledge to the center's development to attract NSF and industrial member funding. Those who are aware of Gee's many grander accomplishments while he was at WVU revere him as the most productive president in our memory.

Soon after recruiting Kono, we scheduled a planning committee meeting for the center, which included Marshall Lih and Morris Ojalvo from NSF; potential industrial members; Robert Volle, the new vice president for research at WVU; and chemical engineering and mechanical engineering faculty members who were interested in participating in center research programs. The meeting went very well until one very tense moment. Lih looked at me and said, “Joe, will you be the director of the center?” With great gusto I stated no, I have done no fluidization research and never will. More importantly I am a new chair and must focus more broadly on the growth of all programs.

Lih knew well that my research was focused on separation processes. Without skipping a beat or changing his facial expression, he said, “Joe, if NSF designates the center, you will be the director. We had great confidence in Jimmy Wen and we have similar confidence in you. We require your leadership, not your direct involvement, in the research program.” The prospective industrial members all supported Lih’s position. It was decided that when the center was designated by NSF that Kono would be technical director and I would be executive director.

**Jean Cropley**, the first chairman of the fluidization center advisory board describes its history:

*“The Center was established with six industrial sponsors plus the National Science Foundation and the WVU Energy Research Center. The six industrial members were Alcoa, ARCO, DuPont, Monsanto, SOHIO, and Union Carbide. The initial funding was:*

| Funding Source | $ |
|---|---|
| National Science Foundation | $140,000/year for five years |
| West Virginia University | $150,000/year for five years |
| Industrial Members: $30,000/year per member | $180,000/year from the six members, industrial funding for first year with possible renewal |
| Total Funding | $470,000/year |

*“Participating faculty at WVU initially included Professors Bailie, Kono, and John Loth of mechanical and aerospace engineering. Professor Eric Johnson of that department was an early participant. There were others I cannot recall.*

*“Laboratory facilities included several small fluidized beds for bench- and small-scale research, plus a large pilot-scale fluidized bed installed about a year later.*

*“Some significant research was carried out and reported by the Center, and the large-scale fluidized bed was constructed and tested over the next several years.”*

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Richard Turton and Nigel Clark were active in the Center soon after they joined the chemical engineering and mechanical engineering faculties, respectively, a few years later.

**Jean Cropley continues:**

*"The Center faced significant challenges. Some of these follow:*

1) *"There was disagreement among the industrial partners themselves and with the University concerning the ownership of patents and right to practice them. Ultimately one sponsor, ALCOA, insisted on sole ownership of all patents and its exclusive right to practice the technology. Refusal of these terms by the other members prompted the withdrawal of ALCOA from the Center and precipitated the departure of some others as well, with a significant drop in funding.*

2) *"Failure to identify a major application of the fluidization technology developed by the Center resulted in a decline of interest of some of the industrial partners and their subsequent withdrawal as well. (I don't recall which partners withdrew and when they did.)*

*"The simple facts were that the Center was devoted to the research and development of design and scale-up technology for bubbling fluidized beds, and especially of the hydrodynamic phenomena associated with them. However (although it was not realized at the time), none of the sponsoring companies had any processes that really were logical candidates for this kind of fluidized bed process.*

*"I recall that DuPont had at least one process that utilized a fast circulating fluidized bed, and SOHIO and ARCO obviously had fast fluidized cat crackers, but the only slow bubbling bed processes among the industrial partners were Union Carbide's UNIPOL polyethylene process and its fluidized bed process for making trichlorosilane from silicon metal.*

*"However, neither of these processes depended upon the nature of the fluidization actually taking place; i.e., whether the bed was bubbling smoothly or slugging, for example, or how much gas was bypassing the solid particles without contacting them. In the polyethylene process, the solid particles actually were the product polyethylene, and in the silicone process, the solid particles were the raw materials. In both of these processes, it was sufficient to know that the particles were being lofted by the fluidizing gas, and the degree of contacting was almost unimportant.*

*"What happened to the gas wasn't particularly important, so long as it could be recirculated. Bubbling bed fluidization phenomena in the usual sense were of little real importance in these processes.*

*"It is a simple truism that most solid-catalyzed gas-phase reactions benefit from plug-flow behavior, in which there is little back-mixing of the gas as it travels through the catalyst bed. Back-mixing simply recycles products back to the catalyst, where they can undergo further reaction, usually to unwanted products.*

*"Back-mixing of the gas is a characteristic of bubbling fluidized beds, so most of the catalytic processes in a company like Union Carbide were not suitable candidates for fluidized bed applications. But this was not realized back in the mid-1980s—it didn't occur to me until some years later—so we*

*didn't realize that part of the Center's problems in attracting members was that we were probably looking at the wrong kind of companies.*

*"To underscore the point I've made above, even now I know of only one industrial chemical synthesis process of the sort we're talking about here that utilizes a bubbling fluidized bed. That one is the Badger process for the synthesis of phthalic anhydride, which benefits from the superb temperature control of this kind of reactor.*

3) *"A third kind of problem may have had some impact on the Center's fortunes. Industrial project time-scales are typically shorter than those in a university environment. In a university, projects are largely carried out by graduate students, who probably work alone and who may still be learning how to do the work they are doing. As a consequence, individual student projects are pretty much geared to a four-year duration that is typical of a Ph.D. program.*

*"In industry, if a project is of sufficient interest to be well-supported financially, resources are provided to see major results within a much shorter time span, typically six months to a year. If the luxury of a four-year project life can be anticipated, the project may not get supported at all because of an apparent lack of interest or relevance. In both cases, I'm referring here to fairly small projects that may be parts of a much larger program that may indeed go on for some years, but the dislocation of time-scales is nevertheless a problem. The problem can be avoided to some degree if active research and engineering is carried out at both the university and industrial laboratories. I don't know whether some of the Center's problems can be attributed to time-scale problems like these, but it is true enough that the large-scale pilot facility took longer to construct and bring on line than it might have in an industrial environment. Whether earlier completion of the facility would have had an impact on its future can only be guessed.*

4) *"There were other lesser problems that attended the Fluidization Center as it matured, but these were of less moment in the final analysis than the three main problems cited above. These lesser problems included some personnel issues within the WVU staff and the decline of Union Carbide's fortunes as a result of the Bhopal disaster and its aftermath, and the acquisition of SOHIO by BP.*

*"The Fluidization Center was eventually terminated for lack of industrial member interest."*

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The NSF perspective on university/industrial centers also changed over the years. Eventually the NSF terminated the program. A much larger NSF engineering centers program was established later. Those centers were funded by NSF at much higher levels with a smaller proportion of industrial funding. Some of the challenges that Jean Cropley discussed above were addressed more generally in the new NSF centers program. It is always the case that national research initiatives in any federal agency evolve and sometimes morph. Change is the rule.

By-products of the Fluidization Center:

1. Richard Turton was WVU's first Presidential Young Investigator (PYI) and Nigel Clark was WVU's second PYI. Their research was much broader than just fluidization.
2. Another byproduct of the Fluidization Center and experiences with Stiller's research (see the faculty research discussion in a later section) was that WVU began to develop a workable intellectual property policy and eventually a research corporation.
3. Most importantly an ethos emerged that WVU could compete effectively to attract nationally funded and highly visible research centers.

## Opportunity to Properly Recognize Fred Galli

One of my own goals when I was appointed chair was to see if I could get Fred Galli promoted to full professor based on his widely recognized teaching excellence. As long as I had been a faculty member beginning in 1972, it was the rule within the University that no faculty member would be promoted to full professor without evidence of major research accomplishments. That sounded like a challenge to me. Sometimes rules must give way to reason. If a university cannot recognize a world class teaching accomplishment, what institution can?

My first step was to nominate Galli for a University-level teaching award. He won that award. I then began to document his major contributions to departmental research programs even though he did not have grants of his own. (See my discussion for the 1972-1981 period when I was a faculty member working for Jimmy Wen regarding the impact of Galli's insights on the development of both my and Wen's research programs.) I then began to accumulate commentary from some of our most successful alumni. Armed with this information, the promotion and tenure committee helped document the case. I lobbied Curt Tompkins, the vice president for academic affairs, and Gordon Gee so they would be ready if a recommendation cleared the departmental and College promotion and tenure committees.

Later, the joy of walking into Galli's office and informing him he had been promoted to full professor and was receiving a 25 percent raise was perhaps my proudest and happiest moment during my time on the chemical engineering faculty.

### Founding of the Chemical Engineering Academy and the First Two Meetings

I decided, with the encouragement of Galli, Reggie Dietz, Walter Baker, Bob Pyle, and others, to organize a Chemical Engineering Academy to recognize our most distinguished alumni and showcase their accomplishments and to motivate future generations of students. We also wanted to build a tradition within the Academy over the years to help fund programs that are important to the continuing excellence of the department. Walter Baker prepared the first draft of the Academy by-laws.

The charter group of distinguished alumni was inducted in April 1986. They were Walter Baker, John Bees, Camden Coberly, Reginald Dietz, L.T. Fan, Alfred Galli, James Kent, Merlan Lambert, Robert Pyle, and C.Y. (Jimmy) Wen (posthumously). The Academy was presented a thorough review of current departmental programs at its first meeting. At one point, Bob Pyle took over the meeting and began a discussion on how best to create an ethos over time of significant contributions that would enhance the excellence of departmental programs. It was clear that folks as successful as Academy members move rapidly to get things done. A consensus developed that most future funding efforts would have the attribute of enhancing students' education as directly as possible.

Neil Bucklew, the newly appointed president of WVU, was at the Academy banquet and induction of the charter members. This was his first public event after becoming president. After hearing the accomplishments of the new members, he stated how impressed he was and he understood well the tradition of excellence in the chemical engineering department.

Jack Bees volunteered to contact Dick Heckert, then CEO of DuPont, and persuade him to speak at the 1987 Academy banquet. That meeting was held in April and Heckert gave his first public address on the coming era of the globalization of the chemical industry.

Glen Hiner, executive vice president of GE and president of GE Plastics, was inducted as the first honorary member of the chemical engineering Academy at the 1987 meeting.

### Evidence of the Quality of Departmental Programs

1. Accomplishments of Chemical Engineering Academy members.
2. I received an unexpected call from President Gee one morning to be in his office at noon. When I got there, an Exxon representative presented an unsolicited check for $95,000. He stated that the purpose of the fund was to show the high esteem Exxon had for the performance of our graduates they had recruited over the years. He also commented on the success of the PRIDE Program, which was funded by Exxon Education Foundation grant.
3. Designation of the NSF University Industry Fluidization Center.
4. DuPont designated our department a member of their favored consortium of Ph.D.-granting chemical engineering departments in 1985.
5. The quality of the faculty we were able to recruit. All but one of the faculty we recruited attracted one or more federal or industrial research grants during this period.
6. Richard Turton received WVU's first NSF Presidential Young Investigator Award.
7. John Zondlo won the College of Engineering's Outstanding Teaching Award.
8. Joe Henry received the Halliburton Award as outstanding researcher in the College.

## New Faculty

### Al Stiller

Al Stiller was the first faculty member hired in August 1981. There was a search underway the previous spring. Stiller was the first faculty member hired by the department who was not a chemical or nuclear engineer. His Ph.D. was in inorganic chemistry. As you might imagine there was a fair amount of debate within the search committee and the Department on the matter of hiring a faculty member without a chemical engineering background. Both John Sears and Richard Bailie had collaborated with Stiller and provided convincing discussions regarding his innovative capabilities and the relevance of his research to important problems of regional and national significance.

Stiller's capacity to do innovative research that was relevant to both national needs and industrial innovation of new processes was a joy to watch. His collaborations with chemical, mechanical engineering, chemistry, physics, and geology faculty led to major research programs in all those departments.

Stiller did not operate as a typical faculty member and presented some challenges for me during my time as department chair and, likely, my successors. By design he did not work within the confines of a single department; he was more concerned about continuing to innovate and spin-off research to other faculty once he established feasibility. To his credit, Stiller always stated he was not easy to fit in a typical faculty box. If he had played the game by typical faculty rules, including the reward system within the College and University, he would have been far less productive. The department, University, state, and country would have missed out on many opportunities.

Having said all this, at WVU and, for that matter, at most universities, the College and departments are structurally not well organized to accommodate such an innovative researcher who has the strength of conviction to purse the innovative process at the expense of his recognition within the system. To paraphrase my comment regarding Fred Galli's promotion to full professor, "If a university cannot recognize research innovation and not attempt to fit every researcher in the same box, what institution can?"

A brief description of several of Stiller's innovative processes, their impact on WVU research programs, and relevance to important real world problems follows:

Stiller's discovery that some dipolar aprotic solvents, tetramethyl urea and N-methyl pyrrolidine, could be used to dissolve large quantities of bituminous coal, led to diverse options for producing high-valued-added materials from coal. This dissolution took place at less than 2200 and atmosphere pressure. He collaborated with John Zondlo and Eric Mintz on the chemistry.

This and further adaptations of the process ultimately led to carbon products research, which was externally funded at level of $1MM/yr for many years.

Stiller worked both on the causes of acid mine drainage (AMD) and the process to reduce its occurrence. He determined that phosphate ion prevented the chemical reactions responsible for acid mine drainage and proved it experimentally. This led to his appointment to Governor John Rockefeller's Acid Mine Drainage Advisory Committee. His work on AMD was funded through NRCCE. Some of this work was funded through the WVU department of geology.

In **Al Stiller**'s words:

*"The group was supported by a major grant from the Bureau of Mines though the Office of Surface Mines. Since I was a charter member, I was supported by major grants from this organization. It was with this money that Jack Renton and I developed an analytic procedure that accurately predicted the quantity and rate of acid mine production from various rocks associated with mining. This program grew to the point where we were doing major field tests. We used to take biweekly visits at mine sites throughout the state and even organized out own technical meeting here in Morgantown."*

Here is an illustration of how Stiller created promising technology. In his words:

*"I was given an old Appalachian toy by a secretary in the chemistry department to play with and study its motion. It was called a 'do nothing machine' and she said I did nothing better than anyone she had ever seen.*

*"I determined how a circle could be translated by its motion and thought I could make it into an engine. I had the machinist in the physics lab make a small model. I talked to Tom Long, who was the associate dean of engineering at the time, and asked if he would support the idea. He talked to Curt Tomkins and they agreed to support it if I would support Jim Smith for his Ph.D. degree on this project. So I quickly agreed. The result was the Stiller-Smith engine.*

*"The excitement it brought was a big surprise to me. Virtually every newspaper in the state and region published articles on the 'New Engine.' This research led to a major research program in mechanical engineering and they got the first million dollar grant that ever came into the College of Engineering based on this invention. A number of faculty—Nigel Clark, Victor Mucino, Nithi Sivaneri—were hired on this money. All the offices in mechanical engineering got carpeted floors because of this grant. Chemical Engineering got nothing. The program lasted three years and was not renewed but it certainly strengthened mechanical engineering."*

A by-product of the Stiller-Smith engine research was the WVU Technology Transfer Center and ultimately the Research Corporation at the University. Before Stiller's early research and inventions, WVU had no intellectual property policy of consequence. Stiller was eventually recognized as one of West Virginia's outstanding inventors.

There are too many stories related to Stiller's inventions to discuss in detail here. Briefly a few others that were conceived well after the 1981 to 1988 period:

1. A major grant from the DOE to make nuclear graphite from coal. It was a multi-million dollar grant run out of the NRCCE.
2. Work with an interdisciplinary Ph.D. student Dave Walker. "We studied cystic fibrosis, which is a genetic disease that affects only northern Europeans. We treated the gene code as a language and used iterated functional system analysis to do the fundamental decoding."
3. A process to make carbon foam from coke.
4. A process to convert chicken droppings to diesel fuel.
5. An approach to analyze fingerprints using a fractal approach that was funded by the National Institute for Justice.

I have maintained a close relationship with Stiller since I left the department in 1988. I always found it exciting when I visited Morgantown to learn about his recent research and inventions. Consequently my memory of his work is better than the other faculty. Their accomplishments are no less important to this history.

## John Zondlo

John Zondlo joined the faculty in January 1982 after completing his Ph.D. at Carnegie Mellon University (CMU). Zondlo had made innovative changes in CMU's undergraduate laboratory courses while he was a graduate student. He was not committed to continuing his doctoral research topic when he joined us. Art Westerberg, then chairman of chemical engineering at CMU, put it this way: "John will become one of your best teachers and will be a productive researcher." Westerber's high regard for Zondlo was more than enough for the search committee and me. Zondlo became an outstanding teacher, receiving numerous awards. He was one of the first departmental faculty members to collaborate with Al Stiller on the solvent–coal processes. Zondlo made it possible in many respects for the solvent-coal research programs to mature to the carbon products program that attracted lots of research funding and the attention of industrial companies.

**Richard Bailie**

Richard Bailie joined the faculty for the second time in June 1982. His contributions to the Fluidization Center were discussed in detail, above. Bailie taught design courses. Perhaps his most significant contribution to the department was collaboration with Fred Galli, Richard Turton, Wallace Whiting, and Joe Shaeiwitiz to assure the excellence of design courses in the undergraduate program. He worked with Turton, Whiting, and Shaeiwitz to write "Analysis, Synthesis, and Design of Chemical Processes", which is now in its fourth edition and is the most widely adopted process design textbook currently in use.

**Ray Yang**

Ray Yang joined the faculty in August 1982. He received his Ph.D. at Princeton and he had previously been a faculty member at the University of Queensland and University of Edinburgh. He had research interests in bioreactors, tissue culture, and systems analysis.

**Wallace Whiting**

Wallace Whiting joined the faculty in late 1982 or early 1983 after completing his Ph.D. at the University of California at Berkeley. His research interests were in thermodynamics and design. From day one Whiting contributed to teaching of process design. He is professor emeritus of the chemical engineering department at the University of Nevada Reno. His wife, Patricia, taught communications to our undergraduates and to students in some of the other departments in the College.

**Charles White**

Charles White joined the faculty in 1982 or 1983 after completing his Ph.D. at the University of Pennsylvania. His research interests were in computer aided design, which was one of the priorities that the faculty and I established early on. He taught design-related courses. After about two years, White decided he wanted to become a physician and eventually obtained his medical degree from WVU.

### Dady Dadyburjor

Dady Dadyburjor joined the faculty in August 1983. He received his Ph.D. from the University of Delaware and he had just been awarded tenure at Rensselaer Polytechnic Institute. His research was focused on catalysis. The tradition of energy research, Jimmy Wen's reaction engineering legacy, and the presence of the Morgantown Energy Technology Center of DOE were all factors in our being able to persuade him to join the faculty. Dadyburjor was successful in diverse catalysis research areas.

### Hisashi Kono

Hisashi Kono joined the department as full professor in 1983. He had been a faculty member at Illinois Institute of Technology. His research interests were in fluidization, powder technology, and reaction engineering. Kono was recruited to be the technical director of the Fluidization Center, which had not yet been designated by NSF. He had significant industrial experience as principal research engineer of the central research laboratory of Ube Industries, Ltd. Kono was twice recognized as a one of the College of Engineering's outstanding researchers, in 1986 and 1987. He trained nine Ph.D. students, and 10 master's students. As of December 2003, Kono had published 52 refereed papers based on his research with graduate students since he joined the faculty.

### Joseph Shaeiwitz

Joseph Shaeiwitz joined the faculty in August 1984. Previously he was a faculty member at the University of Illinois at Champaign Urbana. He did his Ph.D. with Ed Cussler at Carnegie Mellon. His research interests were in surface and colloid science and biochemical separations. Shaeiwitz was recruited to work with me on the development of biochemical separations center. George Keller and his colleagues at Union Carbide were planning to fund the development of the Center at WVU. Both Shaeiwitz and I had doctoral students complete dissertations on new methods of biochemical separation. We were collaborating with faculty in the department of biochemistry at the WVU medical center. Things were going well until the accident at Bhopal. Over the next year or so Union Carbide's discretion to fund such programs were adversely impacted by financial impacts of the Bhopal disaster.

Shaeiwitz is a gifted teacher and has made major contributions to the quality of design education in the department.

**Richard Turton**

*Richard Turton with students.*

Richard Turton joined the faculty in August 1986 after completing his Ph.D. with Octave Levenspiel at Oregon State University. Turton's research interests were in fluidization, reaction engineering, particle technology, and polymer recycling. Two factors permitted us to successfully recruit him. Jean Cropley had a strong relationship with Octave Levenspiel. Cropley called me and told me about Turton and I immediately contacted him. Cropley promised to contact both Turton and Levenspiel on our behalf. The other factor was the fact that the Fluidization Center had been designated a few years before and offered the prospects of a productive research environment.

Once Turton accepted our offer, but before he joined WVU, I began working with him to prepare his proposal for the NSF Presidential Young Investigator program. I had served on the committee to review those proposals for two years and knew well the characteristics of the ones that were funded. Turton worked diligently to get us his proposal, which was submitted to NSF before he arrived at WVU. During the following year, he became WVU's first Presidential Young Investigator.

Turton had active research programs in the Fluidization Center and attracted several grants and contracts for his other research interests. He is a gifted teacher and has made major contributions to design education in the department. I should add that he is a pretty fair golfer. His only limitation was that he would never give me enough strokes to make the matches competitive.

Now for an example of how capable the candidates were on the short list of our faculty searches. The year we hired Turton, Nigel Clark was another candidate we also considered most seriously. After a proposal to Curt Tompkins that we hire both Turton and Clark did not fly, I took Clark's resume to Don Lyons, chair of mechanical engineering, and suggested he consider recruiting him. In what seemed like only a few days, Clark was hired. He quickly became mechanical engineering's most productive researcher. A few years later he became WVU's second NSF Presidential Young Investigator.

The quality of the candidates we were attracting is testimony to the quality of our existing faculty, our research tradition, and the College and Univeristy's strong commitment to our department.

### Edwin L. Kugler

Edwin Kugler joined the department in 1990. He received his Ph.D. at Johns Hopkins. Kugler is a chemist with expertise in catalysis and surface science. We recruited him from Exxon Research and Engineering, where was a catalysis researcher. He was very active in the leadership of the surface and colloid science division of ACS. WVU recruited him over a three-year period beginning in about 1987. He headed the DOE catalysis research program in Germantown, Maryland, before joining the faculty. Years later Kugler became director of the American Chemical Society.

Fred Galli, Gene Cilento, and I were also faculty during this period. See the history of the department from 1972 to 1981 for more detail on our programs.

### Linda Rogers

Linda Rogers has been a remarkably effective office administrator/administrative associate from 1982 to today. During her tenure in chemical engineering, she has been widely recognized for being very well organized. She joined the department to work with Jimmy Wen and Marian Jones in the Fluidization Center. Rogers became department secretary in 1982 and was promoted quickly. She was and still is remarkably productive. There were many efforts in which the department was involved that I simply did not have to think about because of the excellence of her work. When it was time to organize a visiting committee or Academy meeting, I would meet with her to discuss the goals and she would organize the event with class and style. Dean Curt Tompkins liked to initiate planning exercises often. Rogers was able to help me use excerpts from prior documents and add the new items with a minimal increase in my entropy. Put another way, Rogers was able to work with the faculty in ways that freed us all to be more creative. I have no doubt that my successors feel the same way about the quality and impact of her work. She received the College of Engineering and Mineral Recourses Staff Employee of the Year Award in 2001, 2004, 2007, and 2011.

### Marian Jones

Marian Jones, the wife of Paul Jones, was a significant contributor to the development of the PRIDE Program and worked with Jimmy Wen on the Fluidization Center planning grant. She taught technical writing and communications to undergraduate students. Her approaches were well integrated with the design-focused curriculum. Design reports and oral defenses were a way of life for our sophomores, juniors, and seniors. The written and verbal communication skills of our undergraduates were frequently seen by companies that hired our students as a factor that set them apart from undergraduates from many of the best recognized chemical engineering undergraduate programs anywhere. Many faculty members often had her proofread major research proposals to funding agencies.

# The Cilento Era (1988 - 1999)

*Student with Gene Cilento*

In the early years of Gene Cilento's chairmanship, WVU merged with the West Virginia Institute of Technology. The two departments of chemical engineering would become closer. A review of curricula in both departments concentrated on an easy transition from one school to the other.

J. Christopher Ludlow and Al Stiller were on the faculty.

Cilento noted the misery of students who had to stand in long lines to register for courses or pay their fees. New WVU President David Hardesty noticed as well, and made the necessary changes to avoid the troublesome delays.

Though federal funding was decreasing, faculty research funds could come from the University, which would also help find external research funding. Senate Bill (SB) 547 gave a 3.5 percent pay increase to the higher education budget for the next five years, in an attempt to bring faculty salaries within 90 percent of the Southern Region Education Board. This would cost WVU $32 million over those five years.

Eung Ha Cho joined the faculty in 1996-97 with a specialty in corrosion engineering, electroplating, and unit operations in mineral processing. Charter Stinespring also joined the faculty, bringing expertise in surface science.

Cilento noted that the numbers of undergraduate chemical engineering student were down nationally, including WVU. Sixty-five percent of the WVU graduating seniors in chemical engineering found jobs.

In 1997-98, the co-op program looked for more student applicants. Problems with breaking rental leases deterred possible candidates. Internships were more popular with students, but in 1998-99, Dady Dadyburjor and Cilento found that the co-op program was still important.

The department planned video classes and an off-campus Ph.D. program. Dick Turton taught graduate math and Dady Dadyburjor taught reactor engineering in these video classes. Students at WVU, WVU-Parkersburg, and Marshall University Graduate College took these courses. A further goal was to use live video to improve quality.

The Academy of Chemical Engineering, then 10 years old, gave $50,000 to support the department's work. Thirty undergraduates got $20,000 scholarships. Academy members at that time included Walter Baker, John Bees, Cam Coberly, Edward Bartkus, Reg Dietz, L.T. Fan, David Hall, Fred Galli, Jim Kent, Merlan Lambert, Robert Pyle, Patrick Wright, and Glen Hiner.

The faculty published 50 papers and made 36 presentations around the world. Research expenses exceeded $1.4 million.

Statewide, undergraduate engineering education connected WVU to WV Tech's chemical engineering department, with its chairman, Garth Thomas.

By the turn of the century, the faculty felt a need to reach out to small chemical companies in West Virginia. Freshmen enrollment was increasing, and the research dollars coming in were also going up steadily.

## A more complete account of Gene Cilento's tenure as chairman:

Eugene V. Cilento joined the WVU department of chemical engineering in August 1979. A native of New York City, Cilento completed his bachelor's degree in chemical engineering in 1973 at the Pratt Institute in Brooklyn, New York, and his M.S. and Ph.D. degrees in chemical engineering at the University of Cincinnati in 1976 and 1978, respectively. He joined the WVU department of anatomy as a research instructor; his focus was in biomedical engineering with emphasis on microvascular hemodynamics and macromolecular transport in organs and tissues. Cilento continued with a joint faculty appointment in anatomy with his laboratory located in that department.

Dean Curtis Tompkins appointed Ciletno the interim chair of the WVU department of chemical Engineering in August 1988, following the departure of Joe Henry for Arizona State University. Cilento had just returned from a year's sabbatical leave, spending time at Carnegie Mellon University and the University of Arizona. In 1989, following a national search and a last-minute decision by the candidate not to come to WVU, Cilento became chair of the department.

The Cilento decade as chairman was interesting. There were positive enhancements, additions, and changes early, with some difficult financial times for the University later in the decade. The University announced in 1989 that construction would begin on the new Engineering Research Building (ERB), which opened in 1990 adjacent to the Engineering Sciences Building (ESB) on the east side of the building. This was the first new addition to engineering facilities since ESB opened in 1962. ERB provided the department with significant new wet laboratory space for its growing research programs. Nearly the entire third floor became dedicated to chemical engineering research in coal processing, fuels, catalysis, and reaction engineering.

The year after ERB opened, the College of Mineral Resources (COMER) relocated from White Hall to the engineering complex in the new Mineral Resources Building on the west side of ESB. In 1992, the NRCCE opened between ERB and the Evansdale Library. The combined new facilities set the stage for considerable expansion of engineering research at WVU.

Chemical Engineering Acadamy — 1992

There were three significant new additions to the ChemE faculty during this era. Edwin Kugler joined from the Department of Energy in 1990 following a career at Exxon. His interests included catalysis and reaction engineering. Rakesh Gupta joined the faculty in 1991 as the GE Plastics Materials Professor. Gupta brought much-needed expertise in polymers to the department and Charter Stinespring's research thrust (mentioned above) started a new era in electronic materials research.

As the decade rolled on, significant decreases in oil prices led to decreasing interest and funding for new technological advances for extraction and use of fossil resources. West Virginia, which relies heavily on coal severance taxes to support its state economy, began to decrease support for higher education by 1995. State support would decrease to about 27 percent of the University budget as the decade came to a close, and continued to decrease to about 22 percent of the University budget by the middle of the first decade of the new millennium. Faculty began to move away from coal and energy research into other areas.

The Cilento decade was also a time of changing leadership at the dean's level in the College and University. Curt Tompkins left to become president of Michigan Technological University in 1991. After Associate Dean for Research John Jurewicz, a professor of mechanical engineering served as interim dean, a national search resulted in the appointment of Robert Desmond. Significant strategic planning ensued for several years.

With continuing University budget woes and declining interest in fossil resource careers, then-President Neil Bucklew (1987-1995) and the Board of Regents merged the College of Engineering and COMER to form the new College of Engineering and Mineral Resources (CEMR) in 1995-96. By mutual agreement, Larry Grayson stepped down as dean of COMER and Robert Desmond became the interim dean of the newly merged College. A national search resulted in the selection of Allen Cogley as the first dean of CEMR in 1996. He would serve until Cilento was appointed interim dean in July 2000. It was also the dawn of a new era at the University with the appointment of David Hardesty as president and Gerald Lang as provost. They would go on to guide WVU until 2006.

In the late 1990s, the newly formed CEMR went through several additional mergers. The safety management program from COMER merged into the industrial engineering department to form the department of industrial and management systems engineering. The mineral processing department closed prior to the merger. Computer science moved from the department of computer science and statistics in the Eberly College of Arts and Science in 1998 to form the department of computer science and electrical engineering in CEMR. Lang provided some new resources to ease these moves and mergers, but state budget reallocations and cuts through legislative decisions resulted in faculty and staff decreases in CEMR that persisted into the first decade of the new millennium.

In the early 1990s the University began a campaign to raise private support for academic programs. The WVU Foundation managed a campaign for a 501(c)(3) dedicated to raising private support for the University. It was the first such major campaign of its kind at WVU and was successful. The goal was on the order of $100 million. The University gala to celebrate this success was sponsored by GE Plastics, then being led by distinguished alumnus Glen H. Hiner. It was held on the floor of the WVU Coliseum and included testimonials from many dignitaries, students, and friends. This began a new era of thinking for many major public higher education institutions as they began to supplement declining state support with private support. This campaign laid the foundation for the very successful Campaign for West Virginia University that began at the end of the decade, and raised more than $336 million by 2003.

The Cilento decade started well, with significant generosity and loyalty shown by distinguished alums. ChemE alumnus George B. Berry (BSChE ’58) and his spouse, Carolyn, endowed the first Chair of Engineering in 1989, one of a very few at the University at that time. George was CEO of Omicron Capital Corporation and had become a successful venture capitalist following a fine career as vice president with several chemical companies. The first holder of the Berry Chair would be appointed in civil engineering. The holder would work in environmental engineering and develop collaborations in this area between the civil and chemical engineering departments.

Subsequent holders of the Berry Chair would be selected by the dean to best meet the research needs of the College. The first Berry Chair was Bud Cook. Shortly after the announcement of the Berry Chair, Hiner (BSEE ’56), through GE Plastics, endowed the materials professorship in chemical engineering. Both George Berry and Glen Hiner would earn recognition with honorary doctorates of science and induction into the ChemE Academy. They also became members of the WVU Academy of Distinguished Alumni in the early 1990s.

When Cilento took over as interim department chair in 1988, one of the very first people that visited his office was Reginald Dietz. Dietz was a charter member and president of the Distinguished Academy of Chemical Engineers. He came to offer congratulations and to discuss the Academy and how it might help the department. His inspirational visit formed the basis of an enduring relationship with the Academy that has benefited the department immensely. Plans developed to grow and expand the Academy from the class inducted in 1986, with an induction ceremony to be held each spring.

The Academy grew impressively through the decade with significant initiatives by members to help support the department’s educational programs. The Academy inducted many alumni with impressive careers and credentials. The members were a vibrant and dedicated group who made a point to come back to campus each year for the induction ceremony.

George Berry laid the groundwork for providing significant funds by challenging the Academy to match gifts that created the ChemE Academy scholarship endowment and a graduate fellowship endowment. This latter endowment won a generous match by the Bayer Foundation through the efforts of Academy member Tom Harrick (BSChE 1960). The ChemE Academy has gone on to become a model for several other distinguished alumni academies in the College over the years, with civil and environmental engineering becoming the last department establishing an academy in 2007.

Cilento returned to the chemical engineering faculty and turned the leadership of the department over to Dady B. Dadyburjor in February 1999.

# The Dadyburjor Era (1999 - 2009)

***By Dady Dadyburjor***

My moving into the chair role, succeeding E.V. "Gene" Cilento, was remarkable in its unremarkableness, if there is such a word. Then a few months later, Gene took on the interim position of dean of the College. Shortly after that, the front facing of the Engineering Sciences Building needed replacing, and those of us with affected offices had to move out.

I assigned myself the little room diagonally across from the chair's office (including, among other things, the repository of the department's theses, etc.), and Linda Rogers, who needed more access to more papers, took over the conference room.

Fast forward 10 years, to a time between my resignation and my replacement. I decided that the chairman's suite should finally be carpeted. I was headed out of the country for a few weeks, so I packed my papers in boxes, placed them in the nearest classroom, and made arrangements to have all the material placed in my new, humbler, office before I returned.

But it was not to be. My boxes and I lasted a few days in the classroom and, when it was going to be needed for classes, I found myself an alternative office: the same little room where I started. So, with only a little literary license, I can claim to have started and ended my regime in the dinky little room in the corner.

In between, I had the privilege to be there while other faculty, staff, and students did wonderful things. Let me see what I can recall.

Around 2003, the Dominion Post came up with its first listing of the Top 100 Most Influential People in Monongalia County, and Alfred H. Stiller came in at number 31. This was due to not only his work with John Zondlo and others in finding new uses for coal, but also his work on recycling strategies, as a leader of the county's Solid Waste Authority.

No other WVU faculty member (non-administrator) made the list. Around that time, professors Richard Turton and Joseph A. Shaeiwitz won Golden Apples from the Golden Key student honorary for their teaching of senior design. Since the awards happened due to student votes, and there were only six awards, it was significant that two went to faculty in a department with a relatively small student population. The duo won external awards as well, including the Corcoran Award from ASEE around 2008.

Another prominent University award winner was Zondlo, who received the Bucklew Award for Social Justice in April 2005 and the Buswell Award a few years later, both for his efforts on behalf of women and minority students throughout the College. Department faculty won their share and more of College-wide awards in my 10 years as chair: for teaching (Eung Cho, Richard Turton, and Charter Stinespring), research (Brian Anderson), and advising (Edwin Kugler and John Zondlo).

There were College-wide staff awards to Gabriela Perhinschi, and almost routinely to Linda Rogers and Jim Hall. Hall won a special individual Safety Award in 2001 for his efforts during the renovations that led to Galli Laboratory. Ed Kugler became a director of the American Chemical Society, and I served on the board of the North American Catalysis Society. I became a member of the board of directors of the Council for Chemical Research for a three-year term in 2008, and later became chair of Programs and Initiatives.

Professor Hisashi (Sasha) Kono retired in July 2004 but continued on campus for a while, and received recognition at the department's Christmas party later that year. He stayed in touch with some of us until around 2010; some time later, we learned that he had passed away in Japan. At the time of his retirement, I thought that this would be the first of a long list of quick retirements, but fortunately faculty stuck around, at least till the end of my tenure.

Undergraduates and graduate students won their share of awards as well. In 2007, we had two students named WVU Outstanding Seniors—Justin Stover and Tirzah Mills. This honor only happens to one percent of the graduating class. As if that wasn't enough, they were both among the eight inducted into the Order of Augusta! Also that year, Mills won the University's Showalter Award for her efforts on behalf of women students. Mills, Robin Glebes, Cassie Cunningham, and Chris Thomas won Volunteer Service Awards. (Parenthetically, we received a postcard around 2010 from Mills and Glebes, announcing their wedding in Hawaii following Glebe's tour of duty in Iraq.)

In 2009, Erica Trump also became an Outstanding Senior. In fall 2002, Adria Hartman won the first Donald F. and Mildred T. Othmer scholarship awarded to WVU. Typically, there are only 15 of these awards nationwide. After Hartman, there was Justin Hartshorn (2005), Trump (2007), and Cassie Cunningham (2008). That year, we also had Jessica Castillo winning the John J. McKetta award for process engineering, making it four national awards for our undergraduates in four years. At that time we received a nice handwritten note from McKetta to the effect that he had been following our educational efforts for a while. Morgan Ames was awarded a scholarship from the Pittsburgh Section of AIChE in 2007, as was Matthew Page in 2009.

Our undergraduates were starting to get interested in research in significant numbers at the turn of the century. Travis Crites won a prestigious graduate research fellowship from NSF in 2003, followed by Tirzah Mills in 2007. At the Mid-Atlantic Student Chapter Conclaves, held irregularly at various locations, a number of students represented us well and many won awards: Chris Taylor (2002, Virginia Tech), Chris Clark (2003, Villanova), and Zach Schwertfeger (2007, Bucknell). Many other undergraduates made poster presentations at national AIChE meetings, and most of them won recognition from the judges: Tim Hall (2002), Tim Daniels (2004), Brian Holsclaw (2005), Mills (2006), Jennifer Knipe (2007, 2008), and Erica Sladky (2008). Knipe and Schwertfeger won awards in the first statewide Science, Technology and Research (STaR) symposium, organized by the West Virginia Experimental Program to Stimulate Competitive Research, September 2007.

Knipe was one of the few who took advantage of the offer from the provost's office to all National Merit Scholar finalists to spend a semester overseas. She went to Sweden in 2008, co-funded by the College and the department. Finally, no collection of undergraduate achievement would be complete without mention of Thomas Harty (BSChE '07), who went to Tanzania for the Peace Corps. Appalled by the lack of knowledge in science and technology, he set about writing a manual, which was written in English and translated by one of his local colleagues into Swahili. In his introduction, he notes, ". . . the first section is a listing of various technologies, how they work, and their importance. The shorter second section is a brief overview of some of the more important ideas in science." The table of contents for the first part starts with automotive technology and goes on to steel and metallurgy; the second part ranges from the big bang theory to subatomic physics.

AIChE's ChemE Car competition was one which interested our students since its inception. In November 2001, the students had actually qualified two entries for the finals, held in Reno, Nevada, but could only enter one. Unfortunately, the one they picked ran using an electrolytic cell, and the car was placed in the check-in baggage of a foreign student with a Middle Eastern-sounding name. None of this would have mattered, except that it was two months after September 11, 2001. The soldered connections were ripped apart by an overzealous inspector, and this was not discovered till the day before the competition.

By some luck, another competitor had a sheet of the same metal and spare wires, and gave them to the team, in the spirit of the competition. The car was jerry-rigged and completed the circuit both times. Although the car did not win, I declared that the terrorists had not won this time either, and took the group out to a good dinner. Our performance here was a forerunner of the future; the entries did very well at regional competitions, but something always went wrong in the finals. In the 2002 regionals, the car placed first in the design portion; in 2003, it took second place and first place in 2004. In 2006, the entry won the award for the most original design in the regionals at Penn State.

Our graduate students presented research to their peers, and organized at least one symposium in Morgantown, in September 2005. This was a signature event, as the symposium had fallen by the wayside, and our students' work re-energized others to continue the tradition. In 2005, they had a mixer at the Mountainlair to take advantage of WVUp All Night, which had recently started, with a job fair, multiple parallel sessions, a lunch speaker from Dow, and a dinner speaker from the CIA. Participants came from Clarkson University, located in Potsdam, New York, to Louisiana's Tulane University, which arrived by way of Houston, Texas, courtesy of Hurricane Katrina. Award winners at graduate poster sessions during the annual AIChE meetings include Yongxin Song (2004), Preetanshu Pandey (2005), David Statler (2006), and Kushari Kuzilati (2006).

In 2005 and 2006, the local Sigma Xi chapter held research competitions. In 2005, Bhyrava Mutnuri, Mohit Bhardwaj, and Abha Saddawi won awards in the engineering section, and Pandey won in the interdisciplinary division; in 2006, Statler and Kuzilati won awards. Pandey also won the best presentation award from the American Association of Pharmaceutical Scientists in 2005; the following year, he won the outstanding research award in pharmaceutical technologies from the same organization. In the summer of 2006, Huifang Shao won the best presentation award from the Pittsburgh-Cleveland Catalysis Society. In 2007, Statler won first place in the graduate division in the STaR Symposium.

Earlier, we instituted a classroom mentoring opportunity for Kate Ziemer, who was on her way toward a faculty position after her Ph.D. in 2001. This mentoring involved a great deal of interaction between the faculty member and Ziemer. Given the success of this ad-hoc effort, the graduate program committee developed options for interested doctoral students close to graduation for mentoring for a future faculty position. There was some early interest, but most of our Ph.D.s have opted for careers in industry. As far as I know, the option is still available.

By 2005, I reported that we had up to four graduate research fellowships for our students: two endowed by the generosity of Carolyn and George Berry; one from the estate of Victor Pantalone; and one from Bayer, due to the efforts of their loyal alumni. It wasn't quite what we needed to ensure that all our entering graduate students were supported from other than research funds, but the fellowships have been put to good use to attract outstanding applicants and to help new faculty members get started.

But by 2007, using data from both the Council for Chemical Research and the South-East Chemical Engineering Chairs Group, it was clear that our starting offers were not competitive with our peer institutions. The faculty voted for a significant bump to our Ph.D. stipends, to continue for five years, starting in fall 2009. The bump to master's stipends was smaller, to make clear that our priority was going to be for Ph.D. students.

Moving back in time, before my term as chair, the transformation of West Virginia Institute of Technology to the West Virginia University Institute of Technology (WVUIT) to a regional campus of WVU had already begun. The two departments of chemical engineering had already established undergraduate criteria that allowed students to transfer freely between institutions. In 2000, I attended the visiting committee meeting at WVUIT as a guest. The committee chair was Gary Brown from Union Carbide, and he was also the chair of our own visiting committee, so I felt at home. WVUIT chair Garth Thomas was similarly invited to our visiting committee meeting here. A year or so later, Joe Shaeiwitz and I visited WVUIT in somewhat greater depth. We viewed their laboratories and discussed further integration of our courses.

Shortly thereafter, the WVUIT administration felt that it was in the best interests of the institution to be more research-active, and interest in common undergraduate courses, etc., waned. However, WVUIT has been a good colleague, in that they have been able to accommodate our undergraduate students who need to take courses out of our sequence.

In a good example of undergraduate student initiative, transfer senior Lucas Ellis and junior Alex Stanton started the Biodiesel Club around 2007. The idea was to convert used cooking oil from the University kitchens to diesel (fuel or additives) to run the motor pool. The initiative gathered steam for a few years, progressing to a multi-college student effort. I even recall introducing them to an alumnus who ran a used equipment business, and investigating pilot plant locations. But interests eventually dried up. The efforts weren't entirely wasted, however; formation of biodiesel still serves as an attention-grabbing demonstration when high school students visit. Rumors are that the University may be planning an effort of its own.

Probably the single most significant event in these years was the renovation of the senior laboratory, and the evolution of the Alfred F. Galli complex. The department had been working on plans for the laboratory since before 2000, but Kathleen Dubois, the College's development officer at that time, told us we were doing it all wrong. So we started over, with trips to visit interested alumni and plant managers in the southern part of the state for buy-ins and tips on how to proceed.

The next milepost was a substantial donation from The Dow Chemical Company, just shortly after its merger with Union Carbide, around 2002. My comment at that time was, "Dow has, by this single event, made an investment in our graduates for generations to come." Shortly thereafter, we had a simple recognition of Fred and Bea Galli. Retired since around 1985, Fred Galli had taught three generations of chemical engineers, and seemed to know all of them by name. Speaking at the ceremony was alumnus Jim Mitchell, president of the Academy of Chemical Engineers; the dean; the provost; undergraduate Jason Gaspar, representing the students; and members of the Galli family. The provost was sufficiently moved to pledge funds from his office, which was a pleasant surprise. The following year, the bids came in under the contractor's estimate but over what we had planned. With supreme confidence, we had the work start in January 2003. During the construction period, the senior lab was run from a distributed set of laboratory rooms, over all three buildings in the College. Patrick Bolton came on board, as we realized we needed a full-time coordinator of instructional laboratories.

In the meantime, the faculty, led by Ed Kugler and Joe Shaeiwitz, added and revamped experiments to include the new technologies of computing, data-logging, and instrumentation. In some of these, like the tank drainage experiment, the basic setup remained, but new features were added, such as the membrane ultrafiltration unit (sponsored by Academy member Pat Simms, using his connections), and some tricky process control experiments converted to virtual ones. The biggest disappointment for me was the fuel cell unit. A near-prototype for a university laboratory, it needed to be repaired several times before we cut our losses.

All this new equipment meant new resources had to be found. Academy member Verl Purdy, one of the earliest to buy into the project, spearheaded a challenge grant proposal to the Kresge Foundation. The grant, received in 2004, was the largest received by the University at that time. And, yes, we met the challenge of matching the funds.

The University's senior administration, recognizing a mover and a shaker when they saw one, spirited away Verl Purdy for bigger and better things. He became a member of the WVU Foundation Board of Governors but still made time for his department and the Academy. We started using the Galli Lab in fall 2003, but it was dedicated in April 2004, during the annual meeting of the Academy. We counted ourselves fortunate that Galli was with us at the time, because it was clear that his health was failing.

Once the main project was complete—although some might argue that it is a work in progress even today—we moved to anticlimactic things such as junior-level demonstration experiments in adjacent rooms. We were even able to renovate the laboratories of successful researchers such as Rakesh Gupta and Richard Turton.

Around this time, the faculty started to see the need for significant instrumentation. The carbon products group (John Zondlo, Al Stiller, and their colleagues) brought in a state-of-the-art x-ray diffractometer and a field-effect scanning electron microscope with all the bells and whistles, including energy dispersive spectroscopy. In addition, GE Plastics donated a transmission electron microscope.

With help from the College, we were able to renovate rooms in or near the Galli complex to suit all of this instrumentation. Since this type of equipment works best when it is running all the time, our plan was to operate these units for the benefit of departments across the College, the University, and beyond. But it was a struggle to get the College to buy in to the equipment-sharing idea and to have departments contribute to resources needed for maintenance and operation. Nowadays, shared equipment is a talking point of the WVNano program and the Research Corporation; I'd like to think our struggles helped this to happen.

Justifying the use of such instrumentation and the resources required arose because of faculty working together and working with industry, both local and national. In 1999, Rakesh Gupta was already working closely with the state's Polymer Alliance Zone, and a one-year renewable option agreement had already been signed for carbon products. In 2000, the Constructed Facilities Center became College-wide, using faculty from several departments to work closely with state and private concerns. In 2001, Richard Turton started using the NSF's Grant Opportunities for Academic Liaison with Industry to work with pharmaceutical companies. Around that time, multiple faculty from the department collaborated on research using end-of-life electronic materials in a commercialized manner, and the statewide Industries of the Future program (IOF) had multiple companies working with our faculty, including one project on pressure-sensitive adhesives.

The Higher Education Policy Commission established its first Center of Excellence in our department, with Rakesh Gupta heading up the center on polymer compounding. Unfortunately, continued funding for this center and another on polymer-wood composites, was not forthcoming from the state as promised.

Around 2001, the carbon products researchers (Stiller, Zondlo, and Pete Stansberry) started receiving significant funding from DOE for infrastructure and personnel. In 2003, Elliot Kennel entered as the administrative program coordinator, thereby freeing the chair from this task, and ensuring that it was directed by a full-time person with knowledge in the area.

With this concentrated effort, we signed memoranda of understanding and license agreements. This actually led to a significant influx of funds to the University, some of which were distributed to the College, the department, and the principals. This may have been the first time that a license agreement actually produced funds for a department within WVU.

In 2008, the carbon products group finished the production of several barrels of pitch from coal. This was a project undertaken with collaborators at a company named GrafTech (which now includes former WVU faculty member Stansberry), which resulted in the production of multiple electrodes weighing a ton or so apiece. These saw use in a commercial steel-production facility. The coal-based material performed as well or better than the petroleum-based commercial-grade project. One of the electrodes, unused and saved for posterity, went to Charleston during the IOF Day at the Capitol. There was a press conference and testimony to legislators on the use of coal. Photographs of the pitch undergoing preparation for shipment and the electrodes used can be found at the entrance of the new addition of the ESB, along with the actual unused one-ton electrode.

In 2007 the Institute for Advanced Energy Studies started as a collaboration with Carnegie Mellon University, the University of Pittsburgh, and the National Energy Technology Laboratory (NETL) of the DOE. Eight faculty members from each university were designated as resident institute fellows, awarded student and equipment support, and spent a day each week with their students developing laboratories at NETL. Of these eight, three were from the WVU department of chemical engineering:

Brian Anderson, Richard Turton, and myself. Turton went to NRCCE and NETL full-time for an extended period to kick-start their project on the modeling and control of modern gasification processes.

Moving back in time once again, much of where we are as a department is due to events that started around 2001, when we were strongly advised by our visiting committee to work on a long-range plan (five to 10 years) for the department. It would be fair to say that this suggestion was not met with immediate and universal agreement among the faculty. But we engaged a remarkable facilitator and, passing quickly over multiple major events, came up in the summer of 2004 with two major thrusts for ourselves: the recruitment of junior faculty and increasing undergraduate enrollment. One item that could help in both areas was the growing importance of the intersection of biology and engineering, i.e., biochemical engineering, bioengineering, biomedical engineering, all of which we lumped as bio-X engineering. To his credit, the dean immediately bought into these two ideas as well as the bio-X concept.

January 2006 saw our department with two new faculty members, David Klinke and Brian Anderson. Klinke arrived as the result of a cluster hire of three faculty members in bioengineering; the other two positions went to mechanical engineering and electrical engineering. And after earning his Ph.D. at MIT, Anderson arrived back home to his undergraduate alma mater to teach in our department. Later, through the genesis of the biomedical engineering program (described below,) we were able to justify an additional position, and hired Robin Farmer (now Hissam) in August 2008.

Interestingly, Robin claims that when it was my turn to introduce her to the College community, all I mentioned was that she opted out of a fancy dinner during her second visit here in order to participate in a Super Bowl party. The truth is, I mentioned her research interests and background as well, but all anyone ever remembers is the Super Bowl party!

Finally, as my term in office was drawing to a close, we attracted Ceresela Dinu as our first faculty member hired under the aegis of the WVNano program.

Around mid-2006, a departmental committee set up for the purpose of establishing the program in biomedical engineering (BME) came up with a set of procedures. The department would start with a certificate program, leading to a parallel track in the ChemE degree program, and finally separate degrees in ChemE and BME. This led to the creation of a College-wide task force, which recommended dual-degree programs in the chemical, mechanical, and electrical engineering departments.

By 2008, it was evident we lacked the resources to establish such an ambitious set of programs. We decided to go back to the idea of a certificate in BME, housed in our department, but available across the University. By 2009, the paperwork was completed. The certificate would comprise four core courses and two electives. Additional courses established at this time included a laboratory add-on taught by David Klinke, and a new course in tissue engineering taught by Bingyun Li, an adjunct professor in our department and full-time in the WVU Health Science Center .

While we had obtained buy-in from upper administration to have all these faculty positions, the department was still on the hook to find funds for a significant portion of their start-up costs. Accordingly, hat in hand, I approached members of the Academy of Chemical Engineers during their annual meeting on campus in 2007. This is where I received one of the most pleasant surprises of my career. As I was hitting my stride in my spiel to the Academy, George Taylor stood up. “I’m tired of all this talking,” he said, or words to that effect; “It’s time to act.” And right then he pledged a six-figure sum with two conditions: (a) that the fund be named after his mentor and Academy charter member James Kent, and (b) that members in the room pledge to match it “right now.” And it was done, just like that.

The following year, we asked for permission to convert the remaining funds to an endowment for BME, to take advantage of the state’s Research Trust Fund’s one-for-one match for endowments.

But we had not forgotten the other side of the coin. Boosting enrollments involved both recruiting freshmen into the program after their first year, as well as retention. In fall 2002, Mike Carr was hired as the coordinator of the freshman program. His first task was a rigorous study of why so many freshmen leave engineering after the first year. His results were not surprising but, for the first time, they were not simply anecdotal: poor introductory courses in mathematics and chemistry and variability between instructors of different sections in the Introduction to Engineering courses (E101, E102). The department started a course in study skills and tutoring in those classes in which students had difficulty.

As a result, starting in 2003, we could talk to freshmen earlier than in their sophomore year. Carr left for personal reasons the following year, but he had started something. In the fall of 2004, Robin Hensel took over that position. She continued revamping the freshman year to maximize retention of freshmen. In spring 2006, we offered to institute a special topics course for selected freshmen to take as an equivalent to E102.

Our best instructors would teach the course. Joe Shaeiwitz and Dick Turton, both early winners of the Foundation Teaching Award, were the original instructors, but they have been followed by others in the same mold: Brian Anderson and Robin Hissam. The idea was to cover the same material as E102, but with a ChemE slant. We were convinced this would aid in retention. If it also brought interested students under advising influence of our faculty earlier than before, then so be it.

It took some persuasion to get the dean to agree; Hissam was a little easier. In spring 2008, the name was changed to ChE102, and any freshman could take it in lieu of E102. Accordingly, by 2009, enrollment and retention in chemical engineering courses had increased tremendously, and this has continued. Regarding recruitment, we worked the local schools first and then went further afield. We worked with Allan Campbell, the College's recruiting coordinator, and alumnus Steve Alford, then a corporate director of Milliken, to visit schools as far away as Hurricane, Buffalo, and Teays Valley, West Virginia.

In the visit by ABET shortly before I became chair, we had received full accreditation. But we knew that the next visit, scheduled for 2003, would be under the then-new ABET 2000 criteria, a paradigm shift, and we determined to be ready. Around 2001, led by Joe Shaeiwitz, we introduced rubrics for assessments of design projects for the undergraduates, design projects for seniors, and a few undergraduate courses. Eung Cho led the work on graduate theses rubrics and courses but, since there was no deadline for those, they did not get introduced until much later.

In an effort to bring the rest of the College up to speed on the new requirements, Shaeiwitz held a workshop for College faculty. Concurrently, we decided the time was right to incorporate useful suggestions we had accumulated through years of having the undergraduates meet with the chair, the visiting committee, and the Academy; closing the feedback loop, as it were.

We made the changes, noting the national trend toward fewer credit hours for graduation with a B.S., simultaneously increasing flexibility in the program for specializations. Our goal was the optimum distribution between exposure to the liberal arts, expertise in core competencies, and inclusion of new technologies. As I mentioned at the time, “optimum” was a very subjective term, but we finally reached agreement, and implementation started around 2002. The changes, along with the change in leadership in the chemistry department, led to much closer ties and collaborations that would stand us in good stead during the ABET visit in 2003.


*Students in the Operations Lab*

We received ABET’s final report in August 2004, and suffice it to say that it was most complimentary. It listed as strengths the items we had hoped to emphasize, as well as others we had not explicitly considered. Even the items of concern were advantageous; the report listed those things which made it possible for us to hire new faculty, as mentioned earlier.

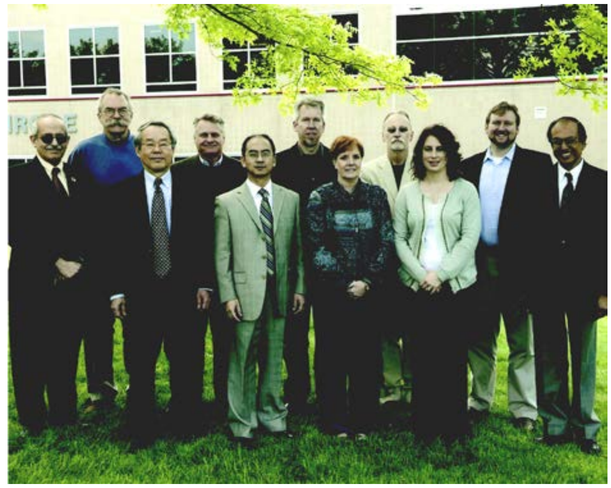
In conclusion, the undergraduate program is functioning well, and has managed to accommodate the changes required for the biomedical engineering certificate as well as whatever changes need to be made in the future. The graduate program and graduate research are also functioning well, and have greatly benefited from our recent additions. It was a busy and enjoyable 10 years, but there is a great deal that remains to be done.

- The faculty considered a statewide Ph.D. program with Marshall University Graduate College. Talks on several issues about this program stalled and it never happened.
- Dow helped fund the Galli lab in 2002. The faculty awarded 16 grants and contracts totaling more than $3.5 million.
- Rakesh Gupta became the first recipient of the George and Carolyn Berry Chair in Chemical Engineering.
- In March of 2004, the Galli lab opened. ABET accredited the chemical engineering department for the maximum six years.
- The Galli lab was up and running for a year by 2005. The lab coordinator was Patrick Bolton, and Jim Hall was instrumentation specialist.
- The department had a successful carbon products program at this time. Also, Gupta and others got startup funding for research in polymer wood products. Work proceeds with the dean of medicine on bioengineering.
- The PROMISE scholarships noticeably increased student quality in 2007. Concerned about gathering future chemical engineers into the program, I had a special interest in working with high school students and non-chemical engineers already enrolled at WVU. I gave them an outline showing how chemical engineering could affect their careers. Undergraduate chemical engineering students helped by hosting an open house for freshmen. One of the lures was “liquid nitrogen” ice cream.
- Richard Turton led the effort to work on a certificate in biomedical engineering.
- Gupta and his colleagues were close to getting a patent for flame retardant polymers.
- Charter Stinespring won one of the outstanding teachers in the College awards in 2009. In the same year, Edwin Kugler won the outstanding advisor award.
- In 2010, the undergraduate chemical engineering major got full accreditation from ABET.

- John Zondlo won the outstanding advisor award in the College for 2009-2010. Brian Anderson won a three-year, $1.2 million research project from the U.S. of Energy to expand geothermal energy use.

- The estate of the late Robert E. Pyle, a charter member of the Academy of Chemical Engineers, gave $50,000 to the to help finance student research.

# The Gupta Era (2009 - Present)



*Chemical Engineering Staff — April 2012*
*Left to Right: Dadyburjor, Kugler, R.Yang, Turton, Y.Yang, Kinke, Rogers, Stinespring, Hissam, Anderson and Gupta*
*Not Pictured: Dinu, Shaeiwitz, Zondlo*

Rakesh Gupta joined the WVU department of chemical engineering in December 1991 as the GE Plastics Professor. He holds a B.Tech. and Ph.D. degrees in chemical engineering from the Indian Institute of Technology and the University of Delaware, respectively. His research focuses on polymer rheology, polymer processing, and polymer composites.

Before coming to WVU, he worked briefly for the Monsanto Textiles Company in Pensacola, Florida, and then was a member of the chemical engineering faculty at the State University of New York at Buffalo for 11 years. After coming to WVU, he spent a year on sabbatical leave as a visiting research scientist at DuPont's Washington Works in Parkersburg, West Virginia. It was here that he wrote "Polymer and Composite Rheology." He is also the coauthor of the textbook "Fundamentals of Polymer Engineering," and the lead co-editor of "Polymer Nanocomposites Handbook." His latest venture is "Graphite, Graphene and their Polymer Nanocomposites," published by CRC Press in October 2012.

Gupta has held the George and Carolyn Berry Chair in Chemical Engineering since August 2003. He became department chair in July 2009 after an internal search following Dady Dadyburjor's decision to return to full time teaching and research.

Gupta's early tenure as department chair saw changes resulting from faculty retirements, after immense stability for almost 25 years. However, this began to change when Hisashi Kono retired in 2004; he later passed away in 2010. An era had already ended in 2009 with the death of Alfred Galli, at the age of 88. Then Eung Ha Cho and Alfred Stiller retired in 2010, and Joseph Shaeiwitz announced his intention to retire in 2013.

There will be other retirements, in anticipation of which, several junior faculty had already been hired. Brian Anderson and David Klinke arrived in January 2006, while Robin Farmer Hissam joined the department in fall 2008. Others who came, in quick succession, are Cerasela Zoica Dinu in 2009, Yong Yang in 2011, and Debangsu Bhattacharyya in 2012. Fernando Lima began as an assistant professor in spring 2013.

Although Dinu was hired as part of the WVNano initiative, some of this growth has been fueled by the decision to move in the direction of biomedical engineering. A certificate program in the discipline had already been established in 2008, which is open to all students in the University provided they have the appropriate prerequisites. It consists of six courses, and it provides students an improved understanding of how engineering principles work within health sciences. The first class to graduate with the certificate was in 2010, with about half the class participating in this program.

Another major change has been in research focus areas. For almost three decades, the department had been home to a large, successful carbon products program aimed at producing pitches, fibers, foams, and composites, among other products. Al Stiller, John Zondlo, Elliot Kennel (now at ASI, Inc.), Peter Stansberry (now with GrafTech International), and their research associates, post-doctoral fellows, and graduate and undergraduate students started and nurtured this program.

One of the major accomplishments was the development of a new process to make coal into liquids, wherein coal is dissolved and not gasified. It is cheaper than competing processes and also does not give off any carbon dioxide. This technology has been licensed by Quantex Energy, Inc. of Canada, which is in the process of commercializing it in collaboration with New Hope Corporation Ltd. of Australia. These companies are hoping to produce up to 50,000 barrels of synthetic oil per day in up to three different demonstration facilities. This likely commercial success resulted in the phasing out of research on this topic and in initiating a search for other promising carbon products.

Within chemical engineering today, the three broad research areas are biotechnology, energy, and materials. In recognition of these thematic areas, we now have the Mylan Seminar, the Dow/Union Carbide Seminar, and the DuPont Seminar, which allow us to bring in distinguished speakers to lecture on these topics. Given that we now have a BME certificate and that bioengineering is the research focus of a third of the department, a logical next step was the initiation of a B.S. degree in biomedical engineering to be housed within chemical engineering.

After much internal discussion and consultation with the Academy of Chemical Engineers and the department visiting committee, we submitted an intent to plan an undergraduate degree in biomedical engineering to the associate provost for undergraduate academic affairs. We received approval in early 2012. The formal proposal includes a full description of the curriculum and all prescribed coursework. This proposal has been approved by the Statler College curriculum committee.

The journey would, however, not be complete until the WVU Faculty Senate and the WVU Board of Governors approved the program in 2013; accreditation will have to await the graduation of the first class of BMEs. We anticipate that we will recruit a senior person having a degree in biomedical engineering as director of the BME program.

The beginning of Gupta's tenure as department chair coincided with a change in the upper administration of the University. James Clements became the University's 23rd president effective June 30, 2009, and Michele Wheatly assumed the duties of provost and vice president for academic affairs on January 1, 2010.

One of the first acts of the new president was to announce the availability of 100 new faculty positions in the University. These have been given out in batches, and Debangsu Bhattacharyya came to us as part of this initiative. Most recently, the University has identified shale gas utilization as an area where there is potential for growth and substantial return on the University's investment. There are to be seven positions in this area, and chemical engineering expects to be authorized to recruit for one or two of these.

On January 12, 2012, WVU's College of Engineering and Mineral Resources became the Benjamin M. Statler College of Engineering and Mineral Resources, in honor of businessman, philanthropist, and alumnus Ben Statler; the dedication of the Statler College was held on March 29, 2012. The historic gift of $34 million made by Statler and his wife, Jo, will go to support engineering in a variety of ways. Besides contributing to the construction of a new Advanced Engineering Research Building (AERB), some of the money will go into an endowment that will provide for the establishment of endowed Statler chairs, Statler scholarships for undergraduate students, and doctoral fellowships. The endowed faculty chairs will be in energy research, and the focus of the holder of the first Statler chair is likely to be shale gas utilization.

The groundbreaking ceremony for AERB was held on September 20, 2012. Once the building is ready for occupancy in early 2015, one or more academic departments will relocate to the new building, and the Engineering Sciences Building will be renovated in stages. This will mean that chemical engineering may get some space in the new building and it will also move to a different floor in the existing building. The move will allow updating of existing facilities, the introduction of new instructional technologies, and space for growth in the future.

This development is just the beginning of a multi-year, $159.5 million program aimed at completely changing the face of the Evansdale campus by the construction of several other buildings, including a new agricultural sciences building and a Student Wellness Center. The new buildings will resemble WVU's downtown historic buildings and will include stone, brick, and bigger entryways.

In terms of challenges, the biggest challenge when Gupta took over was declining undergraduate student numbers. In 2007, there were only 55 students in the sophomore to senior years, and, as a consequence, only nine students graduated with B.S. degrees in 2010. This challenge had been addressed by more active recruitment in high schools in the state, by having younger colleagues make presentations to freshman engineering students in the fall semester, and a by the creation of a dedicated chemical engineering section for freshman students in the spring semester. The certificate in biomedical engineering was also introduced. A combination of these factors helped reverse the enrollment trends, and the department now has a very healthy undergraduate program. It is, however, also true that undergraduate enrollments in chemical engineering bottomed out nationally in 2007.

One challenge currently facing the department is the diminished number of graduate student applications and the ranking of the applicants' undergraduate programs. Traditionally, WVU had been able to attract the most qualified students from China, India, Korea, and Taiwan. Due to attractive opportunities in their home countries, however, these students are no longer looking at higher education in the U.S.

In response to some of these challenges, the department decided to change its program to encourage the entry of non-traditional students, and has begun offering the master of science in engineering degree to domestic students who entered the graduate program without a chemical engineering degree. Students are required to take three undergraduate chemical engineering courses only: reaction engineering, thermodynamics, and transport. This prolongs their study by about one semester compared to those students who have an undergraduate chemical engineering degree.

Similar to other graduate students, these students can now receive financial aid from the time they enter the program. However, the stipend during their first semester will not come from research grants. Members of the Academy of Chemical Engineers, who met in Morgantown in April 2011, pledged money to establish a new endowment, which also qualified for a one-to-one match from the state's Research Trust Fund. The fund will provide support to two graduate students each year. It is expected that these students will continue on for a Ph.D. after earning the MSE degree.

Another avenue that has been pursued in the quest for good graduate students is to secure unrestricted funds for student stipends. The generosity of the Bayer Foundation, for example, has allowed the department to establish the Bayer Scholars Program, which supports Ph.D. students for a total of four years each, and includes a one-semester internship at a Bayer laboratory. In addition, our undergraduate students have been encouraged to compete for University-wide fellowship opportunities. Finally, the chemical engineering faculty decided to increase Ph.D. student stipends in a time-bound manner to remain competitive with chemical engineering programs in other universities. The annual stipend reached $30,000 in 2014.

Another current challenge face by the department is research funding. Faculty members have had a close relationship with the U.S. Department of Energy through NETL. The mission of NETL is fossil energy, especially coal, but this emphasis on coal has been challenged by the promise of abundant natural gas. As a consequence, funds for research on clean coal technologies are now greatly reduced. This is forcing faculty to look at other areas of research.

Even in this challenging climate, the strategic plan of the University seeks to enhance the volume of research in order that WVU is able to achieve the Carnegie Classification status of “very high” in research. In pursuit of this goal, the Statler College undertook a search for an associate dean for research and made an offer to Pradeep Fulay of the University of Pittsburgh; he accepted the offer effective in May 2012 and chose chemical engineering to be his academic home. He has been active in bringing funding opportunities to the attention of faculty. The future will tell as how successful these efforts turn out to be.

## Sources

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